IECC - Commercial

2016 GROUP B COMMITTEE ACTION HEARINGS

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2016 GROUP B – PROPOSED CHANGES TO THE INTERNATIONAL ENERGY CONSERVATION CODE

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TENTATIVE ORDER OF DISCUSSION
2016 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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CE1-16

Part I:
R202
Part II:
R202 (IRC N1106.1)

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 ORDERS FOR THESE COMMITTEES.

Proponent : Chris Mathis, Mathis Consulting Company, representing Mathis Consulting Company (chris@mathisconsulting.com)

Part I

2015 International Energy Conservation Code

Revise as follows:

SECTION C202 DEFINITIONS

AIR BARRIER. ~~Materials assembled and~~
One or more materials joined together to ~~provide a barrier to~~ mitigate air leakage through the ~~building envelope~~*building thermal envelope* assemblies. ~~An air barrier may be a single material or a combination of materials.~~

Part II

2015 International Energy Conservation Code

Revise as follows:

R202 (N1101.6) AIR BARRIER. ~~Material(s) assembled and~~
One or more materials joined together to ~~provide a barrier to~~ mitigate air leakage through the ~~building envelope~~*building thermal envelope* assemblies. ~~An air barrier may be a single material or a combination of materials.~~

Reason: Air leakage through building thermal envelope assemblies can compromise their thermal performance and durability. This change clarifies the construction and function of an air barrier and synchronizes the residential and commercial definitions.

Cost Impact: Will not increase the cost of construction
This is a clarification. The current definition is self referential and "building envelope" has a different, specific meaning in other I-Codes.

CE1-16 : C202-AIR BARRIER-MATHIS13363

CE2-16
Part I:
IECC: 0.
Part II:
R202 (IRC N1101.6)

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

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

Part I

2015 International Energy Conservation Code

Revise as follows:

SECTION C202 DEFINITIONS

AIR BARRIER. Materials assembled and joined together to provide a barrier to air leakage through the building thermal envelope. An air barrier may be a single material or a combination of materials.

Part II

2015 International Energy Conservation Code

Revise as follows:

R202 (N1101.6) AIR BARRIER. ~~Material(s)~~
Materials assembled and joined together to provide a barrier to air leakage through the building thermal envelope. An air barrier may be a single material or a combination of materials.

Reason: Rather than a distinctly different component of the building, the air barrier is part of the assembly that comprises the building thermal envelope. In addition, the IECC has pointed out that in reality w e have both an interior and exterior air barrier system that helps comprise the assembly. For example, exterior sheathing w ould be our primary exterior air barrier and dryw all w ould be a primary interior air barrier. The code points out that w hen the dryw all is not continuous w ith the thermal barrier that additional air barrier material needs to be installed. Examples of location called out in the code are behind tubs or fireplaces. In this w ay, adding the w ord "thermal" to the definition helps impart a clearer understanding of w hat the air barrier assembly is and does.

Cost Impact: Will not increase the cost of construction
The changes are editorial to add clarity and understanding to the definition. No new requirements are added and thus, costs are not impacted.

CE2-16 : R202-AIR BARRIER-SCHWARZ12373

CE3-16

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

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 ORDERS FOR THESE COMMITTEES.

Proponent : Theresa Weston, representing DuPont Building Innovations (theresa.a.weston@dupont.com)

Part I

2015 International Energy Conservation Code

Revise as follows:

SECTION 202 DEFINITIONS

AIR BARRIER. Materials assembled and joined together to ~~provide a barrier to~~ restrict or prevent the passage of air ~~leakage~~ through the building thermal envelope. An air barrier ~~may~~ can be a single material or a combination of materials.

Delete without substitution:

~~**CONTINUOUS AIR BARRIER.** A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.~~

Part II

2015 International Energy Conservation Code

Revise as follows:

R202 (N1101.6) GENERAL DEFINITIONS

AIR BARRIER. ~~Material(s)~~
Materials assembled and joined together to ~~provide a barrier to~~ restrict or prevent the passage of air ~~leakage~~ through the building thermal envelope. An air barrier ~~may~~ can be a single material or a combination of materials.

Delete without substitution:

~~**CONTINUOUS AIR BARRIER.** A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.~~

Reason: This proposal removes a redundant definition. Air Barriers are already defined as "Materials assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material or a combination of materials". Additionally, the definition for Air Barrier is updated.

Cost Impact: Will not increase the cost of construction
This proposal does not change code requirements, only updates definitions and reduces redundancy.

CE3-16 : C202-AIR BARRIER-WESTON13075

CE4-16
Part I:
IECC: C202.
Part II:
Part II
R202 (IRC N1101.6)

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

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

Part I

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

GENERAL DEFINITIONS

Part II

2015 International Energy Conservation Code

Revise as follows:

R202 (N1101.6) BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, ~~floor~~ floors, ~~roof~~ ceilings, roofs and any other building ~~elements~~ element assemblies that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

2015 International Residential Code

Revise as follows:

SECTION R202 DEFINITIONS

[RE] BUILDING THERMAL ENVELOPE. The ~~*basement walls*~~basement walls, ~~*exterior walls*~~exterior walls, ~~floor~~ floors, ~~roof~~ ceilings, roofs and any other building element assemblies that enclose ~~*conditioned spaces*~~conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

Reason: The Thermal envelope completely surrounds the house and the ceiling portion of the envelope was excluded from the previous definition. In addition, the envelope is not one element of the building but rather an **assembly** of materials that create it in each location that is described in the definition. We feel it is important to ensure a common understanding that the entirety of the assembly in each location must be understood in order to create the thermal envelope that functions as intended by the code.

Cost Impact: Will not increase the cost of construction
The changes are editorial to add clarity and understanding to the definition. No new requirements are added and thus, costs are not impacted.

CE4-16 : R202-BUILDING THERMAL ENVELOPE-SCHWARZ12372

CE5-16

Part I:
IECC: C202 (New).
Part II:
R202 (New) [IRC N1101.6 (New)]

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 ORDERS FOR THESE COMMITTEES.

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

Part I

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

CAVITY INSULATION. Insulating material located between framing members.

Part II

2015 International Energy Conservation Code

Add new definition as follows:

R202 (N1101.6) CAVITY INSULATION. Insulating material located between framing members.

SECTION R202 DEFINITIONS

GENERAL DEFINITIONS

Reason: This proposal adds a definition for cavity insulation to complement the existing definition for continuous insulation. Cavity and continuous insulation relate to the location of insulation materials in or on an assembly, not specific types of insulation materials that may be used in these locations. Adding this definition will help clarify the code in regard to terms used to explain where insulation is located.

Cost Impact: Will not increase the cost of construction
The proposal only provides a new definition without any material impact to the code or cost.

CE5-16 : C202-CAVITY INSULATION (NEW)-CRANDELL12862

CE6-16

IECC: C202

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

2015 International Energy Conservation Code

Revise as follows:

SECTION C202 DEFINITIONS

COEFFICENT OF PERFORMANCE (COP) – COOLING. The ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.

Reason: This proposal will clarify and improve the existing definition, which is not clear or technically correct. It will also be consistent with the definition shown in ASHRAE 90.1.

Cost Impact: Will not increase the cost of construction
This change to the definition does not change the intent of the code and does not add any new requirements that would increase costs.

CE6-16 : C202-COEFFICIENT OF PERFORMANCE (COP)-ROSENSTOCK11717

CE7-16

Part I:
C202
Part II:
R202 (IRC N1101.6)

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

Proponent : Lee Kranz, representing City of Bellevue, Washington (lkranz@bellevuewa.gov)

Part I

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

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

COMMERCIAL BUILDING~~.~~ For this code, all buildings or portions of buildings, that are not included in the definition of "Residential building."

Revise as follows:

RESIDENTIAL BUILDING. For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) as well as Group R-2, R-3 and R-4 buildings , or portions thereof, three stories or less in height above grade plane. Areas located outside the confines of the dwelling unit such as corridors, toilet facilities and incidental use rooms and spaces that are considered to be part of the same occupancy shall be considered to be part of that occupancy.

Part II

2015 International Energy Conservation Code

Revise as follows:

SECTION R202 DEFINITIONS

COMMERCIAL BUILDING. For this code, all buildings or portions of buildings, that are not included in the definition of "Residential building."

R202 (N1101.6) RESIDENTIAL BUILDING. For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) as well as Group R-2, R-3 and R-4 buildings , or portions thereof, three stories or less in height above grade plane. Areas located outside the confines of the dwelling unit such as corridors, toilet facilities and incidental use rooms and spaces that are considered to be part of the same occupancy shall be considered to be part of that occupancy.

Reason: Section 101.4.1 makes it clear that for mixed occupancy buildings the designer must comply with the code in effect based on "Occupancy". This is not clear in the definition of "*Residential buildings*". This code change is an attempt to help the reader understand that it is not necessary or permitted to use the commercial provisions in areas that are classified as part of the R-2, R-3 or R-4 occupancy. "...or portions thereof" is added to be consistent with the scoping text in Section 101.4.1.

Cost Impact: Will not increase the cost of construction
This is for clarifyication only.

CE7-16 : C202-COMMERCIAL BUILDING-KRANZ12024

CE8-16

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

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

Proponent : Robby Schwarz, EnergyLogic, Inc., representing EnergyLogic, Inc. (robby@nrglogic.com; smozingo@coloradocode.net)

Part I

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

COMPLIANCE REPORT. A document or set of documents created to demonstrate adherence with the intent of the code for the purpose of obtaining a building permit or acquiring a certificate of occupancy.

Part II

2015 International Energy Conservation Code

Add new definition as follows:

R202 (N1101.6) COMPLIANCE REPORT. A document or set of documents created to demonstrate adherence with the intent of the code for the purpose of obtaining a building permit or acquiring a certificate of occupancy.

Reason: Section R405 and section R406 reference compliance report. Section C407.4 require a compliance report. How ever there is no definition of w hat these reports are in relationship to Construction Documents. In addition, Builders, Insulators, HVAC contractors, Raters and others create RESCheck Compliance Documents and Energy Raters create compliance documents for the Simulated Performance Path R405 and the EIR path R406. Although registered design professionals can create these reports they most often have no desire to and their expertise often does not fall w ithin the preview of compliance documentation. A more distinct definition of compliance reports w ill help w hen further defining w ho can create such reports.

Cost Impact: Will not increase the cost of construction
This new definition add clarity and understanding to the code text w here the term is used. No new requirements are added and thus, costs are not impacted.

CE8-16 : R202-COMPLIANCE REPORTS-SCHWARZ12366

CE9-16
IECC: C202

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

2015 International Energy Conservation Code

Revise as follows:

SECTION C202 DEFINITIONS

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 ~~exceeding~~ of less than 20 watts per square foot of conditioned floor area or a connected design electronic data equipment load of less than 10 kW.

Reason: ASHRAE is developing a new standard for data centers, Standard 90.4, under the ASHRAE consensus process. It is very likely that the new 90.4 standard w ill be published by mid to late 2016. As a part of this effort, there are specific definitions for computer rooms, w hich can be part of many commercial buildings, and data centers, w hich are buildings designed specifically for the remote storage, processing, or distribution of large amounts of data. Data centers provide physical (or virtual) infrastructure for housing computers, servers, netw orking systems, and components for the information technology needs of one company/organization or multiple companies/organizations.
The proposed change w ill make the definition in the IECC w ith the definition changes that are occuring in ASHRAE Standard 90.1 and the new definitions for ASHRAE Standard 90.4. It provides the delineation of coverage that has been agreed to by a consensus process at ASHRAE that includes representatives from the data center industry and other interested stakeholders.

In the future, after changes are made, computer rooms w ill be subject to the provisions of the IECC or ASHRAE 90.1, and data centers w ill be subject to the provisions or ASHRAE Standard 90.4 or an ICC equivalent.

Cost Impact: Will not increase the cost of construction
This proposal represents an update and a clarification to a definition in this code, and does not create any new code requirements that w ould increase construction costs.

CE9-16 : C202-COMPUTER ROOM-ROSENSTOCK11719

CE10-16

Part I:
IECC: , (New), C202, C303.2.2 (New).
Part II:
R202 (New) [IRC N1101.6 (New)], R303.2.2 (New) [IRC N110111.2 (New)]

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

Proponent : Vickie Lovell, InterCode Incorporated, representing Fire Safe North America (vickie@intercodeinc.com); Amanda Hickman, representing AMCA (Air Movement and Control Association) (amanda@intercodeinc.com)

Part I

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

GENERAL DEFINITIONS

Add new definition as follows:

EMITTANCE.

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

INTERIOR RADIATION CONTROL COATING (IRCC).

A coating, having an *emittance* of 0.25 or less that is applied to building assemblies.

Add new text as follows:

C303.2.2 Interior Radiation Control Coatings. The installation of *interior radiation control coatings* shall be in accordance with ASTM C 1321.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:
ASTM C1321-15 Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCCS) in Building Construction.

Part II

2015 International Energy Conservation Code

R202 (N1101.6) GENERAL DEFINITIONS

Add new definition as follows:

EMITTANCE

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

INTERIOR RADIATION CONTROL COATING (IRCC)

A coating, having an *emittance* of 0.25 or less, that is applied to building assemblies.

Add new text as follows:

R303.2.2 (N1101.11.2) Interior radiation control coatings The installation of *interior radiation control coatings* shall be in accordance with ASTM C1321.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:
ASTM C1321-15 Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCCS) in Building Construction.

Reason: Currently the code is silent on Interior Radiation Control Coatings (IRCCs). This technology has been and is widely used in the market place. For this reason, it is critical that the code give direction to the code user and code enforcement community for the proper understanding and installation of this product.

This proposal adds a definition and section for Interior Radiation Control Coatings (IRCCs). The new section includes the appropriate ASTM standard for proper installation of the IRCCs WHEN they are installed (it does not require the use of an IRCC). IRCCs are included in the 2015 Florida Building Code, Performance Section 6.5.4.1.

The American Society for Testing and Materials (ASTM) classifies IRCCS as thermal insulation.

The ASTM committee C16 on Thermal Insulation includes published standards for this product. Subcommittee C16.21 deals specifically with reflective products, which include reflective insulation, radiant barrier and interior radiation control coatings. C16.21 develops standards and practices for these reflective building material thermal insulating products. For this reason, the new language is being proposed in this section of the code.

An IRCC works by changing the emittance of the surface where it is applied. Building products, such as wood, brick, painted surfaces and plasterboard exhibit high emittances (ex: 0.70 to 0.95). When heated above the temperature of adjacent surfaces, they radiate most of their heat energy to cooler surfaces. An IRCC works by lowering their surface emittance to 0.25 or lower, lessening their ability to radiate heat.

ASTM C1321-15 offers the following: "The scope contains instructions related to the use and installation of IRCCS that are sprayed, rolled, or brush applied. Examples that this practice is intended to address include: (*1*) low emittance surfaces in vented building envelope cavities intended to retard radiant transfer across the vented airspace; (*2*) low emittance surfaces at interior building surfaces intended to retard radiant transfer to or from building inhabitants; and (*3*) low emittance surfaces at interior building surfaces intended to reduce radiant transfer to or from heating or cooling systems."[1]

IRCCs were part of an extensive attic test study at the Oak Ridge National Laboratory. The data resulting from running the Large Scale Climate Simulator with an IRCC at a 0.23 emittance resulted in a 19% reduction in heat flow through the attic floor as compared with data from running the simulator without an IRCC.[2]


20 7:17AM

Bibliography: [1]C 1321-15 Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCCs) in Building Construction, C 1321-15, ASTM, 2015.

[2]Thermal Performance Evaluation of Attic Radiant Barrier Systems Using the Large Scale Climate Simulator (LSCS)", ASHRAE Transactions, Shrestha, Som, William Miller, Andre Desjarlais, 2010, vol 116, part 2.

Cost Impact: Will not increase the cost of construction
The code change proposal w ill not increase the cost of construction because the proposal only adds a referenced standard for product installation, if the prduct is chosen to be installed.

CE10-16 : C202-EMITTANCE (NEW)-LOVELL12313

CE11-16

Part I:
IECC: 0.
Part II:
R202 (IRC N1101.6), R202

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

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

Part I

2015 International Energy Conservation Code

Revise as follows:

SECTION C202 DEFINITIONS

FENESTRATION. Products classified as either skylights or vertical fenestration~~ or skylights~~.

~~Skylight~~ Skylights. Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees (1.05 rad) from horizontal.

Vertical fenestration. Windows ~~(~~ that are fixed or ~~moveable)~~ 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 ~~at least~~ not less than 60 degrees (1.05 rad) from horizontal.

ENTRANCE DOOR. ~~Fenestration products~~ A vertical fenestration product used for occupant ingress, egress and access in nonresidential buildings, including, but not limited to, exterior entrances ~~that utilize~~ utilizing latching hardware and automatic closers and ~~contain~~ containing over 50-percent ~~glass~~ glazing specifically designed to withstand heavy ~~use and possibly abuse~~ duty usage .

Part II

2015 International Energy Conservation Code

Revise as follows:

SECTION R202 (N1101.6) DEFINITIONS

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.

Vertical fenestration. Windows (fixed or operable), opaque doors, glazed doors, glazed block and combination opaque/glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of at least 60 degrees (1.05 rad) from horizontal.

Delete without substitution:

~~**SKYLIGHT.** Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees (1.05 rad) from horizontal.~~

SECTION R202 DEFINITIONS

Delete without substitution:

~~**VERTICAL FENESTRATION.** Windows (fixed or moveable), opaque doors, glazed doors, glazed block and combination opaque/glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of a least 60 degrees (1.05 rad) from horizontal.~~

Reason: The definition of entrance doors needs grammatical improvements as shown in the proposal..The key change is adding the word 'occupant' before the purposes of the door. This is to distinguish entrance doors from doors which are used trucks or other cargo or material movement. Changes in the last cycles as well as companion proposals to this proposal in this cycle provide better standards specific to garage doors. As such they need to be distinguished from doors used by people 'not on vehicles' to enter or exit a building. The edit to the definition of Fenestration in the Commercial portion of the code is for consistency with Table C402.4 as well as some editorial clarity.
The final action proposed in this change is to format the Fenestration,Skylights and Vertical Fenestration definitions found in R202 in the same manner as found in C202. In C202 - Skylights and Vertical Fenestration are shown as subdefinitions to Fenestration. With the relocation there is also minor wording changes for consistency with the C202 provisions.

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
These revisions are intended for editorial clarity. There should be no impact on the cost of construction.

Analysis: In Part II, because IRC Section N1101.6 (definitions) does not include a standalone definition for vertical fenestration, the deletion indicated for that definition in Part II is not applicable for Section N1101.6.

CE11-16 : C202-ENTRANCE DOOR-COLLINS11479

CE12-16
IECC: C202

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

2015 International Energy Conservation Code

Revise as follows:

SECTION C202 DEFINITIONS

HEAT TRAP. An arrangement of ~~piping and fittings, such as elbows,~~ valves or loops of pipe for a ~~commercially available heat trap~~ water heater that prevents thermosyphoning of hot water during standby periods.

Reason: This will help to clarify the definition, and remove the words "heat trap" from the definition.

Cost Impact: Will not increase the cost of construction
This is only a clarification of the definition and does not add any new code requirements.

CE12-16 : C202-HEAT TRAP-ROSENSTOCK11726

CE13-16

Part I:
C202 (New)
Part II:
R202 (IRC N1101.6)
Part III:
R202

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

Proponent : Shaunna Mozingo, Colorado Code Consulting - City of Cherry Hills Village, representing Colorado Chapter of ICC Energy Code Development Committee (smozingo@coloradocode.net)

Part I

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

GENERAL DEFINITIONS

Add new definition as follows:

<u>INSULATED SIDING.</u>

<u>A type of continuous insulation, not used as part of a vented cladding system and having manufacturer-installed insulating material as an integral part of the cladding product having a minimum *R*-value of R-2.</u>

Part II

2015 International Energy Conservation Code

R202 <u>(N1101.6)</u> GENERAL DEFINITIONS

Revise as follows:

SECTION 202 DEFINITIONS

INSULATED SIDING. A type of continuous insulation ~~with~~ <u>, not used as part of a vented cladding system and having</u> manufacturer-installed insulating material as an integral part of the cladding product having a minimum *R*-value of R-2.

Part III

2015 International Residential Code

Revise as follows:

SECTION 202 DEFINITIONS

[RB] INSULATED SIDING. A type of continuous insulation, ~~with~~ <u>not used as part of a vented cladding system and having</u> manufacturer-installed insulating material as an integral part of the cladding product~~,~~ having a minimum *R*-value of R-2.

Reason: Over the past couple of code cycles there have been changes made in how we have to look at insulated siding. In the IECC it is now considered to be a form of continuous insulation. In the IRC and IBC however, it is also something used as a vented cladding system. If used as a vented cladding there are air spaces that come into play and the insulated siding should not be considered as a continuous insulation. By definition you cannot be both a vented cladding and a continuous insulation.
The same definiton is added to the IECC-CE to be in coordination with the IECC-RE as the term is used in several locations in the IECC-CE. It doesn't make sense for the defintion to not also be in the IECC-CE.

The definition of continuous insulation states that it is an insulating material that is continuous across all structural members without thermal bridges. A vented cladding does not meet the requirements of continuous insulation.

Cost Impact: Will not increase the cost of construction
This is a clarification and will not increase the cost of construction.

CE13-16 : C202-INSULATED SIDING-MOZINGO12885

CE14-16

Part I:
C202
Part II:
Part II
R202 (IRC N1101.6)

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 ORDERS FOR THESE COMMITTEES.

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

Part I

2015 International Energy Conservation Code

SECTION 202 DEFINITIONS

LOW-VOLTAGE LIGHTING. Lighting equipment ~~powered through~~ that utilizes a transformer ~~such as a cable conductor, a rail conductor and track lighting~~ to reduce 120 VAC line voltage to supply lamps that are rated for 12 VAC or 24 VAC.

Part II

2015 International Energy Conservation Code

Revise as follows:

SECTION R202 (N1101.6) DEFINITIONS

LOW-VOLTAGE LIGHTING. Lighting equipment ~~powered through~~ that utilizes a transformer ~~such as a cable conductor, a rail conductor and track lighting~~ to reduce 120 VAC line voltage to supply lamps that are rated for 12 VAC or 24 VAC.

Reason: This proposal modifies and clarifies the definition of low -voltage lighting.

Cost Impact: Will not increase the cost of construction
This proposal only modifies a definition and does not change any of the lighting requirements in the code.

CE14-16 : C202-LOW-VOLTAGE LIGHTING-ROSENSTOCK11868

CE15-16

IECC: C202

Proponent : Steven Rosenstock (srosenstock@eei.org)

2015 International Energy Conservation Code

Revise as follows:

SECTION C202 DEFINITIONS

NAMEPLATE HORSEPOWER. The nominal motor ~~horsepower~~ output power rating stamped on the motor nameplate.

Reason: Many small motors that are covered in Tables C405.8(3) and C405.8(4) provide information on the input and output power. This can be confusing for SI units where the input and output power are both stated in kW. The revision to the definition will clarify the power rating that is intended to be used (e.g. output) for efficiency requirements of small (and large) electric motors.
Approval of this code change proposal will ensure consistency with ASHRAE Standard 90.1-2016, which will be adopted by reference as an alternative path to the 2018 IECC Commercial Provisions

Cost Impact: Will not increase the cost of construction
This proposal is a simple clarification of a definition and results in no added construction cost.

CE15-16 : C202-NAMEPLATE HORSEPOWER-ROSENSTOCK10594

CE16-16
IECC: C202

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

2015 International Energy Conservation Code

Revise as follows:

SECTION C202 DEFINITIONS

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.

Reason: Biogas is another form of renewable energy that should be added to the definition. It can be used for thermal energy needs (such as space/water heating) or to produce electricity.
As described by the Department of Energy, "Biogas is produced from various biomass sources through a biochemical process, such as anaerobic digestion, or through thermochemical means, such as gasification."

Biogas can be produced from raw materials such as agricultural waste, manure, plant material, waste water sewage, or food waste.

See the following web sites for more information:

http://www.afdc.energy.gov/fuels/natural_gas_renewable.html

https://www.americanbiogascouncil.org/

According to DOE. "As of January 2015, there were about 247 anaerobic digester systems operating at commercial livestock farms in the United States" and "about 1,500 [Waste water treatment plants] employ anaerobic digestion to produce biogas that is used on site"

Cost Impact: Will not increase the cost of construction
This will not increase the cost of construction as it only updates a definition, and does not add any new requirements to the code.

CE16-16 : C202-ON-SITE RENEWABLE ENERGY-ROSENSTOCK11728

CE17-16

IECC: 0.

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

2015 International Energy Conservation Code

Revise as follows:

SECTION C202 DEFINITIONS

SCREW LAMP HOLDERS. A lamp base that ~~requires~~ receives a screw-in-type lamp, such as a compact-fluorescent, incandescent, light emitting diode or tungsten-halogen ~~bulb~~ lamp.

Reason: This proposal will update the definition to account for the LED general service lamps that can be used in standard residential and commercial screw-in sockets.

Cost Impact: Will not increase the cost of construction
This proposal provides an update to the definition and does not create any new code requirements.

CE17-16 : C202-SCREW LAMP HOLDERS-ROSENSTOCK11745

CE18-16

Part I:
IECC: 0, C202 (New).
Part II:
R202 (New) [IRC N1101.6 (New)], R405.4 (New) [IRC N1105.4 (New)], IRC Appendix U102

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

Proponent : Joseph Cain, SunEdison, representing Solar Energy Industries Association (SEIA) (joecainpe@aol.com)

Part I

2015 International Energy Conservation Code

Revise as follows:

SECTION C202 DEFINITIONS

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

Add new definition as follows:

RENEWABLE ENERGY Energy derived from solar radiation, wind, waves, tides, landfill gas, biomass or the internal heat of the earth.

Part II

2015 International Energy Conservation Code

R202 (N1101.6) GENERAL DEFINITIONS

Add new definition as follows:

ON-SITE RENEWABLE ENERGY.

Energy generated by a renewable energy system located on the *building site.*

RENEWABLE ENERGY.

Energy derived from solar radiation, wind, waves, tides, landfill gas, biomass or the internal heat of the earth.

Add new text as follows:

R405.4 (N1105.4) On-site renewable energy *On-site renewable energy* shall be considered as a reduction in energy use of the building.

2015 International Residential Code

SECTION U102 GENERAL DEFINITIONS

Add new definition as follows:

ON-SITE RENEWABLE ENERGY.
Energy derived from solar radiation, wind, waves, tides, landfill gas, biomass or the internal heat of the earth.

Reason: This proposal clarifies an existing definition. The second sentence of the existing definition seems to include charging language within a definition. Separating this information into two definitions provides better clarity. The term "project site" is modified to "building site," which is a defined term. "Project site" is not defined.
The resulting definitions are copied into the residential section of the code. This will allow better coordination with the International Residential Code.

Cost Impact: Will not increase the cost of construction
This proposal does not change any technical requirements, and will therefore not increase the cost of construction.

CE18-16 : C202-ON-SITE RENEWABLE ENERGY-CAIN12167

CE19-16

IECC: C202, C202 (New).

Proponent : jim edelson (jim@newbuildings.org)

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

ON-SITE RENEWABLE ENERGY SYSTEM. An energy generation system that derives its energy from a *renewable energy source* and is located on the *building*, the *building site*, or a combination of adjoining lots, that are being developed and maintained subject to the provisions of this code. The *renewable energy source* shall be derived at the *building*, the *building site*, or a combination of adjoining lots, that are being developed and maintained subject to the provisions of this code.

Revise as follows:

SECTION C202 DEFINITIONS

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

Reason: The definition of On-site Renew able Energy w as created in the 2012 IECC w hen it w as offered as one of the alternative compliance paths in Section C406. At the time, there w as no precedent in the ICC codes about how to define renew able energy provisions for code purposes. This definition w as split into tw o parts by the 2015 IgCC. This proposal introduces a definition of Renew able Energy Source that parallels the language of the IgCC,and modifies Onsite Renew able Energy System w ithout having to redefine '*building site*' in the IECC. By enlarging the property scale on w hich renew able systems can be located, this definition matches the tendency to look at adjacent properties undergoing common development for the provision of onsite renew able energy
How ever, a much w ider range of physical and financial renew able products that could potentially be used to satisfy this requirement have been developed in the past six years, including community solar systems legislated in over 15 states and a range of renew able natural gas products. This proposal clarifies that if an on-site renew able energy system is used instead of an energy efficiency measure in Section C406, the renew able fuels must also be derived "onsite", now reconfigured in this definition to match the larger IgCC scale. This clarification w ill help code officials avoid the problem of enforcing the validity of claims made for renew able products that are shipped or transmitted to the building site - and also avoid the problem of enforcing that those same renew able products are going to be used for the life of the renew able energy system.

Cost Impact: Will not increase the cost of construction
This proposal clarifies the intent of one provision appearing only in the Alternative Packages (Section C406), and thus is not required of any specific project. In addition, renew ble energy systems are generally more expensive than the alternative packages in C406.

CE19-16 : C202-ON-SITE RENEWABLE ENERGY SYSTEM-EDELSON12682

CE20-16

IECC: C202.

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2015 International Energy Conservation Code

Delete without substitution:

SECTION C202 DEFINITIONS

~~**SCREW LAMP HOLDERS.** A lamp base that requires a screw-in-type lamp, such as a compact-fluorescent, incandescent or tungsten-halogen bulb.~~

Reason: The term "screw lamp holder" is not used anyw here in this code. The index indicates that it is used in C405.4.1 but the term "screw lamp holder" is not used there (the term used there is "screw -in lamps".

Cost Impact: Will not increase the cost of construction
The proposal is editorial in nature and does not have any impact on the technical requirements of the code.

CE20-16 : C202-SCREW LAMP HOLDERS-BAILEY12065

CE21-16

Part I:
IECC: C301.1, C301.2, C301.3.
Part II:
R301.1 (IRC N1107.1), Table R301.1 (IRC Table N1101.7), R301.3 (IRC N1107.3), Table R301.3(1) [IRC Table N1107.2(1)], Table R301.3(2) [IRC Table N1107.2(2)]

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

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org); Martha VanGeem, representing self (martha.vangeem@gmail.com)

Part I

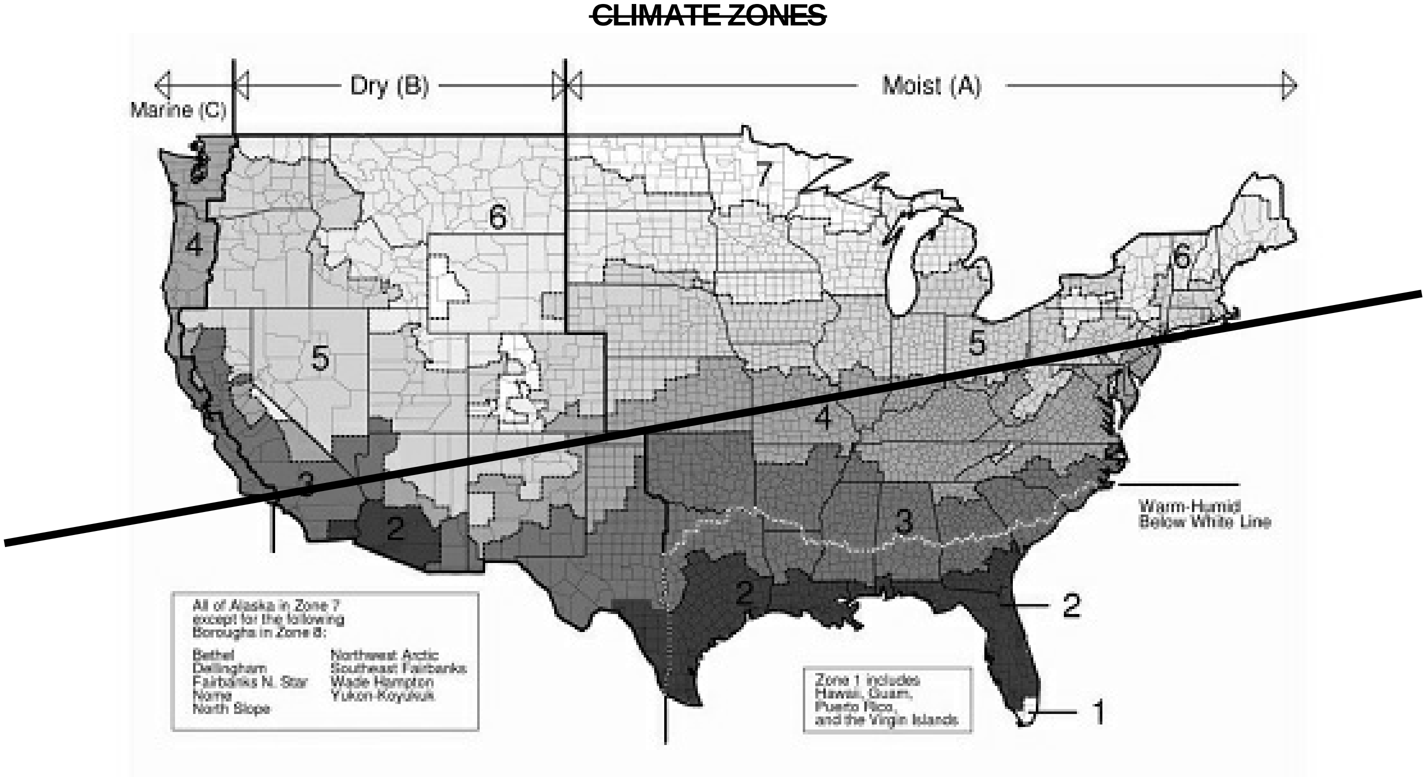
2015 International Energy Conservation Code

Revise as follows:

C301.1 General. *Climate zones* from Figure ~~C301.1~~ B-1 or Table ~~C301.1~~ B-1 of ASHRAE 169 shall be used in determining the applicable requirements from Chapter 4. Locations not in Table ~~C301.1~~ B-1 (outside the United States) shall be assigned a *climate zone* based on Table A-5,Table A-6, or Section ~~C301.3~~ A3 including Table A-3 of ASHRAE 169.

Delete without substitution:

~~C301.1~~
~~CLIMATE ZONES~~



~~**TABLE C301.1**~~
~~**CLIMATE ZONES, MOISTURE REGIMES, AND WARM-HUMID DESIGNATIONS BY STATE, COUNTY AND TERRITORY**~~

~~**C301.2 Warm humid counties.** Warm humid counties are identified in Table C301.1 by an asterisk.~~

~~**TABLE C301.3 (1)**~~
~~**INTERNATIONAL CLIMATE ZONE DEFINITIONS**~~

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

~~**TABLE C301.3 (2)**~~
~~**INTERNATIONAL CLIMATE ZONE DEFINITIONS**~~

~~For SI: °C = [(°F)-32]/1.8.~~

Part II

2015 International Energy Conservation Code

Revise as follows:

R301.1 (N1107.1) General. *Climate zones* from Figure ~~R301.1~~ B-1 or Table ~~R301.1~~ B-1 in ASHRAE 169 shall be used in determining the applicable requirements from Chapter 4. Locations not in Table ~~R301.1 (outside the United States)~~ B-1 shall be assigned a *climate zone* based on Table A-5, Table A-6, or Section ~~R301.3~~ A3, including Table A-3, in ASHRAE 169.

Delete without substitution:

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

~~**R301.3 (N1101.7.2) International climate zones.** 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).~~

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

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

~~**TABLE R301.3(2) [N1101.7.2(2)]**~~
~~**INTERNATIONAL CLIMATE ZONE DEFINITIONS**~~

~~For SI:°C =[(°F)-32]/1.8.~~

-

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:
ASHRAE *Standard 169-2013*, Climatic Data for Building Design *Standards*

Reason: This proposal updates the climate zones to correspond with the release of *ASHRAE Standard 169-2013, Climatic Data for Building Design Standards*. *Standard 169-2013* includes more-recent weather data and the creation of a new Climate Zone 0. Approximately 10% of the counties in the United States have a change in Climate Zone designation due to this change, with most of these changes resulting in a change to warmer climate zones. Generally, the new Climate Zone 0 is the hotter portion of the previous Climate Zone 1, which was the warmest climate zone. Cities in Climate Zone 0 include 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 hotter regions of Climate Zone 0.

This proposes to reference ASHRAE 169 for two reasons:

1) There are hundreds of entries in the IECC and Standard 169, and verifying the validity/accuracy of all entires would be impossible.

2) 169 is the original source of the tables, and it's proper to reference the source of the tables, rather than duplicate and modify which would create a divergence in requirements between the IECC and 90.1.

The changes to the climate zone were compiled as part of ASHRAE Research Project RP-1613 for 6,443 locations in the United States, Canada, and around the world—information used for design, sizing, distribution, installation, and marketing of HVAC and dehumidification equipment, as well as for other energy-related processes in residential, agricultural, commercial, and industrial applications.

Tables, included as a .zip file with ASHRAE Standard 169, include dry-bulb, wet-bulb, and dew-point temperatures; wind speed with direction at various frequencies of occurrence; monthly degree-days to various bases; precipitation; and parameters to calculate clear-sky irradiance. Information includes monthly and annual percentiles, to provide seasonally representative combinations of temperature, humidity, and solar conditions.

Climatic design conditions in Chapter 14 of the *2009 ASHRAE Handbook - Fundamentals* (HOF) are used for the sizing and design of building energy systems to allow for optimal energy efficiency measures and ensure that the energy systems have enough capacity to meet the climatic loads in a probabilistic sense. Regular updating of the climatic conditions is critical in this respect for many practical reasons and to show due diligence in a world of changing climate.

In response to that need, ASHRAE initiated research project 1613-RP, Update Climatic Design Data in Chapter 14 of the 2013 Handbook of Fundamentals, to update the tables of climatic design conditions in the 2013 HOF and in Standard 169. The purpose was to expand on the 5564 worldwide locations present in the 2009 HOF, use a more recent period of record (1986-2010 vs. 1982-2006) to keep track of changes in the climate, fine-tune the clear-sky solar radiation model that was introduced in the 2009 HOF, and add new elements, such as precipitation, which is required by Standard 169 for the calculation of climate zones. An update to the Weather Data Viewer was also required. Finally, the project was to establish (if possible) temperature trends for all locations in the Handbook.

Bibliography: ASHRAE Standard 169-2013 Climatic Data for Building Design *Standards*
ASHRAE RP-1613 -- Update Climatic Design Data in Chapter 14 of the 2013 Handbook of Fundamentals

Cost Impact: Will not increase the cost of construction
According to a preliminary analysis, this will not increase or decrease the energy use for the U.S as a whole. For about 10% of the U.S. locations, the climate zone has changed and the cost of construction will decrease or increase based on the location. Approximately 9% of the locations moved to a warmer climate zone and will have a decrease in the stringency of the building envelope. Approximately 1% of the locations moved to a colder climate zone and will have an increase in the stringency of the building envelope. The largest cities impacted are Dallas and Milwaukee, which moved to warmer climate zones.

Analysis: A review of the standard(s) proposed for inclusion in the code, ASHRAE 169 , 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 1, 2015.

CE21-16 : C301.1-FERGUSON12403

CE22-16

Part I:
Table C301.1
Part II:
Table R301.1 (IRC Table N1101.7)

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 ORDERS FOR THESE COMMITTEES.

Proponent : Craig Conner, self (craig.conner@mac.com); Howard Wiig, representing self (howard.c.wiig@hawaii.gov)

Part I

2015 International Energy Conservation Code

TABLE C301.1
CLIMATE ZONES, MOISTURE REGIMES, AND WARM-HUMID DESIGNATIONS BY STATE, COUNTY AND TERRITORY
Key: A – Moist, B – Dry, C – Marine, <u>T – Tropical</u>. Absence of moisture designation indicates moisture regime is irrelevant. Asterisk (*) indicates a warm-humid location.

Portions of Table not shown remain unchanged

3A Crawford	2A Lanier*	3A Taylor*	5B Cassia	4A Crawford
3A Crisp*	3A Laurens*	3A Telfair*	6B Clark	5A Cumberland
4A Dade	3A Lee*	3A Terrell*	5B Clearwater	5A DeKalb
4A Dawson	2A Liberty*	2A Thomas*	6B Custer	5A De Witt
2A Decatur*	3A Lincoln	3A Tift*	5B Elmore	5A Douglas
3A DeKalb	2A Long*	2A Toombs*	6B Franklin	5A DuPage
3A Dodge*	2A Lowndes*	4A Towns	6B Fremont	5A Edgar
3A Dooly*	4A Lumpkin	3A Treutlen*	5B Gem	4A Edwards
3A Dougherty*	3A Macon*	3A Troup	5B Gooding	4A Effingham
3A Douglas	3A Madison	3A Turner*	5B Idaho	4A Fayette
3A Early*	3A Marion*	3A Twiggs*	6B Jefferson	5A Ford
2A Echols*	3A McDuffie	4A Union	5B Jerome	4A Franklin
2A Effingham*	2A McIntosh*	3A Upson	5B Kootenai	5A Fulton
3A Elbert	3A Meriwether	4A Walker	5B Latah	4A Gallatin
3A Emanuel*	2A Miller*	3A Walton	6B Lemhi	5A Greene
2A Evans*	2A Mitchell*	2A Ware*	5B Lewis	5A Grundy
4A Fannin	3A Monroe	3A Warren	5B Lincoln	4A Hamilton
3A Fayette	3A Montgomery*	3A Washington	6B Madison	5A Hancock
4A Floyd	3A Morgan	2A Wayne*	5B Minidoka	4A Hardin
3A Forsyth	4A Murray	3A Webster*	5B Nez Perce	5A Henderson
4A Franklin	3A Muscogee	3A Wheeler*	6B Oneida	5A Henry
3A Fulton	3A Newton	4A White	5B Owyhee	5A Iroquois
4A Gilmer	3A Oconee	4A Whitfield	5B Payette	4A Jackson
3A Glascock	3A Oglethorpe	3A Wilcox*	5B Power	4A Jasper
2A Glynn*	3A Paulding	3A Wilkes	5B Shoshone	4A Jefferson
4A Gordon	3A Peach*	3A Wilkinson	6B Teton	5A Jersey
2A Grady*	4A Pickens	3A Worth*	5B Twin Falls	5A Jo Daviess

3A Greene
3A Gwinnett
4A Habersham
4A Hall
3A Hancock
3A Haralson
3A Harris
3A Hart
3A Heard
3A Henry
3A Houston*
3A Irwin*
3A Jackson
3A Jasper
2A Jeff Davis*
3A Jefferson
3A Jenkins*
3A Johnson*
3A Jones
3A Lamar
2A Pierce*
3A Pike
3A Polk
3A Pulaski*
3A Putnam
3A Quitman*
4A Rabun
3A Randolph*
3A Richmond
3A Rockdale
3A Schley*
3A Screven*
2A Seminole*
3A Spalding
4A Stephens
3A Stewart*
3A Sumter*
3A Talbot
3A Taliaferro
2A Tattnall*

HAWAII

~~1A~~ T (all)*

IDAHO

5B Ada
6B Adams
6B Bannock
6B Bear Lake
5B Benewah
6B Bingham
6B Blaine
6B Boise
6B Bonner
6B Bonneville
6B Boundary
6B Butte
6B Camas
5B Canyon
6B Caribou
6B Valley
5B Washington

ILLINOIS

5A Adams
4A Alexander
4A Bond
5A Boone
5A Brown
5A Bureau
5A Calhoun
5A Carroll
5A Cass
5A Champaign
4A Christian
5A Clark
4A Clay
4A Clinton
5A Coles
5A Cook
4A Johnson
5A Kane
5A Kankakee
5A Kendall
5A Knox
5A Lake
5A La Salle
4A Lawrence
5A Lee
5A Livingston
5A Logan
5A Macon
4A Macoupin
4A Madison
4A Marion
5A Marshall
5A Mason
4A Massac
5A McDonough
5A McHenry

6A Ozaukee
6A Pepin
6A Pierce
6A Polk
6A Portage
7 Price
6A Racine
6A Richland
6A Rock
6A Rusk
6A Sauk
7 Sawyer
6A Shawano
6A Sheboygan
6A St. Croix
7 Taylor
6A Trempealeau
6A Vernon
7 Vilas
6A Walworth
7 Washburn
6A Washington
6A Waukesha
6A Waupaca
6A Waushara
6A Winnebago
6A Wood

WYOMING

6B Albany
6B Big Horn
6B Campbell
6B Carbon
6B Converse
6B Crook
6B Fremont
5B Goshen
6B Hot Springs
6B Johnson
6B Laramie
7 Lincoln
6B Natrona
6B Niobrara
6B Park
5B Platte
6B Sheridan
7 Sublette
6B Sweetwater
7 Teton
6B Uinta
6B Washakie
6B Weston

US TERRITORIES

AMERICAN SAMOA

~~1A~~ T (all)*

GUAM

~~1A~~ T (all)*

NORTHERN MARIANA ISLANDS

~~1A~~ T (all)*

PUERTO RICO

~~1A~~ T (all)*

VIRGIN ISLANDS

~~1A~~ T (all)*

Part II

2015 International Energy Conservation Code

Revise as follows:

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

Key: A-Moist, B-Dry, C-Marine, T-Tropical. Absence of moisture designation indicates moisture regime is irrelevant. Asterisk (*) indicates warm-humind location.

Prortions of Table not shown remain unchanged.

3A Crawford
3A Crisp*
4A Dade
4A Dawson
2A Decatur*
3A DeKalb
3A Dodge*
3A Dooly*
3A Dougherty*
3A Douglas
3A Early*
2A Echols*
2A Effingham*
3A Elbert
3A Emanuel*
2A Evans*
4A Fannin
3A Fayette
4A Floyd
3A Forsyth
4A Franklin
3A Fulton
4A Gilmer
3A Glascock
2A Glynn*
4A Gordon
2A Grady*
3A Greene
3A Gwinnett
4A Habersham
4A Hall
3A Hancock
3A Haralson
3A Harris
3A Hart
3A Heard
3A Henry
3A Houston*
3A Irwin*
3A Jackson
3A Jasper
2A Jeff Davis*
3A Jefferson
3A Jenkins*
3A Johnson*
3A Jones
3A Lamar

2A Lanier*
3A Laurens*
3A Lee*
2A Liberty*
3A Lincoln
2A Long*
2A Lowndes*
4A Lumpkin
3A Macon*
3A Madison
3A Marion*
3A McDuffie
2A McIntosh*
3A Meriwether
2A Miller*
2A Mitchell*
3A Monroe
3A Montgomery*
3A Morgan
4A Murray
3A Muscogee
3A Newton
3A Oconee
3A Oglethorpe
3A Paulding
3A Peach*
4A Pickens
2A Pierce*
3A Pike
3A Polk
3A Pulaski*
3A Putnam
3A Quitman*
4A Rabun
3A Randolph*
3A Richmond
3A Rockdale
3A Schley*
3A Screven*
2A Seminole*
3A Spalding
4A Stephens
3A Stewart*
3A Sumter*
3A Talbot
3A Taliaferro
2A Tattnall*

3A Taylor*
3A Telfair*
3A Terrell*
2A Thomas*
3A Tift*
2A Toombs*
4A Towns
3A Treutlen*
3A Troup
3A Turner*
3A Twiggs*
4A Union
3A Upson
4A Walker
3A Walton
2A Ware*
3A Warren
3A Washington
2A Wayne*
3A Webster*
3A Wheeler*
4A White
4A Whitfield
3A Wilcox*
3A Wilkes
3A Wilkinson
3A Worth*

HAWAII

~~1A~~ T(all)*

IDAHO

5B Ada
6B Adams
6B Bannock
6B Bear Lake
5B Benewah
6B Bingham
6B Blaine
6B Boise
6B Bonner
6B Bonneville
6B Boundary
6B Butte
6B Camas
5B Canyon
6B Caribou

5B Cassia
6B Clark
5B Clearwater
6B Custer
5B Elmore
6B Franklin
6B Fremont
5B Gem
5B Gooding
5B Idaho
6B Jefferson
5B Jerome
5B Kootenai
5B Latah
6B Lemhi
5B Lewis
5B Lincoln
6B Madison
5B Minidoka
5B Nez Perce
6B Oneida
5B Owyhee
5B Payette
5B Power
5B Shoshone
6B Teton
5B Twin Falls
6B Valley
5B Washington

ILLINOIS

5A Adams
4A Alexander
4A Bond
5A Boone
5A Brown
5A Bureau
5A Calhoun
5A Carroll
5A Cass
5A Champaign
4A Christian
5A Clark
4A Clay
4A Clinton
5A Coles
5A Cook

4A Crawford
5A Cumberland
5A DeKalb
5A De Witt
5A Douglas
5A DuPage
5A Edgar
4A Edwards
4A Effingham
4A Fayette
5A Ford
4A Franklin
5A Fulton
4A Gallatin
5A Greene
5A Grundy
4A Hamilton
5A Hancock
4A Hardin
5A Henderson
5A Henry
5A Iroquois
4A Jackson
4A Jasper
4A Jefferson
5A Jersey
5A Jo Daviess
4A Johnson
5A Kane
5A Kankakee
5A Kendall
5A Knox
5A Lake
5A La Salle
4A Lawrence
5A Lee
5A Livingston
5A Logan
5A Macon
4A Macoupin
4A Madison
4A Marion
5A Marshall
5A Mason
4A Massac
5A McDonough
5A McHenry

6A Ozaukee
6A Pepin
6A Pierce
6A Polk
6A Portage
7 Price

7 Taylor
6A Trempealeau
6A Vernon
7 Vilas
6A Walworth
7 Washburn

6B Big Horn
6B Campbell
6B Carbon
6B Converse
6B Crook
6B Fremont

6B Sheridan
7 Sublette
6B Sweetwater
7 Teton
6B Uinta
6B Washakie

NORTHERN MARIANA ISLANDS

~~1A~~ T (all)*

6A Racine	6A Washington	5B Goshen	6B Weston	**PUERTO RICO**
6A Richland	6A Waukesha	6B Hot Springs	**US TERRITORIES**	~~1A~~ T (all)*
6A Rock	6A Waupaca	6B Johnson		**VIRGIN ISLANDS**
6A Rusk	6A Waushara	6B Laramie		
6A Sauk	6A Winnebago	7 Lincoln	**AMERICAN SAMOA**	~~1A~~ T (all)*
7 Sawyer	6A Wood	6B Natrona		
6A Shawano	**WYOMING**	6B Niobrara	~~1A~~ T(all)*	
6A Sheboygan		6B Park	**GUAM**	
6A St. Croix	6B Albany	5B Platte		
			~~1A~~ T(all)*	

Reason: This change aligns the climate zone table with the code text that added the Tropical Zone in the last cycle. Islands that are in the tropical zone are given a "T" in the table. The Tropical Zone applies to Hawaii, American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and Virgin Islands. This same change was approved for ICC 700's Climate Zone Table C200.

Cost Impact: Will not increase the cost of construction
Addition of a Tropical Climate Zone does not add costs. In settings where it is practical, the residential option for the tropical zone (existing Section R401.2.1) lowers first cost and saves more energy.

CE22-16 : TABLE C301.1-CONNER12534

CE23-16

Part I:

IECC: , 0, C202 (New), C302.1, C401.2, C402.1.1, C409.1 (New), C409.2 (New), C409.3 (New), C409.3.1 (New), C409.4 (New), C409.4.1 (New), C409.4.2 (New), C409.5 (New), C409.5.1 (New), C409.5.2 (New), C409.5.2.1 (New), C409.5.2.2 (New), C409.5.2.3 (New), C409.6 (New), C409.6.1 (New), C409.6.2 (New), C409.6.3 (New).

Part II:

R202 (New) [IRC N1101.6 (New)], R302.1 (IRC N1101.9), R401.2 (IRC N1101.13), R402.1 (IRC N1102.1), R407 (New) [IRC N1107 (New)], R407.1 (New) [IRC N1107.1 (New)], Table R407.1(1) (New) [IRC Table N1107.1(1) (New)], Table R407.1(2) (New) [IRC Table N1107.1(2) (New)], R407.2 (New) [IRC N1107.2 (New)], R407.3 (New) [IRC N1107.3 (New)], R407.3.1 (New) [IRC N1107.3.1 (New)], R407.4 (New) [IRC N1107.4 (New)], R407.4.1 (New) [IRC N1107.4.1 (New)], R407.4.2 (New) [IRC N1107.4.2 (New)], R407.4.2.1 (New) [IRC N1107.4.2.1 (New)], R407.4.2.2 (New) [IRC N1107.4.2.2 (New)], R407.4.3 (New) [IRC N1107.4.3 (New)] , R407.5 (New) [IRC N1107.4.5 (New)], R407.6 (New) [IRC N1107.6 (New)] , R407.6.1 (New) [IRC N1107.6.1 (New)], R407.6.2 (New) [IRC N1107.6.2 (New)], R407.6.3 (New) [IRC N1107.6.3(New)]

THIS IS A 2 PART CODE CHANGE. PART I WILL BE HEARD BY THE IECC COMMERCIAL ENERGY COMMITTEE. PART II WILL BE HEARD BY THE IECC RESIDENTIAL ENERGY COMMITTEE.

Proponent : Joseph Zimmer, Joseph Zimmer, Architect (self employed), representing Joseph Zimmer, Architect (joe@studiojosephzimmer.com)

Part I

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floors, floor slabs, insulation, roof and any other building elements that enclose *conditioned space* or provide a boundary between *conditioned space*and exempt or unconditioned space.

CONDITIONED PASSIVE BUILDING. A building, or portion thereof, having *conditioned spaces* separated from the remainder of the building by *building thermal envelope* assemblies, and that has a building envelope air leakage rate, an annual *source energy* demand, a space conditioning energy design rate and vertical fenestration and skylight performance values less than or equal to values in Table C409.3.

CONDITIONED SPACE. An area, room or space that is enclosed within the ~~building thermal envelope~~*building thermal envelope* and is directly or indirectly heated or cooled by systems capable of maintaining a temperature of not less than 68ºF (20ºC) and, if cooled, a temperature of not greater than 79ºF (26ºC). Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces, where they are separated from conditioned spaces by uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling.

LOW ENERGY BUILDING. A building, or portion thereof, with *semi-heated spaces* or *conditioned spaces* that are separated from the remainder of the building by *building thermal envelope* assemblies and that comply with section C402 and have a peak design rate of energy use less than or equal to 3.4 Btu/h * ft^2 (10.7 W/m^2) or 1.0 W/ft^2 (10.7 W/m^2) for space heating or cooling purposes.

PROCESS LOAD. Energy consumption for manufacturing, industrial or commercial purposes other than that consumed for space conditioning, service water heating, mechanical ventilation, and fan, pump, lighting and receptacle loads associated with maintaining occupant comfort.

PROPOSED DESIGN. A description of the proposed building used to estimate annual energy ~~use~~ demand for determining compliance based on ~~total building performance~~ Section C407, Total Building Performance or Section C409, Conditioned Passive Building Performance Benchmark.

SEMI-HEATED SPACE. An area, room or space that is enclosed within the *building thermal envelope* and is directly or indirectly heated by systems that are not capable of maintaining a temperature of 68ºF (20ºC) or higher.

SITE ENERGY. The total amount of energy used by a building and its associated site energy consuming systems and components in association with the operation of the building as measured by meters at the building site.

SOURCE ENERGY. Total amount of *site energy* plus the amount of energy expended to extract, transport, refine, convert, transmit and distribute the energy fuel source in a usable form to the building site. The Source Energy value shall be determined by multiplying the *site energy* by the *source energy factor* for each fuel energy consuming system and component.

SOURCE ENERGY FACTOR. The value that the *site energy* value is multiplied by to determine *source energy* value.

C302.1 Interior design conditions. The interior design temperatures used for heating and cooling load calculations shall be ~~a maximum of~~ not greater than 72°F (22°C) and not less than 68ºF (20ºC) for heating and ~~minimum of~~ not less than 75°F (24°C) and not greater than 79ºF (26ºC) for cooling.

Exceptions:

1. Non *conditioned spaces*
2. *Semi-heated spaces*
3. Saunas and steam rooms
4. Walk-in freezers and coolers
5. Walk-in ovens
6. Other *process load* spaces
7. Spaces not intended for human comfort

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. 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, C404, C405.1, C405.2, C405.3, C405.5, C405.6, C405.7, C405.8 and C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.
4. The requirements of Sections C402.5, C403.2, C404, C405.1 C405.2, C405.3, C405.5, C405.6, C405.7, C405.8 and C409.

C402.1.1 ~~Low-energy~~ Exempt 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. *Low energy buildings*.
2. ~~Those with a peak design rate of energy usage less than 3.4 Btu/h • ft^2 (10.7 W/m^2) or 1.0 watt per square foot (10.7 W/m^2) of floor area for space conditioning purposes.~~
2. *Conditioned passive buildings*.
3. ~~Those that do not contain *conditioned* space.~~
3. Those that do not contain *semi-heated* or *conditioned space*.
4. ~~Greenhouses.~~
4. *Greenhouses*.

SECTION C409 CONDITIONED PASSIVE BUILDING PERFORMANCE BENCHMARK

C409.1 Scope. This section establishes criteria for compliance using a *conditioned passive building* performance benchmark criteria analysis. The following systems and loads shall be included in determining the *conditioned passive building* performance:

1. heating systems
2. cooling systems
3. *service water heating* system
4. fan systems
5. lighting power
6. receptacle loads
7. *process loads*.

This method is applicable to buildings with use groups A-3, A-4, B, E, F, I, M, R-1 and S where occupant use patterns are predictable and *approved* by the *code official*. This method is applicable to buildings with A-1 , A-2, A-5, H and U occupancies, where *approved* by the *code official*. Occupancy group classifications shall be in accordance with Chapter 3 of the *International Building Code*.

C409.2 Mandatory requirements. Compliance with this section requires compliance with Sections C402.5, C403.2, C404, C405.1, C405.2, C405.3, C405.5, C405.6, C405.7 and C405.8.

C409.3 Conditioned passive building performance benchmark based compliance. Compliance based upon *conditioned passive building* performance benchmark requires that a proposed design for the proposed building be shown to be a *conditioned passive building* in accordance with the definition for such and Table C409.3. Annual *source energy* demand shall be total based upon approved *source energy factor*(s). Documentation supporting *source energy factor*(s) used in simulation shall be provided to the *code official*. Nondepletable energy collected off site shall use same *source energy factor* as depletable fuel source or shall provide *approved* documentation of *source energy factor*(s) used. Energy from nondepletable energy sources collected on site shall be omitted from the annual energy demand of the proposed design.

Note: (1 kWh = 3412 Btu)

C409.3.1 Source Energy Factor The *source energy factor* value shall be one of the following:

1. Within the US, 3.16 for mixed grid connected electricity and 1.1 for fuels other than electricity.
2. Within the US, as determined or approved by the US Energy Information Administration's (EIA) last published report prior to date of publication of this code based upon the electrical or other fuel distribution system.
3. Other source *approved* by the *code official*.

TABLE C409.3
CONDITIONED PASSIVE BUILDING PERFORMANCE BENCHMARK CRITERIA[1]

Climate zone			1	2	3	4 except Marine	5 and Marine 4	6	7	8
Air leakage[2, 5]			≤0.1 cfm/ft^2 (0.05 L/s m^2) of exterior surface of the building thermal envelope at pressure differential of 0.3 inch water gauge (75 Pascals), or ≤1.25 air changes per hour (ACH) (0.02083 changes per minute) of enclosed building volume at pressure differential of 0.2 inch water gauge (50 pascals)							
Source (site) *Energy* Demand per *conditioned floor area* unit[3]		A-3, A-4	≤49.20 kBtu/ft^2, 14.42 kWh/ft^2, 155.0 kWh/m^2 (15.57 kBtu/ft^2, 4.56 kWh/ft^2, 49.05 kWh/m^2 if all *source energy* is mixed grid electricity and *source energy factor* is 3.16)							
		B	≤58.73 kBtu/ft^2, 17.21 kWh/ft^2, 185.0 kWh/m^2 (18.58 kBtu/ft^2, 5.45 kWh/ft^2, 58.54 kWh/m^2 if all *source energy* is mixed grid electricity and *source energy factor* is 3.16)							
		E	≤46.03 kBtu/ft^2, 13.49 kWh/ft^2, 145.0 kWh/m^2 (14.57 kBtu/ft^2, 4.27 kWh/ft^2, 45.89 kWh/m^2 if all *source energy* is mixed grid electricity and *source energy factor* is 3.16)							
		F	≤115.87 kBtu/ft^2, 33.96 kWh/ft^2, 365.0 kWh/m^2 (36.67 kBtu/ft^2, 10.75 kWh/ft^2, 155.51 kWh/m^2 if all *source energy* is mixed grid electricity and *source energy factor* is 3.16)							
		I-1, I-3	≤49.20 kBtu/ft^2, 14.42 kWh/ft^2, 155.0 kWh/m^2 (15.57 kBtu/ft^2, 4.56 kWh/ft^2, 49.05 kWh/m^2 if all *source energy* is mixed grid electricity and *source energy factor* is 3.16)							
	Occupancy Group	I-2 hospital	≤174.60 kBtu/ft^2, 51.17 kWh/ft^2, 550.0 kWh/m^2 (55.25 kBtu/ft^2, 16.19 kWh/ft^2, 174.05 kWh/m^2 if all *source energy* is mixed grid electricity and *source energy factor* is 3.16)							
		I-2 long term care	≤133.33 kBtu/ft^2, 39.08 kWh/ft^2, 420.0 kWh/m^2 (42.19 kBtu/ft^2, 12.36 kWh/ft^2, 132.91 kWh/m^2 if all *source energy* is mixed grid electricity and *source energy factor* is 3.16)							
		M	≤46.03 kBtu/ft^2, 13.49 kWh/ft^2, 145.0 kWh/m^2 (14.57 kBtu/ft^2, 4.27 kWh/ft^2, 45.89 kWh/m^2 if all *source energy* is mixed grid electricity and *source energy factor* is 3.16)							

		M supermarket	≤217.46 kBtu/ft^2, 63.73 kWh/ft^2, 685.0 kWh/m^2 (68.82 kBtu/ft^2, 20.17 kWh/ft^2, 216.77 kWh/m^2 if all *source energy* is mixed grid electricity and *source energy factor* is 3.16)							
		R-1	≤49.20 kBtu/ft^2, 14.42 kWh/ft^2, 155.0 kWh/m^2 (15.57 kBtu/ft^2, 4.56 kWh/ft^2, 49.05 kWh/m^2 if all *source energy* is mixed grid electricity and *source energy factor* is 3.16)							
		S unrefrigerated	≤44.44 kBtu/ft^2, 13.03 kWh/ft^2, 140.0 kWh/m^2 (14.06 kBtu/ft^2, 4.12 kWh/ft^2, 44.30 kWh/m^2 if all *source energy* is mixed grid electricity and source energy factor is 3.16)							
Space conditioning energy per *conditioned floor area* unit3	Annual Demand	Heating kBtu/ft^2 (kWh/ft^2) [kWh/m^2]	≤2.0 (0.586) [6.300]	≤3.5 (1.026) [11.023]	≤4.5 (1.319) [14.173]	≤6.5 (1.905) [20.472]	≤8.0 (2.345) 25.197]	≤9.0 (2.638) [28.346]	≤11.0 (3.224) [34.646]	≤17.0 (4.985) [53.543]
		Cooing kBtu/ft^2 (kWh/ft^2) [kWh/m^2]	≤24.0 (7.034) [75.590]	≤19.0 (5.568) [59.842]	≤12.0 (3.517) [37.795]	≤8.0 (2.345) [25.197]	≤5.0 (1.465) [15.748]	≤4.0 (1.172) [12.598]	≤2.0 (0.586) [6.300]	≤1.5 (0.440) [4.724]
	Peak Load7	Heating Btu/h * ft^2 (W/ft^2) [W/m^2]	≤5.0 (1.465) [15.748]	≤6.0 (1.758) [18.898]	≤7.0 (2.052) [22.047]	≤7.5 (2.198) [23.622]	≤8.0 (2.345) [25.197]	≤8.5 (2.491) [26.772]	≤9.0 (2.638) [28.346]	≤9.5 (2.784) [29.921]
		Cooling Btu/h * ft^2 (W/ft^2) [W/m^2]	≤8.5 (2.491) [26.772]	≤13.0 (3.810) [33.071]	≤10.5 (3.077) [33.071]	≤9.5 (2.784) [29.921]	≤9.0 (2.638) [28.346]	≤7.0 (2.052) [22.047]	≤6.5 (1.905) [20.472]	≤4.5 (1.319) [14.173]
Vertical *fenestration* and *skylight* performance 4, 5	U unit	Fixed window	≤0.25	≤0.25	≤0.23	≤0.19	≤0.19	≤0.18	≤0.15	≤0.13
		Operable window	≤0.33	≤0.33	≤0.30	≤0.23	≤0.23	≤0.22	≤0.19	≤0.17
		Entry/exit door	≤0.55	≤0.42	≤0.38	≤0.38	≤0.38	≤0.38	≤0.38	≤0.38
		Skylight	≤0.38	≤0.33	≤0.28	≤0.25	≤0.25	≤0.25	≤0.25	≤0.25
	SHGC		Dimensions of overhead projections, measured horizontally from face of glazing and vertically from bottom of glazing to underside of projection, and side projections measured horizontally from edge of glazing and perpendicular to face of glazing, that shade glazing shall be input into the *energy simulation tool*. SHGC of glazing of each individual glazed opening, window, door and skylight shall be input into the *energy simulation tool*.							

1. Limitations in Section C409.1 apply.

2. Required building thermal envelope air leakage shall be tested in accordance with ASTM E779 at pressure differential of 0.3 inch water gauge (75 pascals), or, for enclosed volumes ≤100,000

ft^3 (2831.68 m^3) tested for air volume exchange rate in accordance with ASTM E779 or ASTM E1827 at pressure differential of 0.2 inch water gauge (50 pascals).
3. Values can be higher where specific *process loads* beyond HVAC, *service water heating*, lighting, MEL plug and auxiliary system pump and fan demands are *approved* by the *code official*.
4. Section C409.6 addresses *energy simulation tool* capabilities.
5. Improved fenestration and skylight air leakage, U_{unit} and SHGC performance is required where necessary to meet other performance benchmark values in this table.
6. Based upon dry bulb temperature.
7. Based upon ANSI/ASHRAE/ACCA Standard 183 or and *approved* equivalent computational procedure using the interior design conditions required by Section C302.1.

C409.4 Documentation. Documentation verifying that the methods of accuracy of compliance software tools conform to the provisions of this section shall be provided to the *code official*.

C409.4.1 Compliance report. Permit submittals shall include a report documenting that the *proposed design* complies with Section C409.3. The compliance report shall include the following information:

1. Building street address, or other building site identification.
2. A statement indicating that the *proposed design* complies with Section C409.3.
3. A statement indicating the air leakage rate in accordance with SectionC402.5 presumed in compliance software tool analysis.
4. A document summarizing building component characteristics of the *proposed design* as listed in Table C409.5.1 used as inputs in the compliance software tool analysis.
5. A site-specific energy analysis report that is in compliance with Section C409.3.
6. Name of individual completing the compliance report.
7. Name and version of compliance software tool.

C409.4.2 Additional documentation. The following documents shall be submitted where required by the *code official*:

1. A copy of document summarizing building component characteristics of the *proposed design* as listed in Table C409.5.1 available during inspections by the *code official* or an *approved agency* to verify each characteristic installed matches inputs entered into the software tool analysis. Inspections shall be not less than those required by Section C104.
2. The thermal zoning diagrams consisting of floor plans showing thermal zoning scheme for *proposed design*.
3. The input and output reports from energy analysis simulation program containing the complete input and output files as applicable. The output file shall include energy demand totals and energy by energy source and end use served, percentage of annual heating season or cooling season time or total hours that space conditioning loads are not met and any errors or warning messages generated by the simulation tool as applicable.
4. An explanation of any error or warning messages appearing in the simulation tool output.
5. The results of *building thermal envelope* air leakage test in accordance with Section C402.5 prior to final inspection required by Section C104.2.6.
6. The name of *approved agency* reviewing and verifying accuracy of compliance reports prior to submission to *code official*.
7. The name and qualifications of *approved agency(ies)* performing inspections and tests required by Section C104.2 or commissioning required by Section C408 in

accordance with Section C104.4.

C409.5 Calculation procedure. Calculations of the performance of the *proposed design* shall be configured and analyzed in accordance with Sections C409.5.1 through C409.5.3.

C409.5.1 Building specifications. The *proposed design* shall be configured and analyzed using input data inclusive of building components listed in Table C409.5.1.

TABLE C409.5.1
SPECIFICATIONS OF THE CONDITIONED PASSIVE BUILDING PROPOSED DESIGN

BUILDING COMPONENT	PROPOSED DESIGN CHARACTERISTICS	QUANTITY OR % OF ANNUAL ENERGY DEMAND if requested by *code official*
Space use classification(s). Chosen in accordance with Table C405.4.2 for all areas of the building covered by this permit. where space use classification for the building is not known, the building shall be categorized as an office building (Occupancy Use group B).		NA
Roofs	Type:	Total annual building thermal envelope assemblies heat transmission losses and/or gains
	Gross Area:	
	U-factor:	
	Solar absorptance:	
	Emittance:	
Walls, above grade	Type:	
	Gross Area:	
	U-factor:	

	Solar absorptance:	
	Emittance:	
Walls, below grade	Type:	
	Gross Area:	
	U-factor:	
Floors, above grade	Type:	
	Gross Area:	
	U-factor:	
Floors, slab on grade	Type (heated or unheated):	
	U-factor:	
Opaque doors	Type (swinging, rolling, sectional):	Total annual building thermal envelope openings heat transmission losses and/or gains Total annual glazed opening solar radiation gains
	Area (% of area of above grade walls):	
	U-factor:	
Vertical fenestration other than opaque doors	Area (% of area of above grade walls):	
	U-factor:	
	SHGC:	
	External shading type and PF:	
Skylights	Area (% of roof gross area):	
	U-factor:	
	SHGC:	
Lighting, interior	Wattage density (W/ft2 [W/m2]) and total wattage:	Total annual

		interior lighting demand
Lighting, exterior	Total wattage:	Total annual exterior lighting demand
Miscellaneous Electrical Loads (MEL's)	Types of plug-in items and presumed power density:	Total estimated annual MEL demand
Internal gains	Receptacle, motor and process loads shall be modeled and estimated based upon the use classification, All 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. Occupant load shall be based upon space use classification and Section 1004 of the *International Building Code*.	Total annual internal heat gains
Schedules	Operating schedules shall include hourly profiles for daily operation and shall account for variation between weekdays, weekends, holidays and any seasonal operation. Schedules shall model 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 *code official*.	NA
Mechanical ventilation	In accordance with Section C403.2.6.	Total mechanical ventilation air heat and/or humidity losses and/or gains Total annual mechanical ventilation fan operation

		demand
Heating system(s)	Fuel type:	Total annual active space heating demand
	Equipment typea:	
	Efficiency (AFUE, HSPF, EER, COP):	
	Capacity:	
Cooling system(s)	Fuel type:	Total annual active space cooling (and dehumidification) demand
	Equipment typeb:	
	Efficiency (EER, SEER, COP):	
	Capacity:	
	Economizer:	
Auxiliary electric system(s)	Pumps, fans, charging stations for systems:	Total annual auxiliary system(s) demand
Service water heatingc	Fuel type:	Total annual service water heating demand
	Efficiency (For Occupancy Group R, multiply by SWHF. For other than Occupancy Group R multiply efficiency provided by manufacturer of DWHR unit (EF, COP):	
	Capacity:	
	Presumed gallons/day or year:	
	Where no service water heating system exists or is specified, no service hot water heating shall be modeled.	

SWHF = Service water heat recovery factor, DWHR = Drain water heat recovery

a. Where a heating system does not exist or has not been specified, the heating system shall be modeled as fossil fuel.

b. Where a cooling system does not exist or has not been specified, the cooling system shall be modeled as an air-cooled single zone system, one unit per thermal zone.
c. The SWHF shall be applied as follows:
1. Where potable water from DWHR unit supplies one or two showers, and the drain water from such showers flows through the DWHR unit, the SWHF = [1-(DWHR unit efficiency * 0.36)].
2. Where potable water from DWHR unit supplies three or four showers, and the drain water from such showers flows through the DWHR unit, the SWHF = [1-(DWHR unit efficiency * 0.33)].
3. Where potable water from the DWHR unit supplies five or six showers,and the drain water from such showers flows through the DWHR unit, the SWHF = [1-(DWHR unit efficiency * 0.26)].
4. Where items 1 through 3 do not apply, the SWHF = 1.0.

C409.5.2 Thermal blocks. The *proposed design* shall be analyzed using thermal blocks as specified in Sections C409.5.2.1, C409.5.2.2 and C409.5.2.3.

C409.5.2.1 HVAC zones designed. Where HVAC zones are defined on HVAC design drawings, each HVAC zone shall be modeled as a separate thermal block.
Exception: Where different HVAC zones are combined to create a single thermal block or identical thermal blocks to which multipliers are applied, all of the following shall apply:

1. The space use classification is the same throughout the block.
2. All HVAC *zones* in the thermal block that are adjacent to the glazed exterior walls face the same orientation or their orientations are within 45 degrees (0.79 rad) of each other.
3. All of the *zones* are served by the same HVAC system or by the same type of HVAC system.

C409.5.2.2 HVAC zones not designed. Where HVAC *zones* have not yet been designed, thermal blocks shall be defined based upon similar internal load densities, occupancy, lighting, thermal and temperature schedules, and in combination with the following:

1. Separate thermal blocks shall be assumed for interior and perimeter spaces. Interior spaces shall be those located more than 15 feet (4572 mm) from an *exterior wall*. Perimeter spaces shall be those located closer than 15 feet (4572 mm) from an *exterior wall*.
2. Separate thermal blocks shall be assumed for spaces adjacent to glazed *exterior walls.* A separate *zone* shall be provided for each orientation. Orientations that differ by not more than 45 degrees (0.79 rad) shall be considered as different orientations or as the same orientation. Each *zone* shall include floor area that is 15 feet (4572 mm) or less from a glazed perimeter wall, except that floor area within 15 feet (4572 mm) of glazed perimeter walls having more than one orientation shall be divided proportionately between zones.
3. Separate thermal blocks shall be assumed for spaces having floors that are in contact with the ground or exposed ambient conditions from zones that do not share these features.
4. Separate thermal blocks shall be assumed for spaces having exterior ceiling or roof assemblies from zones that do not share these features.

C409.5.2.3 Multifamily residential buildings. Residential spaces in other than *residential buildings* required to comply with the Residential Provisions of this code shall be modeled using one thermal block per space except that those facing the same orientations are not required to be combined into one thermal block. Corner units and units with roof or floor loads shall be combined only with units sharing these features.

C409.6 Calculation software tools. Calculation software tools used to comply with this section shall be capable of calculating annual *source energy* demand of all building elements of the *proposed design* and shall include the following capabilities:

1. Building operation for a full calendar year (8,760 hours).
2. Climate data for a full calendar year (8,760 hours) and shall reflect *approved* coincident hourly data for temperature, solar radiation, humidity and wind speed representative for the site in which the *proposed design* is located. For cities and urban regions with several climatic data sets, and for locations where recorded weather data is not available, the individual performing the analysis shall select a data set that best represents the climate at the site.
3. Calculation of glazed wall, window, door and skylight U-factor specific to each wall or roof opening by summing (U_{frame} x $Area_{frame}$) + ($U_{glazing}$ x $Area_{glazing}$) + ($\psi_{glazing\ spacer}$ x $Length_{glazing\ spacer}$) + ($\psi_{perimeter\ installation\ gap}$ x $Length_{perimeter\ installation\ gap}$) and dividing by the Area of the wall or roof opening.
4. Calculatation of affects of solar radiation gains at glazed walls, windows, doors and skylights based upon orientation, shading from overhead and side projections at each wall or roof opening and *SHGC* of glazing.
5. Ten or more thermal *zones* or separate analysis calculations provided for each thermal block.
6. Thermal mass effects.
7. Hourly variances in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any *process loads*.
8. Part-load performance curves for mechanical equipment.
9. Capacity and efficiency correction curves for mechanical heating and cooling equipment.

C409.6.1 Specific approval. Performance analysis tools complying with applicable subsections of Section C409 and tested according to *approved* methods shall be *approved*. Tools shall be *approved* based upon meeting a specified threshold for a jurisdiction or climate zone. The *code official* shall approve tools for a specified application or limited scope.

C409.6.2 Input values. Where calculations require input values not specified by Sections C402, C403, C404 and C405, those input values shall be taken from an *approved* source.

C409.6.3 Exceptional calculation methods. Where the software tool does not model a design, material or device of the *proposed design*, an exceptional calculation method shall be used where *approved* by the *code official*. Where there are multiple designs, materials or devices that the simulation program does not model, each shall be calculated separately and exceptional demand determined for each. Applications for approval of an exceptional method shall include all of the following:

1. Step-by-step documentation of the exceptional calculation method performed, detailed enough to reproduce the results.
2. Copies of all spreadsheets used to perform the calculations.
3. A sensitivity analysis of energy consumption where each of the input parameters is varied from half to double the value assumed.
4. The calculations shall be performed on a time step basis consistent with the software tool used.
5. The performance rating calculated with and without the exceptional calculation

method.

Delete without substitution:

TABLE C409 (2)
SPECIFICATIONS OF THE CONDITIONED PASSIVE BUILDING PROPOSED DESIGN

Part II

2015 International Energy Conservation Code

Revise as follows:

SECTION 202 DEFINITIONS

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floors, floor slabs, insulation, roof and any other building elements that enclose ~~conditioned space~~*conditioned space* or provide a boundary between ~~conditioned space~~*conditioned space* and exempt or unconditioned space.

Add new definition as follows:

CONDITIONED PASSIVE RESIDENCE. A *residential building*, or portion thereof, with *conditioned spaces* separated from the remainder of the building by *building thermal envelope* assemblies, and that has a building envelope air leakage rate, an annual *source energy* demand, a space conditioning energy design rate and vertical fenestration and skylight performance values less than or equal to values in Table R407.3.

Revise as follows:

CONDITIONED SPACE. An area, room or space that is enclosed within the ~~building thermal envelope~~*building thermal envelope* and that is directly or indirectly heated or cooled by systems capable of maintaining a temperature of not less than 68ºF (20ºC) and, if cooled, a temperature of not greater than 79ºF (26ºC). Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces, where they are separated from conditioned spaces by uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling.

Add new definition 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.

LOW ENERGY BUILDING. A building, or portion thereof, with *semi-heated spaces* and/or *conditioned spaces* that are separated from the remainder of the building by *building thermal envelope* assemblies complying with section R402 and that have a peak design rate of energy use less than or equal to 3.4 Btu/h * ft2 (10.7 W/m2) or 1.0 W/ft2 (10.7 W/m2) for space heating or cooling purposes.

Revise as follows:

PROPOSED DESIGN. A description of the proposed ~~*building*~~building used to estimate annual energy ~~use~~ demand for determining compliance based on ~~total building performance~~ Section R405 (Simulated Performance Alternative) or Section R407 (Conditioned Passive Residence

Performance Benchmark Alternative).

Add new definition as follows:

SEMI-HEATED SPACE. An area, room or space that is enclosed within the building thermal envelope and is directly or indirectly heated by systems that are not capable of maintaining a temperature of 68ºF (20ºC) or higher.

SITE ENERGY. The total amount of energy used by a building and its associated site energy consuming systems and components in association with the operation of the building as measured by meters at the building site.

SOURCE ENERGY. Total amount of *site energy* plus the amount of energy expended to extract, transport, refine, convert, transmit and distribute the energy fuel source in a usable form to the building site. The Source Energy value shall be determined by multiplying the site energy by the source energy factor for each fuel energy consuming system and component.

SOURCE ENERGY FACTOR. Value that *site energy* value is multiplied by to determine *source energy* value.

Revise as follows:

R302.1 Interior design conditions. The interior design temperatures used for heating and cooling load calculations shall be~~ a maximum of ~~ not greater than 72°F (22°C) and not less than 68ºF (20ºC) for heating and minimum of 75°F (24°C) and maximum of 79ºF (26ºC) for cooling.

Exceptions:

1. Non *conditioned spaces*
2. *Semi-heated spaces*
3. Saunas and steam rooms
4. Spaces not intended for human comfort

R401.2 Compliance. Projects shall comply with one of the following:

1. Sections R401 through R404.
2. Section R405 and the mandatory provisions of Sections ~~R401 through~~ R401.3, R402.4, R402.5, R403.1, R403.3.2, R403.3.3, R403.3.5, R403.4, R403.5.1, R403.6, R403.7, R403.8, R403.9, R403.10, R403.11 and R404~~ labeled "Mandatory~~.~~"~~
3. An energy rating index (ERI) approach in Section R406 and the mandatory provisions in Sections R401.3, R402.4, R402.5, R403.1, R403.3.2, R403.3.3, R403.3.5, R403.4, R403.5.1, R403.6, R403.7, R403.8, R403.9, R403.10, R403.11 and R404.
4. A conditioned passive residence performance benchmark alternative approach in Section R407 and the mandatory provisions in Sections R401.3, R402.4, R402.5, R403.1, R403.3.2, R403.3.3, R403.3.5, R403.4, R403.5.1, R403.6, R403.7, R403.8, R403.9, R403.10, R403.11 and R404.

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

> **Exception:** 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. *Low-energy buildings*.

2. *Conditioned passive residences.*
~~3. 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.~~
4. Those that do not contain *semi-heated space* or *conditioned space*.
~~5. Those that do not contain *conditionedspace*.~~
6. *Greenhouses.*

Add new text as follows:

SECTION R407 CONDITIONED PASSIVE RESIDENCE PERFORMANCE BENCHMARK ALTERNATIVE

R407.1 Scope. This section establishes criteria for compliance using the *conditioned passive residence* performance benchmark analysis. Such analysis shall include heating, cooling, *service water heating*, lighting and electrical power appliances and other building systems consuming energy.

R407.2 Mandatory requirements. Compliance with this section requires that the mandatory provisions identified in Sections R401.3, R402.4, R402.5, R403.1, R403.3.2, R403.3.3, R403.3.5, R403.4, R403.5.1, R403.6, R403.7, R403.8, R403.9, R403.10, R403.11 and R404 be met. All supply and return ducts must be completely inside the *building thermal envelope*.

Exception: Outdoor air intake and exhaust ducts associated with mechanical ventilation systems that pass through the *building thermal envelope* shall be insulated a minimum of R-6 for their entire length from the mechanical ventilation unit to the outdoor air intake and exhaust dampers.

R407.3 Conditioned passive residence performance benchmark based compliance. Compliance based on *conditioned passive residence* performance benchmark requires that the proposed residence (*proposed design*) be shown to be a *conditioned passive residence* in accordance with definition and Table R407.3. Annual *source energy* demand shall be total based upon approved source energy factor(s) used in the simulation. Documentation supporting *source energy factor*(s) used in simulation shall be provided to the *code official*. Nondepletable energy collected off site shall use same source energy factor as depletable fuel source or shall provide *approved* documentation of *source energy factor(s)* used. Energy from nondepletable energy sources collected on site shall be omitted from the annual energy demand of the *proposed design*.
Note: (1 kWh = 3412 Btu)

R407.3.1 Source Energy Factor The *source energy factor* value shall be:

1. Within the US, 3.16 for mixed grid connected electricity and 1.1 for fuels other than electricity, or
2. Within the US, as determined or approved by the US Energy Information Administration's (EIA) last published report prior to date of publication of this code based upon the electrical or other fuel distribution system, or
3. Other source *approved* by the *code official*.

TABLE R407.3
CONDITIONED PASSIVE RESIDENCE PERFORMANCE BENCHMARK CRITERIA

Climate	4 except	5 and

zone	_	_	1	2	3	Marine	Marine 4	6	7	8
Air leakage[1, 3]	_	_	≤0.1 cfm/ft^2 (0.05 L/s * m^2) of exterior surface area of the building thermal envelope at pressure differential of 0.3 inch water gauge (75 pascals), or ≤1.25 air changes per hour (ACH) (0.02083 changes per minute) of enclosed building volume at pressure differential of 0.2 inch water gauge (50 Pascals)							
Source *(site) Energy* Demand per *conditioned floor area* unit	Occupancy Group	R-2	≤49.20 kBtu/ft^2 (15.57 kBtu/ft^2 If all source energy is mixed grid electricity and source enrgy factor is 3.16)							
		R-3	14.42 kWh/ft^2 (4.56 kWh/ft^2 If all source energy is mixed grid electricity and source enrgy factor is 3.16) 155 kWh/m^2 (49.05 kWh/m^2 If all source energy is mixed grid electricity and source enrgy factor is 3.16)							
		R-4								
Space conditioning energy per conditioned floor area unit[4]	Annual Demand	Heating kBtu/ft^2 (kWh/ft^2) [kWh/m^2]	≤2.0 (0.586) [6.300]	≤3.5 (1.026) [11.023]	≤4.5 (1.319) [14.173]	≤6.5 (1.905) [20.472]	≤8.0 (2.345) [25.197]	≤9.0 (2.638) [28.346]	≤11.0 (3.224) [34.646]	≤17.0 (4.985) [53.543]
		Cooling kBtu/ft^2 (kWh/ft^2) [kWh/m^2]	≤24.0 (7.034) [75.590]	≤19.0 (5.568) [59.842]	≤12.0 (3.517) [37.795]	≤8.0 (2.345) [25.197]	≤5.0 (1.465) [15.748]	≤4.0 (1.172) [12.598]	≤2.0 (0.586) [6.300]	≤1.5 (0.440) [4.724]
	Peak Load[5]	Heating Btu/h * ft^2 (W/ft^2) [W/m^2]	≤5.0 (1.465) [15.748]	≤6.0 (1.758) [18.898]	≤7.0 (2.052) [22.047]	≤7.5 (2.198) [23.622]	≤8.0 (2.345) [25.197]	≤8.5 (2.491) [26.772]	≤9.0 (2.638) [28.346]	≤9.5 (2.784) [29.921]
		Cooling Btu/h * ft2 (W/ft2) [W/m2]	≤8.5 (2.491) [26.772]	≤13.0 (3.810) [33.071]	≤10.5 (3.077) [29.921]	≤9.5 (2.784) [29.921]	≤9.0 (2.638) [28.346]	≤7.0 (2.052) [22.047]	≤6.5 (1.905) [20.472]	≤4.5 (1.319) [14.173]
Vertical fenestration and skylight performance 2, 3	U_{unit}	Fixed window	≤0.25	≤0.25	≤0.23	≤0.19	≤0.19	≤0.18	≤0.15	≤0.13
		Operable window	≤0.33	≤0.33	≤0.30	≤0.23	≤0.23	≤0.22	≤0.19	≤0.17
		Entry/exit door	≤0.55	≤0.42	≤0.38	≤0.38	≤0.38	≤0.38	≤0.38	≤0.38
		Skylight	≤0.38	≤0.33	≤0.28	≤0.25	≤0.25	≤0.25	≤0.25	≤0.25

SHGC	-	Dimensions of overhead (horizontal from face of glazing and vertical from bottom of glazing to underside of projection) and side (horizontal from edge of glazing and perpendicular to face of glazing) projections that shade glazing shall be entered into the *energy simulation tool*. SHGC of glazing of each individual glazed window, door and skylight shall also be entered into the *energy simulation tool*.

1. Required *building thermal envelope* air leakage rate shall be tested in accordance with ASTM E779 at pressure differential of 0.3 inch water gauge (75 pascals) or enclosed building air volume air exchange rate in accordance with ASTM E779 or ASTM E1827 at pressure differential of 0.2 inch water gauge (50 pascals).
2. See R407.6.1 for minimum *energy simulation tool* capabilities.
3. Improved fenestration and skylight air leakage, U_{unit} and SHGC performance is required if necessary to meet other performance framework values in this table.
4. Based upon dry bulb temperature.
5. Based upon ACCA Manual J or other *approved* heating and cooling calculation methodology using interior design conditions required by Section R302.1.

R407.4 Documentation. Documentation of the software used for the *conditioned passive residence* performance benchmark design and the parameters for the building shall be in accordance with Sections R407.4.1 through R407.4.3.

R407.4.1 Compliance software tools. Documentation verifying the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the *code official*.

R407.4.2 Compliance report. Compliance software tools shall generate a report that documents the proposed design complies with Section R407.3. A compliance report on the proposed design shall be submitted with the application for building permit. Upon completion of the building, a compliance report based upon as-built condition of the building shall be submitted to the *code official* before a certificate of occupancy is issued. Batch sampling of buildings to determine energy code compliance for all buildings in the batch shall be prohibited. Compliance reports shall include information in accordance with Sections R407.4.2.1 and R407.4.2.2. Where the *proposed design* of a building on each site is different, compliance of the proposed design for the purposes of the application for the building permit shall be based on the worst-case orientation, worst-case configuration, worst-case building air leakage and worst-case duct leakage. Such worst-case parameters shall be used as inputs to the compliance software for energy analysis.

R407.4.2.1 Compliance report for permit application. A compliance report submitted with application for building permit shall include the following:

1. Building street address, or other building site identification.
2. A statement indicating that the *proposed design* complies with Section R407.3.
3. A statement indicating the air leakage rate in accordance with Section R402.4 that was presumed in compliance software tool analysis.
4. A site specific energy analysis report that is in compliance with Section R407.3.
5. The name of individual performing analysis and generating the report.
6. The name and version of the compliance software tool.

R407.4.2.2 Compliance report for certificate of occupancy. A compliance report submitted for obtaining a certificate of occupancy shall include the following:

1. Building street address, or other building site identification.
2. A statement indicating that the *proposed design* complies with Section R407.3.

3. As built air leakage rate in accordance with Section R402.4 determined during test(s) performed in accordance with Section R402.4.1.2.
4. Summary of building component characteristics of the as-built building listed in Table R407.5 matching the inputs used in the compliance software tool as-built analysis.
5. A site specific as-built energy analysis report that is in compliance with Section R407.3.
6. The name of individual performing as-built analysis and generating the report.
7. The name and version of the compliance software tool.

R407.4.3 Additional documentation. The following documents shall be submitted when required by the *code official*:

1. Copy of document summarizing building component characteristics of the *proposed design* in accordance with Table R407.5 available during inspections by the *code official* or an *approved agency* to compare each component installed with the inputs entered into the compliance software tool. Inspections shall not be less than those required by Section R104.
2. Name of *approved agency* reviewing and verifying accuracy of compliance reports prior to submission to the *code official*.
3. Name and qualifications of *approved agency(ies)* performing inspections and tests required by Section R104.2 or verification (rating) where requested under Section R408.

R407.5 Building Specifications. The *proposed design* shall be configured and analyzed using input data inclusive of building components listed in Table R407.5.

TABLE R407.5
SPECIFICATIONS OF THE CONDITIONED PASSIVE RESIDENCE PROPOSED DESIGN

BUILDING COMPONENT	**PROPOSED DESIGN CHARACTERISTICS**	**QUANTITY OR % OF ANNUAL ENERGY DEMAND** where requested by the code official
Above-grade walls	Type:	Total annual *building thermal envelope* assemblies annual heat transmission losses and/or gains
	Gross Area:	
	U-factor:	
	Solar absorptance:	
	Emittance:	
Basement and crawl space walls	Type:	
	Gross Area:	
	U-factor:	

Above-grade floors	Type:	
	Gross Area:	
	U-factor:	
Ceilings	Type:	
	Gross Area:	
	U-factor:	
Roofs	Type:	
	Gross Area:	
	Solar absorptance:	
	Emittance:	
Attics	Type (vented 1/300 ft^2 ceiling area or unvented):	
Foundations	Type:	
	Gross Area above grade:	
	Gross Area below grade:	
Opaque doors	Area:	Total annual *building thermal envelope* openings heat transmission losses and/or gains
	Orientation:	
	U-factor:	
Vertical fenestration other than opaque doors	Total area (% of *conditioned floor area*):	Total annual glazed opening solar radiation gains
	Orientation:	
	Area per orientation:	

	U-factor:	
	SHGC:	
	Interior shade factor (none if not included in design):	
	External shading type and PF:	
Skylights	Area (% of roof gross area):	
	U-factor:	
	SHGC:	
Thermally isolated *sunrooms*	Separated via building thermal envelope:	Total annual active space heating and/or cooling demand if *conditioned* or *semi-heated space*
Air exchange rate[a, b]	Building envelope leakage rate:	Total annual heat losses and/or gains due to air leakage
	Gross interior building volume at 0.2 w.g. (50 Pa) air changes per hour (ACH):	
	Gross exterior building thermal envelope surface area at 0.3 w.g. (75 Pa) cfm/ft^2:	
Mechanical ventilation	Mechanical ventilation	Total annual mechanical ventilation air heat and/or humidity losses and/or gains
	Supply (incoming outdoor) air:	
	Exhaust (outgoing indoor) air:	
	Difference (unbalance) of supply and exhaust air:	
	Heat and/or humidity recovery (efficiency if yes, or none):	
	Annual vent fan energy use: If not calculated by the *energy simulation*	Total annual mechanical ventilation fan operation demand

	tool, use the following equation: kWh/yr = 0.03942 x CFA + 29.565 x (N_{br} + 1)	
Internal gains	Annual gains: If not calculated by the *energy simulation tool*, use the following equation: 17,900 + 23.8 x CFA + 4104 x N_{br} (Btu/day per dwelling unit)	Total annual internal heat gains
Internal mass	If not calculated by the energy simulation tool, use the following equation: 8 lbs. x CFA (for furniture and contents)	NA
Structural mass	Floor slab type:	NA
	Basement wall type and insulation location (inside or outside wall):	
	Other floor type:	
	Other wall type:	
	Ceiling/roof type:	
Heating system(s)[c]	Fuel type:	Total annual active space heating demand
	Equipment type:	
	Efficiency (AFUE, HSPF, EER, COP):	
	Capacity:	
Cooling system(s)[c]	Fuel type:	Total annual active space cooling (and dehumidification) demand
	Equipment type:	
	Efficiency (EER, SEER, COP):	
	Capacity:	

Service water heating[c]	Fuel type:	Total annual service water heating demand
	Equipment type:	
	Efficiency (EF, COP):	
	Capacity:	
	Presumed gallons/day/occupant:	
Thermal distribution system[a]	Type (air duct, fluid piping or wire resistance):	Total annual fan and/or pump energy demand
	Insulation type and R-value:	
	Duct leakage results	
	System total cfm at fan/unit:	
	System total at diffusers:	
	Difference between total at fan/unit and diffusers:	
Thermostat	Type: (analogue or digital):	NA
	Heating temperature setpoint:	
	Cooling temperature setpoint:	
Lighting	Type(s) (% by type):	Total annual lighting demand
	Total wattage of permanent fixtures (indoor and outdoor):	
	Estimated total wattage of plug-in fixtures (indoor):	
Appliances	Types:	Total annual appliance demand

	Annual demand for each fixture:	
Miscellaneous Electrical Loads (MEL) (plug loads)	Types of plug-in items:	Total estimated annual MEL demand

For SI: 1 ft^2 = 0.093 m^2, 1 Btu = 1055 J (0.293 W), 1 lb/ft^2 = 4.88 kg/m^2, 1 gallon (US) - 3.785 L, ºC = (ºF-32)/1.8, 1 degree = 0.79 rad.
a. Where required by the *code official*, testing shall be conducted by an *approved agency*.
b. Where testing by an *approved agency* has not been conducted to determine air leakage rate and mechanical ventilation rate, the combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of the 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. When multiple heating, cooling or water heating systems using different fuel types, the capacities and fuel types shall be weighted in accordance with their respective loads.

R407.6 Calculation software tools. Calculation software shall be in accordance with Sections R407.6.1 through R407.6.3.

R407.6.1 Minimum capabilities. Calculation procedures used to comply with this section shall be with software tools capable of calculating annual *source energy* demand of all building elements of the *proposed design* and shall include the following capabilities:

1. Calculation of bulk whole-building or whole dwelling unit (as single zone) sizing for the heating and cooling equipment in the *proposed design* residence in accordance with Section R403.7.
2. Climate data for a full calendar year (8760 hours) and shall reflect *approved* coincident hourly data for temperature, solar radiation, humidity, and wind speed representative for the site in which the *proposed design* is located. For cities and urban regions with several climatic data sets, and for locations where recorded weather data is not available, the individual performing the analysis shall select a data set that best represents the climate at the site. *Code official* may request or approve the data set selected.
3. Calculations that account for the effects of indoor and outdoor temperatures, building specific location and orientation solar radiation gains and part load ratios on the performance of heating, ventilating and air conditioning equipment based on climate and equipment sizing.
4. Calculate glazed wall, window, door and skylight U-factor specific to each wall or roof opening by summing (U_{frame} x $Area_{frame}$) + ($U_{glazing}$ x $Area_{glazing}$) + ($\psi_{glazing\ spacer}$ x $Length_{glazing\ spacer}$) + ($\psi_{perimeter\ installation\ gap}$ x $Length_{perimeter\ installation\ gap}$) and dividing by the Area of the wall or roof opening.
5. Calculate affects of solar radiation gains at glazed walls, windows, doors and skylights based upon orientation, shading from overhead and side projections at each roof opening and SHGC of glazing.

R407.6.2 Specific approval. Performance analysis tools meeting the applicable sections of Section R407 shall be permitted to be *approved*. Tools shall be *approved* based upon meeting a specified threshold for a jurisdiction or climate zone. The *code official* shall approve tools for a specified application or limited scope.

R407.6.3 Input values. When calculations require input values not specified by Sections R402, R403, R404 and R407, those input values shall be taken from an *approved* source.

Reason:

Part I: The proposal provides an alternative to the current 1. prescriptive/trade-off and 2. proposed to reference building comparison compliance methods that is based upon comparing the proposed building to performance citeria similar to those already established and in alignment with goals established by the US and Canadian Federal governments and policies already in place in other nations.

The US DOE/EPA has documented Source Energy Use intensity for over 28 billion ft^2 in 260,000 private and public buildings accross 50 States in 13 building types representing 40% of the commercial market using the Energy Star Portfolio Manager. The Canadian National Government has documented 40,000 crown-owned building CO^2e emissions levels based upon source energy use. BOMA of Canada has determined site energy use intensity for 8 building types.

NREL has determined source energy factors for distributed electricity in all of the interconnected electrical grids in the US. The average source energy factor value of distributed electricity and all other fossil fuels has been included in the IECC Section R405 since its 2012 edition and matches the NREL and Natural Gas Codes and Standards Research Consortium study national average values.

Based upon collected information, capability of current computer software and existing performance benchmark meeting buildings, meeting a performance energy use intensity benchmark is possible without the need to compare to a reference building with pre-specified components.

The proposed benchmark alternative is a proven methodology in 10's of thousands of buildings throughout the world (including multi-unit residences, schools, dormitories, medical offices, high rises and factories) and has even become the minimum compliance requirement in countries such as Belgium. President George W. Bush's executive order 13514 requiring, starting in 2020, all US federally owned buildings to reduce their fossil fuel energy generated energy use 100% by 2030 will require determining and reducing a buildings energy use intensity.

Buildings currently meeting the 3-pillar performance metric are in most cases, regardless of occupancy or climate zone, designed to meet a single set of values:

1. ≤ 0.6 Air changes/hour (0.01/minute) building enclosed volume building envelope air leakage rate. Purpose is to mitigate airborne moisture movement through and condensation within envelope assemblies and reduce space conditioning energy demand.

2. ≤ 120 kWh/m^2 * year (38.1 $kBtu/ft^2$ * year) [11.1 kWh/ft^2 * year] total annual source (primary) energy demand. Purpose is to cap total CO^2 emissions in effort to combat global warming/climate change. The value selected is based upon meeting the <2ºC (<3.6ºF) global average temperature increase.

3. ≤ 15 kWh/m^2 * year (4.75 $kBtu/ft^2$ * year) [1.4 kWh/ft^2 * year] space conditioning annual demand OR ≤ 10 W/m^2 (3.17 Btu/ft^2) [0.93 W/ft^2] peak space conditioning load. Value was originally based upon peak active space conditioning load limited to amount that could be delivered through air distribution system in quantity that is limited to only that required for ventilation.

The third value above was developed in the early 1990's for the climate of central Europe (comparable to climate zone 4B in the US). A more recent study, funded by the USDOE, for all of the climate zones in the US and Canada determined values that varied depending on several factors including HDD, CDD, available solar radiation and variation in distributed electricity cost for the location. That herein proposed for space conditioning benchmarks is a simplified tabular approach to that study's results such that no value in the table is more restrictive (more difficult performance level) than any value, by climate zone, established by the study.

As compared to second value above, values proposed are based upon information gathered for existing buildings in the US and Canada of multiple occupancy types. Those buildings were not buildings designed to meet a performance benchmark standard and thus values are reflective of energy use intensity of existing building stock performance levels as of December of 2011. The values included in proposal table are based upon a 35-45% total demand reduction between December of 2011 and December of 2018, when the new code edition is likely to be published and adopted by jurisdictions. These proposed values remain less restrictive than the second value above that has already been achieved by buildings of many sizes, construction methods and occupancy types throughout the world (including the US).

As compared to first value above, the values proposed are slightly less restrictive and facilitate measure based upon surface area of building envelope rather than enclosed building volume so as to match measure currently within the IECC commercial provisions, ANSI/ASHRAE/IES Standard 90.1 and US Army Core of Engineers protocol.

The 75 Pascal and surface area measure is also in parallel to the definition of 'air impermeable'.

The proposed method of compliance is aligned with goals and results in a measure of performance easily understood by consumers - and energy use intensity value that parallels the mpg value concept for vehicles.

Added definitions are written so as to not conflict with other I-Codes or the ANSI/ASHRAE/IES Standard 90.1.

Part II: Intial building energy conservation standards in both the US and Canada were established in the mid to late 1970's. These initial standards were based upon prescriptive performance requirements for the building envelope, HVAC systems, water heating systems, lighting and electrical systems. Meeting prescriptive performance requirements remain compliance options within the ICC IECC and the NRCC NBC Part 9. As these standards evolved, building 'tradeoff' and 'proposed building performance comparison to a pre-specified reference building' and 'energy rating value based upon proposed building performance comparison to a pre-specified reference building' compliance options have been added based upon capability of computer software. These added compliance options allow increased flexibility for building designers. All current compliance options are comparisons to a building meeting pre-specified component performance levels.
The US DOE/EPA has documented Source Energy Use intensity for over 28 billion ft2 in 260,000 private and public buildings accross 50 States in 13 building types representing 40% of the commercial market using the Energy Star Portfolio Manager. The Canadian National Governmant has documented 40,000 crown-owned building CO_2e emissions levels based upon source energy use. BOMA of Canada has determined site energy use intensity for 8 building types including multi-unit residential buildings.

NREL has determined source energy factors for distributed electricity in all of the interconnected electrical grids in the US. The average source energy factor value of distributed electricity and all other fossil fuels has been included in the IECC Section R405 since its 2012 edition and matches the NREL and Natural Gas Codes and Standards Research Consotium study national average values.

Based upon collected information, capability of current computer software and existing performance benchmark meeting buildings, meeting a performance energy use intensity benchmark is possible without the need to compare to a reference building with pre-specified components.

The proposed benchmark alternative is a proven methodology in 10's of thousands of buildings throughout the world (including multi-unit residences, high rise residences and and one-two family dwellings) and has even become the minimum compliance requirement in countries such as Belgium. President George W. Bush's executive order 13514 requiring, starting in 2020, all US federally owned buildings to reduce their fossil fule energy generated energy use 100% by 2030 will require determining and reducting a buildings energy use intensity.

Buildings currently meeting the 3-pillar performance metric are in most cases, regardless of occupancy or climate zone, designed to meet a single set of values:

1. ≤ 0.6 Air changes/hour (0.01/minute) building enclosed volume building envelope air leakage rate. Purpose is to mitigate airborne moisture movement through and condensation within envelope assemblies and reduce space conditioning energy demand.

2. ≤ 120 kWh/m2 * year (38.1 kBtu/ft2 * year) [11.1 kWh/ft2 * year] total annual source (primary) energy demand. Purpose is to cap total CO_2 emissions in effort to combat global warming/climate change. The value selected is based upon meeting the <2ºC (<3.6ºF) global average temperature increase.

3. ≤ 15 kWh/m2 * year (4.75 kBtu/ft2 * year) [1.4 kWh/ft2 * year] space conditioning annual demand OR ≤ 10 W/m2 (3.17 Btu/ft2) [0.93 W/ft2] peak space conditioning load. Value was originally based upon peak active space conditioning load limited to amount that could be delivered through air distribution system in quantity that is limited to only that required for ventilation.

The third value above was developed in the early 1990's for the climate of central Europe (comparable to climate zone 4B in the US). A more recent study, funded by the USDOE, for all of the climate zones in the US and Canada determined values that varied depending on several factors including HDD, CDD, available solar radiation and variation in distributed electricity cost for the location. That herein proposed is a simplified tabular approach to that study's results such that no value in the table is more restrictive (more difficult performance level) than any value, by climate zone, established by the study.

As compared to second value above, values proposed are based upon information gathered for existing buildings in the US and Canada of multiple occupancy types. Those buildings were not buildings designed to meet a performance benchmark standard and thus values are reflective of energy use intensity of existing building stock performance levels as of December of 2011. The values included in proposal table are based upon a 35-45% total demand reduction between December of 2011 and December of 2018, when the new code edition is likely to be published and adopted by jurisdictions.

As compared to first value above, the values proposed are slightly less restrictive and facilitate measure based upon surface area of building envelope rather than enclosed building volume so as to match measure currently within the IECC commercial provisions, ANSI/ASHRAE/IES Standard 90.1 and US Army Core of Engineers protocol. The 75 Pascal and suface area measure is also in parallel to the definition of 'air impermeable'.

The proposed method of compliance is aligned with goals and results in a measure of performance easily understood by consumers - and energy use intensity value that parallels the mpg value concept for vehicles.

Added definitions are written so as not to conflict with other I-Codes.

Bibliography:

Part I: 2015 ICC IECC Commercial Provisions Chapter 4, Section C401.2 and ANSI/ASHRAE/IES Standard 90.1-2013 Chapter 4, Section 4.2 and appendix G, section G1
2015 ICC IECC Residential Provisions Chapter 4, Section R405.3

NREL Technical Report NREL/TP-550-38617, revised June 2007 http://www.nrel.gov/docs/fy07osti/38617.pdf

Natural Gas Codes and Standards Research Consortium Source Energy and Emission Factors for Building Energy Consumption, August 2009 http://s3.amazonaws.com/zanran_storage/www.aga.org/ContentPages/220158860.pdf

NRC of Canada NECB development overview http://www.firecomm.gov.mb.ca/docs/necb_overview_sept2014.pdf

BOMA BESt application guide and energy performance benchmarking, Module 5 pages 63 through 78 http://www.bomabest.com/wp-content/uploads/BOMA-BESt-V2-Application-Guide-FULL.pdf

Energy Star Portfolio Manager data trends energy use benchmarking http://www.energystar.gov/sites/default/files/buildings/tools/DataTrends_Energy_20121002.pdf

US General Services Administration requirement to follow Energy Independence and Security Act executive order 13514 http://www.gsa.gov/portal/content/104462

Government of Canada goals for sustainability in Crown-owned buildings http://ec.gc.ca/dd-sd/default.asp?lang=En&n=D39CB7AC-1#ftn2a

Part II: 2015 ICC IECC Residential Provions Chapter 4, Section R401.2
2015 ICC IECC Residential Provisions Chapter 4, Section R405.3

NREL Technical Report NREL/TP-550-38617, revised June 2007 http://www.nrel.gov/docs/fy07osti/38617.pdf

Natural Gas Codes and Standards Research Consortium Source Energy and Emission Factors for Building Energy Consumption, August 2009 http://s3.amazonaws.com/zanran_storage/www.aga.org/ContentPages/220158860.pdf

NRC of Canada NECB development overview http://www.firecomm.gov.mb.ca/docs/necb_overview_sept2014.pdf

BOMA BESt application guide and energy performance benchmarking, Module 5 pages 63 through 78 http://www.bomabest.com/wp-content/uploads/BOMA-BESt-V2-Application-Guide-FULL.pdf

Energy Star Portfolio Manager data trends energy use benchmarking http://www.energystar.gov/sites/default/files/buildings/tools/DataTrends_Energy_20121002.pdf

US General Services Administration requirement to follow Energy Independance and Security Act executive order 13514 http://www.gsa.gov/portal/content/104462

Government of Canada goals for sustainability in Crown-owned buildings http://ec.gc.ca/dd-sd/default.asp?lang=En&n=D39CB7AC-1#ftn2a

Cost Impact:

Part I: Will not increase the cost of construction
First, the addition of this compliance methodology does not mandate its use. Other existing compliance options may continue to be used.

Already constructed buildings throughout the w orld including w ithin the US have been designed and constructed to meet the original single set of performance benchmark values w ithout a construction cost premium. As passive building design strategies associated w ith the building envelope reduce space conditioning loads up to 90%, the increased costs associated w ith building envelope component materials and labor are offset by the reduced size and complexity of space conditioning systems. Passive building design measures often do not result in any construction cost increase, simply making informed (via energy modeling) decisions during the design process.

Adding this compliance alternative allow s building designers, builders and ow ners to elect to meet performance benchmark criteria through benchmark performance based energy modeling softw are, w ithout requiring added energy modeling or documentation required to demonstrate compliance w ith prescriptive or proposed to reference building comparison compliance. This encourages those committed to meeting benchmark performance criteria, by reducing current, potentially redundant, energy modeling or documentation required by other current compliance paths. In the case of projects w here desigers, builders and ow ners elect to seek more rigorous performance criteria, allow ing this added compliance methodology w ill reduce project costs by eliminating added energy modeling and/or documentation that does not improve the project building's performance.

Part II: Will not increase the cost of construction
First, the addition of this compliance methodology does not mandate its use. Other existing compliance options may continue to be used.
Already constructed residential buildings throughout the w orld including w ithin the US have been constructed w ithout a construction cost premium. As passive building design strategies associated w ith the building envelope reduce space conditioning loads, often substantially, the increased costs associated w ith building enevelope component materials and labor are offset by the reduced size and sometimes complextity of space conditioning systems. Where, on smaller scale buildings, the construction cost reduction of smaller space conditioning systems does not completely offset the increased construction cost of improved building envelope materials and labor, the reduction in operating cost causes a nuetral or reduced cost of ow nership. Passive building design measures often do not result in any construction cost increase, simply making informed decisions during the design process.

CE23-16 : C302.1-ZIMMER11857

CE24-16

Part I:
IECC: C303.1.2.
Part II:
R303.1.2 (IRC N1101.10.2)

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

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

Part I

2015 International Energy Conservation Code

Revise as follows:

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, the insulation installer shall place an insulation certificate in a conspicuous location within the building, immediately after installing the insulation. Such certificate shall certify the installed R-value of the insulation material.

Part II

2015 International Energy Conservation Code

Revise as follows:

R303.1.2 (N1101.10.2) 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, the insulation installer shall place an insulation certificate in a conspicuous location within the building, immediately after installing the insulation. Such certificate shall certify the installed R-value of the insulation mater

Reason: More and more insulation products are being developed and installed that do not come with a manufacture'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, HVAC contractor, and others who must utilize the R-value for calculations or verification of the code, to be satisfied that what is installed actually meets the R-value requirements.

Other insulation materials that often are installed without observable R-value Marks include vinyl draped 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 or 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 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: Will not increase the cost of construction
Cost of construction should not increase as documentation of the installation is already required. This proposal only clarifies that the documentation 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.

CE24-16 : R303.1.2-SCHWARZ12440

CE25-16

Part I:
IECC: , C202 (New), C303.1.1.
Part II:
R202 (New) [IRC N1101.6 (New)], R303.1.1 (IRC N1101.10.1)

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

Proponent : Amanda Hickman, InterCode Incorporated, representing Reflective Insulation Manufacturers Association International (amanda@intercodeinc.com); Vickie Lovell, representing Fire Safe North America (vickie@intercodeinc.com)

Part I

2015 International Energy Conservation Code

Add new definition as follows:

<u>SECTION</u> <u>C202</u> DEFINITIONS

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

<u>SECTION</u> <u>C202</u> DEFINITIONS

<u>**REFLECTIVE INSULATION.** A material installed in an assembly consisting of one or more surfaces having an *emittance* of 0.1 or less with at least one low-emittance surface that faces an unventilated cavity with a continuous border of building components.</u>

Revise as follows:

C303.1.1 Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope*insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be *listed*on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be *listed*on the certification. For <u>*reflective insulation*, the number of reflective sheets, the number and thickness of each enclosed air space and the *R*-value, shall be *listed* on the certification. For </u>insulated siding, the R-value shall be labeled on the product's package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

Part II

2015 International Energy Conservation Code

Add new definition as follows:

<u>**R202 (N1101.6)** **EMITTANCE.** The ratio of the radiant heat flux emitted by a specimen to that</u>

emitted by a blackbody at the same temperature and under the same conditions.

R202 (N1101.6) REFLECTIVE INSULATION. A material installed in an assembly consisting of one or more surfaces having an *emittance* of 0.1 or less with at least one low-emittance surface that faces an unventilated cavity with a continuous border of building components.

Revise as follows:

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

Reason:

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

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

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

- IBC 2015 – Section 720; 2613
- FL – 2007 Florida Building Code, Section 719.1; 719.2.1 & Table 13-C1.2.3 & ASTM References Subchapter 13-3 (C1224)
- FL – 2010 Florida Building Code, Table 303.2 (ASTM Standards C1224 & C727)
- FL – 2015 Florida Building Code, Table 303.2.1 (ASTM Standards C1224 & C727)
- MN - Thermal Insulation Standards 2015, Section 7640.0130, Subpart 7
- CA – Title 24, 2013, Reference Residential Appendices, Envelope Measures, RA4.2.1

The purpose of this proposal is to incorporate into the IECC language that clarifies the pertinent requirements regarding reflective insulation R-values that are based on ASTM standards and shall be listed on certifications.

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

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

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- FL – 2010 Florida Building Code, Table 303.2 (ASTM Standards C1224 & C727)
- FL – 2015 Florida Building Code, Table 303.2.1 (ASTM Standards C1224 & C727)
- MN - Thermal Insulation Standards 2015, Section 7640.0130, Subpart 7
- CA – Title 24, 2013, Reference Residential Appendices, Envelope Measures, RA4.2.1

The purpose of this proposal is to incorporate into the IECC language that clarifies the pertinent requirements regarding reflective insulation R-values that are based on ASTM standards and shall be listed on certifications.

Cost Impact:

Part I: Will not increase the cost of construction
This proposal will not increase the cost of construction because only information regarding reflective insulation is being added.

Part II: Will not increase the cost of construction
This proposal will not increase the cost of construction because only information regarding reflective insulation is being added.

CE25-16 : C303.1.1-HICKMAN12285

CE26-16

Part I:
IECC: C303.1.1.
Part II:
IECC: R303.1.1.

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

Proponent : Jason Wilen AIA CDT RRO, National Roofing Contractors Association (NRCA), representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net)

Part I

2015 International Energy Conservation Code

Revise as follows:

C303.1.1 Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope*insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be *listed*on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be *listed*on the certification. For insulated siding, the R-value shall be labeled on the product's package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

<u>**Exception:** For roof insulation installed above the deck, the *R*-value shall be labeled as required by the material standards specified in Table 1508.2 of the *International Building Code.*</u>

Part II

2015 International Energy Conservation Code

Revise as follows:

R303.1.1 <u>**(N1101.10.1)**</u> **Building thermal envelope insulation.** An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope*insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be *listed*on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be *listed* on the certification. For insulated siding, the *R*-value shall be labeled on the product's package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

<u>**Exception:** For roof insulation installed above the deck, the *R*-value shall be labeled as required</u>

by the material standards specified in Table 1508.2 of the *International Building Code* or Table R906.2 of the *International Residential Code,* as applicable.

Reason: The purpose of this change is to clarify how R-values for above deck roof insulation products are identified. For insulation installed above a roof deck, *R*-value identification markings on individual insulation pieces are not practical because products installed above roof decks are covered by other roof system components almost immediately after installation due to the need to quickly achieve a weathertight condition. Because of this, material standards for above deck roof insulation do not require marking individual pieces of insulation; rather R-value information is included on product packaging. This change references IBC Table 1508.2, "Material Standards for Roof Insulation" and will require that above deck roof insulation products have *R*-value identification markings in accordance with the material standards already referenced in IBC. For those buildings covered by the IRC, the residential part of the change also refers to Table R906.2 of the IRC.

Cost Impact: Will not increase the cost of construction
The proposed change is a clarification and does not change the stringency of existing code requirements so the cost of construction will be unchanged.

CE26-16 : C303.1.1-WILEN AIA CDT RRO12589

CE27-16

Part I:
IECC: C202, C202 (New), C303.1.1.
Part II:
R202 (New) [IRC N1101.6 (New)], R303.1.1 (IRC N1101.10)

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 ORDERS FOR THESE COMMITTEES.

Proponent : Jason Wilen AIA CDT RRO, National Roofing Contractors Association (NRCA), representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net)

Part I

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

GENERAL DEFINITIONS

<u>**CERTIFICATE OF COMPLIANCE.**</u> <u>A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents.</u>

Revise as follows:

C303.1.1 Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope*insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be *listed*on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be *listed*on the ~~certification~~<u>*certificate of compliance*</u>. For insulated siding, the R-value shall be labeled on the product's package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

Part II

2015 International Energy Conservation Code

R202<u> (N1101.6)</u> GENERAL DEFINITIONS

Add new definition as follows:

<u>**CERTIFICATE OF COMPLIANCE.**</u>
<u>A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents.</u>

Revise as follows:

R303.1.1<u> (N1101.10.1)</u> Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope*insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be *listed*on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be *listed* on the ~~certification~~*certificate of compliance*. For insulated siding, the *R*-value shall be labeled on the product's package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

Reason: The purpose of this change is to use terminology consistently throughout the I-Codes. In IECC Section C303.1.1 the term "certification" is used. There is a defined term in IBC for "certificate of compliance" that describes the intent of "certification" as it is used in this section. This change replaces "certification" with ""certificate of compliance" and adds the definition for "certificate of compliance" from IBC.

Cost Impact: Will not increase the cost of construction
The proposed change adds a definition and provides clarification for an existing section. The stringency of the existing code requirement is not changed due to this change so the cost of construction will be unchanged.

CE27-16 : C303.1.1-WILEN AIA CDT RRO12592

CE28-16

Part I:

IECC: , C202 (New), C303.1.5 (New).

Part II:

R202 (New) [IRC N1101.6 (New)], R303.1.5 (New) [IRC N1101.10.5 (New)]

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

Proponent : Amanda Hickman, InterCode Incorporated, representing Reflective Insulation Manufacturers Association International (amanda@intercodeinc.com); Vickie Lovell, representing Reflective Insulation Manufacturers Association International(vickie@intercodeinc.com)

Part I

2015 International Energy Conservation Code

Add new definition as follows:

<u>SECTION</u> <u>C202</u> DEFINITIONS

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

<u>SECTION</u> <u>C202</u> DEFINITIONS

<u>**RADIANT BARRIER.** A material that is installed in building assemblies and that has a low *emittance* surface of 0.1 or less.</u>

Add new text as follows:

<u>**C303.1.5 Radiant barrier.** The *emittance of radiant barriers shall be 0.1 or less. Radiant barriers* shall comply with ASTM C1313/C1313M.</u>

Reference standards type: This is an update to reference standard(s) already in the ICC Code Books

Add new standard(s) as follows:

ASTM C1313/C1313M-13 Standard Specification for Sheet Radiant Barriers for Building Construction Applications.

Part II

2015 International Energy Conservation Code

R202 <u>(N1101.6)</u> GENERAL DEFINITIONS

Add new definition as follows:

<u>EMITTANCE.</u>

<u>The ratio of the radiant heat flux emitted by a specimen to that emitted by a blackbody at the same temperature and under the same conditions.</u>

<u>RADIANT BARRIER.</u>

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

Add new text as follows:

R303.1.5 (N1101.10.5) Radiant barrier. The emittance of *radiant barriers* shall be 0.1 or less. *Radiant barriers* shall comply with ASTM C1313/C1313M.

Reference standards type: This is an update to reference standard(s) already in the ICC Code Books

Add new standard(s) as follows:

ASTM C1313/C1313M-13 Standard Specification for Sheet Radiant Barriers for Building Construction Applications.

CE28-16 : C303.1.1.2 (NEW)-HICKMAN12289

CE29-16

Part I:
IECC: C303.1.3.
Part II:
R303.1.3 (IRC N1101.10.3)

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 ORDERS FOR THESE COMMITTEES.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

Part I

2015 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.

    ~~**Exception:** Where required, garage door *U*-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.~~

~~*U*~~2. 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*~~*labeled* and certified by the manufacturer.

Products lacking such a ~~*labeledU*~~*labeled U*-factor shall be assigned a default ~~*U*~~*U*-factor from Table C303.1.3(1) or C303.1.3(2). The solar heat gain coefficient (SHGC) and ~~*visible transmittance*~~*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*~~*labeled* and certified by the manufacturer. Products lacking such a ~~*labeled*~~*labeled* SHGC or VT shall be assigned a default SHGC or VT from Table C303.1.3(3).

Part II

2015 International Energy Conservation Code

Revise as follows:

R303.1.3 (N1101.10.3) 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.

    ~~**Exception:** Where required, garage door *U*-factors shall be determined in accordance with~~

~~either NFRC 100 or ANSI/DASMA 105.~~

2. For garage doors, *U*-factors 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 *labeledU*-factor shall be assigned a default *U*-factor from Table R303.1.3(1) or R303.1.3(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 R303.1.3(3).

Reason: The scope of ANSI/DASMA 105 includes both garage doors and rolling doors w hich are w ithin the scope of the IECC content. The reformatting of Section C403.1.3 is in acknow ledging that there are tw o categories of criteria. The current format w rongly places the door criteria as an exception. Changes to R303.1.3 (N1101.10.3) are to make the format of the tw o sections identical. Rolling doors are not found in Residential Buildings.
This proposal w as submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC w as established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes w ith 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 2015, the SEHPCAC has held three tw o- or three-day open meetings and 25 w orkgroup calls, w hich included members of the SEHPCAC as w ell as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC w ebsite at: http://w w w .iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
This proposal is simply an editorial clarification of w hich standards apply to w hich fenestration products. There is no technical revision.

CE29-16 : C303.1.3-COLLINS12696

CE30-16

Part I:
IECC: C303.1.3.
Part II:
Table R303.1.3(2) [IRC Table N1101.10.3(2)]

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 ORDERS FOR THESE COMMITTEES.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee (SEHPCAC@iccsafe.org)

Part I

2015 International Energy Conservation Code

Revise as follows:

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

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

TABLE ~~C303.1.3~~ C303.1.3(1) (1)
DEFAULT GLAZED ~~FENESTRATION~~ WINDOW, GLASS DOOR AND SKYLIGHT *U*-FACTORS

FRAME TYPE	WINDOW AND GLASS DOOR		SKYLIGHT	
	SINGLE PANE	DOUBLE PANE	Single	Double
Metal	1.20	0.80	2.00	1.30

Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

Part II

2015 International Energy Conservation Code

Revise as follows:

TABLE R303.1.3(2) <u>[N1103.10.3(2)]</u>
DEFAULT <u>OPAQUE</u> DOOR *U*-FACTORS

DOOR TYPE	<u>OPAQUE</u> *U*-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

TABLE ~~R303.1.3~~ <u>R303.1.3(1)</u> (1)
DEFAULT GLAZED ~~FENESTRATION~~ <u>WINDOW, GLASS DOOR AND SKYLIGHT</u> *U*-FACTORS

FRAME TYPE	WINDOW OR GLASS DOOR		SKYLIGHT	
	Single pane	Double Pane	Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

Reason: The default U-factor tables should distinguish opaque doors from glazed windows, doors and skylights. The headings in the Tables should be revised accordingly. The proposed insulated metal value is approximately 25% higher than the DASMA research tested value of 0.82.

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The proposal involves clarifying default values and editorially changing Table headings, and thus does not affect construction costs.

CE30-16 : C303.1.3-COLLINS12710

CE31-16

Part I:
IECC: C303.1.3.
Part II:
R303.1.3 (IRC N1101.10.3)

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 ORDERS FOR THESE COMMITTEES.

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, ICF International, representing Energy Efficient Codes Coalition

Part I

2015 International Energy Conservation Code

Revise as follows:

C303.1.3 Fenestration product rating. *U*-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100.

> **Exception:** Where required, garage door *U*-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

U-factors shall be determined by an accredited, independent laboratory, certified by a nationally-recognized certification program 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, certified by a nationally-recognized certification program 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).

Part II

2015 International Energy Conservation Code

Revise as follows:

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

> **Exception:** Where required, garage door *U*-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

U-factors shall be determined by an accredited, independent laboratory, certified by a nationally-recognized certification program, and *labeled* ~~and certified~~ by the manufacturer. Products lacking such a *labeled* *U*-factor shall be assigned a default *U*-factor from Table R303.1.3(1) or R303.1.3(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, certified by a nationally-recognized certification program, 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 R303.1.3(3).

Reason: The purpose of this code proposal clarifies that the energy rating for fenestration must be certified by a nationally-recognized certification program. Although the requirement that the rating be "labeled" (as defined in the code) already requires independent oversight, some may still misread the current language to mean that the manufacturer can self-certify w ith no oversight. This proposal is intended to correct this problem.

Cost Impact: Will not increase the cost of construction
Code requirements are not proposed to be changed, rather clarified as to the intent of the current code that the selected w indow s are independently rated and certified and properly labeled.

CE31-16 : C303.1.3-FAY12587

CE32-16

IECC: C303.1.3.

Proponent : Julie Ruth, American Architectural Manufacturers Association, representing American Architectural Manufacturers Association (julruth@aol.com)

2015 International Energy Conservation Code

Revise as follows:

C303.1.3 Fenestration product rating. *U*-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100.

> **Exception:** Where required, garage door *U*-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

U-factors shall be determined by an accredited, independent laboratory~~, and~~ . Products shall be *labeled* and certified for U-factor by the manufacturer.

Products lacking such a *labeledU*-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~~ . Products shall be *labeled* and certified for SHGC and VT 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).

Where Section C407 or C402.1.5 are used to demonstrate compliance, U-factors, SHGC , and VT shall be determined in accordance with one of the following:

1. By an accredited, independent laboratory based upon actual fenestration product size and slope, in accordance with NFRC 100 and NFRC 200.
2. By an accredited, independent laboratory, based upon model fenestration size and standard slope, in accordance with NFRC 100 and 200. Product shall be labeled and certified for U-factor and SHGC by the manufacturer

Reason: The application of U-Factor, SHGC and VT based on NFRC standard model sizes may not be appropriate for performance trade-off calculations or w hen employing w hole-building energy modeling. In these situations, the use of U-Factor, SHGC and VT based on actual product size may more accurately indicate actual building envelope performance, and therefore be more appropriate. Determination of U-Factor, SHGC and VT w hether at NFRC standard model size or actual size, must be determined in accordance w ith NFRC 100 and NFRC 200 by a qualified laboratory.

Cost Impact: Will not increase the cost of construction
This code change proposal addresses the fenestration product size used to determine its performance characteristics. As such, it w ill not affect the cost of construction.

CE32-16 : C303.1.3-RUTH10962

CE33-16

Part I:
IECC: C303.1.3, C402.5.2, C403.2.14, C403.2.3.
Part II:
R303.1.3 (IRC N1101.10.3), R402.4.3 (IRC N1102.4.3)

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 ORDERS FOR THESE COMMITTEES.

Proponent : Joseph Zimmer, Self, representing Joseph Zimmer, Architect (joe@studiojosephzimmer.com)

Part I

2015 International Energy Conservation Code

Revise as follows:

C303.1.3 Fenestration product rating. *U*-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100 or for products manufactured outside of the United States, in accordance with Section C102.1.

> **Exception:** Where required, garage door *U*-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105 or for products manufactured outside of the United States, in accordance with Section C102.1 .

U-factors shall be determined by an accredited, independent laboratory, and *labeled* and certified by the manufacturer.

Products lacking such a ~~*labeled*~~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 or for products manufactured outside of the United States, in accordance with Section C102.1. The U-factor shall be determined by an accredited, independent laboratory, and the product *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).

C402.5.2 Air leakage of fenestration. The air leakage of fenestration assemblies shall meet the provisions of Table C402.5.2. Testing shall be in accordance with the applicable reference test standard in Table C402.5.2 or for products manufactured outside of the United States, in accordance with Section C102.1. The testing shall be performed by an accredited, independent testing laboratory and the product *labeled*by the manufacturer.

C403.2.3 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.2.3(1), C403.2.3(2), C403.2.3(3), C403.2.3(4), C403.2.3(5), C403.2.3(6), C403.2.3(7), C403.2.3(8) and C403.2.3(9) when tested and rated in accordance with the applicable test procedure or for products manufactured outside of the United States, in accordance with Section C102.1 . Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of Table C403.2.3(10) or for products manufactured outside of the United States, in accordance with Section C102.1. 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.

C403.2.14 Refrigeration equipment performance. Refrigeration equipment shall have an energy use in kWh/day not greater than the values of Tables C403.2.14(1) and C403.2.14(2) when tested and rated in accordance with AHRI Standard 1200 or for products manufactured outside of the United States, in accordance with Section C102.1. 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.

Part II

2015 International Energy Conservation Code

Revise as follows:

R303.1.3 (N1101.10.3) Fenestration product rating. U-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100 or for products manufactured outside of the United States, in accordance with Section R102.1.

> **Exception:** Where required, garage door *U*-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105 or for products manufactured outside the United States, in accordance with Section R102.1.

U-factors shall be determined by an accredited, independent laboratory, and *labeled* and certified by the manufacturer.

Products lacking such a ~~*labeled*~~labeled *U*-factor shall be assigned a default *U*-factor from Table R303.1.3(1) or R303.1.3(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 or for products manufactured outside of the United States, in accordance with Section R102.1. The *U*-factor shall be determined by an accredited, independent laboratory, and the product *labeled* and certified by the manufacturer. Products lacking such a *labeled* SHGC or VT shall be assigned a default SHGC or VT from Table R303.1.3(3).

R402.4.3 (N1102.4.3) Fenestration air leakage. Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m^2), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m^2), when tested according to NFRC 400 ~~or~~ , AAMA/WDMA/CSA 101/I.S.2/A440 or for products manufactured outside of the United States, in accordance with Section R102.1. The air leakage shall be determined by an accredited, independent laboratory and the product *listed* and *labeled* by the manufacturer.

> **Exception:** Site-built windows, skylights and doors.

Reason: Products used in buildings come from manufacturers all over the world.
In some cases, in order to select a fenestration product, HVAC equipment or refrigeration equipment to achieve a project goal or performance level, it may be required to select/specify products manufactured outside of the United States. Depending on the location of manufacture, the testing standards/methods are not identical to standards of organizations within the United States. Though ANSI's goal is to have standards that are consistent and parallel globally; temperature, thermal and/or dimensional unit convention differences, cause standard metrics to not always be identical.

This proposal more clearly allows such higher performing or specific function systems manufactured outside of the

United States to be approved by the code official.

Cost Impact: Will not increase the cost of construction
No effect on construction cost, perhaps a reduction as manufactures outside of the United States are not always required to test fenestration, HVAC equipment or refrigeration equipment to another standard in addition to the one prevalent in the country which they are manufactured.

CE33-16 : C303.1.3-ZIMMER11987

CE34-16

IECC: C303.3, C408, C408.1, C408.1.1 (New).

Proponent : jim edelson, representing new building institute (jim@newbuildings.org)

2015 International Energy Conservation Code

Delete without substitution:

~~**C303.3 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 label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.~~

Revise as follows:

SECTION C408 MAINTENANCE INFORMATION AND SYSTEM COMMISSIONING

C408.1 General. This section covers the provison of maintenance information and the commissioning of ~~the~~ building ~~mechanical~~ systems ~~in Section C403 and electrical power and lighting systems in Section C405~~.

Add new text as follows:

C408.1.1 Building operations and maintenance information. The buildings operations and maintenance documents shall be provided to the owner and shall consist of manufacturer's information, specifications, and recommendations, programming procedures and data points, narratives, and other mean of illustrating to the owner how the building, site, equipment and systems are intended to be installed, maintained and operated. Required regular maintenance actions for equipment and systems shall be clearly stated on a readily accessible label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.

Reason: The operations and documentation requirements in Section C303 were written prior to the IECC having section C408. Section C408 covers commissioning requirements, but in several places it also addresses what type of operations and maintenance documents must be included in the information given to building owners and operators. As C408 is the new section that embraces those activities that occur as the building is "turned over" to the occupants, it is the proper place to locate this measure.

Cost Impact: Will not increase the cost of construction

There is no additional cost as this proposal merely relocates an existing requirement.

CE34-16 : C303.3-EDELSON12408

CE35-16

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

Proponent : Craig Conner, representing self (craig.conner@mac.com)

2015 International Energy Conservation Code

Add new text as follows:

C401.2 On-site renewable limit. The energy savings credited to on-site renewables shall not be limited in Sections 405 or 406.

C401.3 On-site renewable credit The energy savings credited to on-site renewables shall not be limited by options in this chapter.

Reason: Renew ables low er the need for fossile fuels; thereby reducing consumption of fossil fuels. Ultimately fossile fuels, or at least fossible fuels at a reasonable price, w ill be limited. Allow ing that reduction in non-renew able to happen in new buildings is just good public policy.
Increased use of reneables is happening in many areas. Some states and cities are making major reductions in non-reneable use, including legistatively mandated reductions. Some large companies are greatly reducing or going to net zero use of non-reneables. Some new er building codes are requireing substantial future reductions in non-renew able energy use. It seems very counter productive to limit the choice to reduce or greatly reduce the net energy use in a building. Let those w ho w ant to use renew able energy use as much renew able energy as they like. Would any of us seriously contemplate telling someone w ho built a net zero energy home or commercial building that they had choosen to use too much renew able energy?

Cost Impact: Will not increase the cost of construction
Using renew able energy or not using renew able energy in the IECC is a choice. Using large amounts of renew able energy in new building w ould most often be an increase in first cost, although there are limited situations w here it w ould not be. Operating a building w ith a high level of renew ables w ould generally be low er in cost.

CE35-16 : C401.2 (NEW)-CONNER12849

CE36-16

IECC: C401.2, C403.2.11, C404.11, C408.1, C408.2.5.2, C408.3, C408.3.1, C408.3.2, C408.3.2.1 (New), C408.3.2.2 (New), C408.3.2.3 (New).

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2015 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 Section 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, C404, C405.2, C405.3, C405.5, C405.6, C407, and ~~C407~~ Section C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

Delete without substitution:

~~**C403.2.11 Mechanical systems commissioning and completion requirements.** Mechanical systems shall be commissioned and completed in accordance with Section C408.2.~~

~~**C404.11 Service water-heating system commissioning and completion requirements.** *Service water heating systems*, swimming pool water-heating systems, spa water-heating systems and the controls for those systems shall be commissioned and completed in accordance with Section C408.2.~~

Revise as follows:

C408.1 General. This section covers the commissioning ~~of the~~ and functional testing requirements for building ~~mechanical~~ systems ~~in Section C403 and electrical power and lighting systems in Section C405~~.

C408.2.5.2 Manuals. An operating and maintenance manual shall be provided and include all of the following:

1. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
2. Manufacturer's operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
3. Name and address of at least one service agency.
4. HVAC and service hot water controls system maintenance and calibration information, including wiring diagrams, schematics and control sequence descriptions. Desired or field-determined set points shall be permanently recorded on control drawings at control devices or, for digital control systems, in system programming instructions.
5. ~~Submittal data indicating all selected options for~~ A narrative of how each ~~piece of lighting equipment and lighting controls~~ system is intended to operate, including recommended set points.

6. ~~Operation and maintenance manuals for each piece of lighting equipment. Required routine maintenance actions, cleaning and recommended relamping shall be clearly identified.~~
7. ~~A schedule for inspecting and recalibrating all lighting controls.~~
8. ~~A narrative of how each system is intended to operate, including recommended set points.~~

C408.3 Lighting ~~system~~ controls functional testing. ~~Controls for automatic~~ Automatic lighting ~~systems~~ controls required by this code shall comply with this section.

C408.3.1 Functional testing. Prior to passing final inspection, the *registered design professional* 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 ~~and C408.3.1.2~~ through C408.3.1.3 for the applicable control type.

C408.3.2 Documentation requirements. The *construction documents* ~~documents~~ shall specify that the documents ~~certifying that the installed lighting controls meet documented performance criteria of Section C405 are to~~ described in this section be provided to the building owner or owner's authorized agent within 90 days ~~from~~ of the date of receipt of the *certificate of occupancy*.

Add new text as follows:

C408.3.2.1 Drawings *Construction documents* shall include the location and catalogue number of each piece of equipment.

C408.3.2.2 Manuals. An operating and maintenance manual shall be provided and include the following:

1. Name and address of not less than one service agency for installed equipment.
2. A narrative of how each system is intended to operate, including recommended set points.
3. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
4. Operation and maintenance manuals for each piece of lighting equipment. Required routine maintenance actions, cleaning and recommended relamping shall be clearly identified.
5. A schedule for inspecting and recalibrating all lighting controls.

C408.3.2.3 Report. A report of test results shall be provided and include the following:

1. Results of functional performance tests.
2. Disposition of deficiencies found during testing, including details of corrective measures used or proposed.

Reason: This proposal is editorial in nature, and is intended to solve two problems with the existing code:
First, charging language is provided for the mechanical and service hot water heating sections indicating that the commisioning requirements of Section C408 are mandatory, but similar language has not been provided for the lighting section. Rather than including this language sepaately in C403, C404, and C405, it makes more sense to simply add Section C408 to the list of applicable sections in C401.2, and delete the charging language from C403.2.1 and C404.11.

Second, functional testing requirements for lighting controls have been split between the mechanical and lighting sections C408.2 and C408.3. This proposal relocates all of the lighting requirments in C408.3, where they belong.

The documentation requirements for lighting functional testing have also been clarified.

Cost Impact: Will not increase the cost of construction
The documentation requirements for lighting controls functional testing are somewhat more robust than in the current code, but it is hard to see how that will have any meaningful impact on construction costs. The remainder of the proposal is simply editorial.

CE36-16 : C401.2-BAILEY12055

CE37-16

IECC: , C202 (New), C401.2, C409.1 (New), C409.2 (New), C409.2.1 (New), C409.2.1.1 (New), C409.2.2 (New), C409.2.2.1 (New), C409.3 (New), C409.3.1 (New), C409.3.1.1 (New), C409.3.1.1.1 (New), C409.3.1.1.2 (New), C409.3.1.2 (New), C409.3.2 (New), C409.3.3 (New), C409.3.4 (New).

Proponent : Ryan Colker, representing National Institute of Building Sciences (rcolker@nibs.org)

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

POST OCCUPANCY VERIFICATION PERMIT. A permit issued before a certificate of occupancy to address requirements of this code that occur post occupancy.

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. 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, C404, C405.2, C405.3, C405.5, C405.6 and C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.
4. The requirements of Sections C402.5, C405.6, C408 and C409.

Add new text as follows:

SECTION C409
OUTCOME-BASED COMPLIANCE

C409.1 Scope Outcome-based compliance shall be determined by actual measurement of all the energy being used by the building and the energy using elements associated with the building site. Outcome-based compliance buildings and building sites shall be in accordance with Sections C409.1 through C409.3.

C409.2 Outcome-based compliance. Compliance for buildings and their sites to be designed on an outcome basis shall be determined by actual measurement of all the energy being used after the building and the energy using elements associated with the building site are in full operation in accordance with this section. Where a building has multiple occupancy types, the maximum allowable energy use shall be based on total gross floor area of each occupancy type in relation to the total gross floor area of all occupancy types within the building. Compliance shall be based on a determination of actual energy use in accordance with this section. Buildings having one or more uses or occupancies not listed in Table C409.2(1) shall not be eligible to demonstrate compliance with this code in accordance with Section C409.

C409.2.1 Target EUI (EUIt). The building shall demonstrate a measured EUI (EUI_a) less than or equal to the energy target (EUI_t) in Table C409.2(1) for the building use and occupancy and for the *climate zone* in which the building is located.
Where the *code official* requires an adjustment of EUI_t due to a variation in the building location's

heating degree days base 65 (HDD_{65}) from the reference HDD_{65} in Table C409.2(1) for the *climate zone* in which the building is located, an adjusted energy target (EUI_{tadj}) shall be determined in accordance with Equation 4-10.

$$EUI_{tadj} = EUI_t + EUI_{adj} \qquad \text{(Equation 4-10)}$$

Where:
EUI_t = the Target Annual Source Energy Use Index in Table C409.2(1) for the building use and occupancy and for the *climate zone* in which the building is located.
EUI_{adj} = HDD_{65} adjustment factor as determined by Equation 4-11.

$$EUI_{adj} = (HDD_a - HDD_r) * ((HDD_r * EUI_{slope}) + EUI_{base}) \qquad \text{(Equation 4-11)}$$

Where:
HDD_a = the annual HDD_{65} at the building location as listed in ANSI/ASHRAE Standard 90.1, Appendix D.
HDD_r = the reference HDD_{65} in Table C409.2(1) for the *climate zone* in which the building is located.
EUI_{slope} = the change in EUI per HDD_{65} in Table C409.2(2) for the building use and occupancy.
EUI_{base}= a constant value for EUI in Table C409.2(2) for the building use and occupancy.

TABLE C409.2.1
TABLE C409.2(1) TARGET ANNUAL SOURCE ENERGY USE INDEX (EUI_t)

Climate Zone[A]	**1A**	**2A**	**2B**	**3A**	**3B-C**	**3B-O**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
Reference HDD_{65} (HDD_r)	**200**	**1509**	**1350**	**3082**	**1458**	**2708**	**3016**	**4707**	**4425**	**4927**	**6536**	**5861**	**5267**	**7771**	**8031**	**9818**	**13940**
Use and Occupancy[B]	**EUI_t skBTU/sf/yr**																
Administrative/professional office	89	92	83	95	69	82	68	79	66	86	66	66	66	73	69	79	111
Bank/other financial	127	131	117	134	98	116	97	113	94	122	94	93	95	104	97	112	157
Government office	112	115	103	118	86	102	85	99	82	107	83	82	84	91	86	99	138
Medical office (non-diagnostic)	76	78	70	81	59	69	58	68	56	73	56	56	56	62	58	67	94
Mixed-use office	103	107	96	110	80	94	79	92	76	99	77	76	77	85	79	92	128
Other office	86	89	80	92	67	79	66	77	64	83	64	63	65	71	66	76	107
Laboratory	409	404	359	399	309	347	324	337	289	380	287	294	309	317	306	341	453
Distribution/shipping center	28	36	35	45	22	37	29	47	38	46	49	47	41	67	58	82	154
Nonrefrigerated warehouse	14	17	17	22	11	18	14	23	18	22	24	23	20	33	28	40	75
Convenience Store	309	335	285	347	267	292	289	288	250	334	245	254	285	265	260	285	360
Convenience store with gas	249	270	230	279	215	235	232	232	201	269	197	205	230	213	209	230	290

Grocery stor/food market	257	279	237	289	223	243	240	240	208	278	204	212	237	221	216	238	300
Other food sales	78	84	72	87	67	74	73	73	63	84	62	64	72	67	65	72	91
Fire station/police station	151	149	132	147	114	128	119	124	106	140	106	108	114	117	113	126	167
Other public order and safety	137	136	121	134	104	116	109	113	97	127	96	99	104	106	103	114	152
Medical office (diagnostic)	77	74	68	73	63	68	55	55	51	60	42	47	48	43	44	42	48
Clinic/other outpatient health	115	111	103	110	95	102	82	83	76	90	63	70	72	64	66	63	72
Refrigerated warehouse	158	156	139	155	120	134	126	131	112	147	111	114	119	123	119	132	175
Religious worship	54	53	47	52	41	46	43	44	38	50	38	39	41	42	40	45	59
Entertainment/culture	53	53	47	52	40	45	42	44	38	49	37	38	41	41	40	44	59
Library	141	139	123	137	106	119	112	116	99	131	99	101	106	109	105	117	156
Recreation	61	60	53	59	46	51	48	50	43	56	43	44	46	47	45	51	67
Social/meeting	63	62	56	62	48	54	50	52	45	59	44	45	48	49	47	53	70
Other public assembly	65	64	57	63	49	55	51	53	46	60	45	47	49	50	49	54	72
College/university	141	141	127	142	94	122	103	125	100	137	107	102	111	124	113	136	201
Elementary/middle school	87	85	76	85	64	73	65	71	60	77	58	58	60	63	59	67	99
High school	103	103	92	104	69	89	75	91	73	100	78	75	80	90	82	99	147
Preschool/daycare	112	110	97	110	82	94	84	91	77	99	75	75	78	82	77	86	127
Other classroom education	58	57	52	58	38	50	42	51	41	56	44	42	46	51	46	55	82
Fast food	600	615	553	632	499	559	515	532	467	603	455	473	503	497	484	538	680
Restaurant/cafeteria	324	333	296	343	265	300	280	288	253	331	246	256	283	267	262	291	367
Other food service	177	182	162	187	145	164	153	158	138	181	135	140	155	146	143	159	200
Hospital/inpatient health	325	328	295	322	281	291	266	249	215	287	191	199	230	195	189	196	227
Nursing home/assisted living	193	191	169	188	146	164	153	159	136	179	135	139	145	150	145	161	214
Dormitory/fraternity/sorority	92	98	89	108	66	91	82	101	81	115	90	87	89	103	96	117	163
Hotel	114	116	102	117	98	102	98	95	87	111	79	86	90	84	85	89	103
Motel or inn	127	121	110	116	100	106	95	90	83	102	73	79	84	76	76	78	94
Other lodging	121	115	105	111	96	101	91	86	79	97	69	76	80	73	73	75	90
Vehicle dealership/showroom	112	115	103	120	79	100	86	104	86	110	93	92	99	107	100	119	170
Retail store	64	66	59	69	45	57	49	59	49	63	53	53	56	61	57	68	97
Other retail	112	115	102	119	79	100	86	103	86	110	93	91	97	106	100	118	170
Post office/postal center	98	97	86	96	74	83	78	81	69	91	69	70	73	76	73	82	108

Repair shop	65	64	57	64	49	55	52	54	46	61	46	47	49	51	49	54	72
Vehicle service/repair shop	76	75	66	74	57	64	60	62	54	70	53	54	56	59	57	63	84
Vehicle storage/maintenance	33	32	29	32	25	28	26	27	23	30	23	24	26	25	25	27	36
Other service	138	137	121	135	105	117	110	114	98	128	97	99	104	107	104	115	153
Strip shopping mall	135	135	121	142	96	120	104	124	103	135	112	110	121	129	122	145	207
Enclosed mall	129	128	115	135	92	114	99	118	98	128	107	105	116	123	116	138	197

[A] Climate zones as determined in accordance with Section C301.

[B] Use and occupancy as determined by Chapter 3 of the International Building Code.

TABLE C409.2.1
TABLE C409.2(2) CHANGE IN EUI_t PER HDD_{65}

Use and Occupancy[a]	EUI_{slope}	EUI_{base}
Administrative/professional office	1.21E-06	-0.00727
Bank/other financial	1.70E-06	-0.01027
Government office	1.50E-06	-0.00905
Medical office(non-diagnostic)	1.03E-06	-0.00621
Mixed-use office	1.40E-06	-0.00842
Other office	1.16E-06	-0.00700
Laboratory	4.75E-06	-0.03038
Distribution/shipping center	1.49E-06	-0.00190
Nonrefrigerated warehouse	7.15E-07	-0.00089
Convenience store	2.60E-06	-0.01653
Convenience store with gas	2.09E-06	-0.01328

Grocery store/food market	2.17E-06	-0.01378
Other food sales	6.58E-07	-0.00418
Fire station/police station	1.74E-06	-0.01116
Other public order and safety	1.59E-06	-0.01018
Medical office (diagnostic)	7.25E-07	-0.00745
Clinic/other outpatient health	1.09E-06	-0.01117
Refrigerated warehouse	1.84E-06	-0.01178
Religious worship	6.21E-07	-0.00398
Entertainment/culture	6.14E-07	-0.00393
Library	1.63E-06	-0.01046
Recreation	7.02E-07	-0.00449
Social/meeting	7.34E-07	-0.00470
Other public assembly	7.48E-07	-0.00479
College/university	2.17E-06	-0.01097
Elementary/middle school	1.23E-06	-0.00804
High school	1.59E-06	-0.00804
Preschool/daycare	1.58E-06	-0.01030
Other classroom education	8.81E-07	-0.00445

Fast food	5.79E-06	-0.03700
Restaurant/cafeteria	2.97E-06	-0.01884
Other food service	1.62E-06	-0.01028
Hospital/inpatient health	3.03E-06	-0.03040
Nursing home/assisted living	2.24E-06	-0.01437
Dormitory/fraternity/sorority	1.12E-06	-0.00297
Hotel	8.55E-07	-0.00721
Motel or inn	1.31E-06	-0.01175
Other lodging	1.25E-06	-0.01121
Vehicle dealership/showroom	1.60E-06	-0.00708
Retail store	9.16E-07	-0.00407
Other retail	1.60E-06	-0.00711
Post office/postal center	1.14E-06	-0.00730
Repair shop	7.56E-07	-0.00484
Vehicle service/repair shop	8.84E-07	-0.00566
Vehicle storage/maintenance	3.76E-07	-0.00241
Other service	1.61E-06	-0.01029
Strip shopping mall	1.90E-06	-0.00805

Enclosed mall	1.80E-06	-0.00764
[A] Use and occupancy as determined by Chapter 3 of the *International Building Code.*		

C409.2.1.1 Weighted occupied floor area. The target energy use intensity shall be determined utilizing Table C409.2(1). The EUI_t value from Table C409.2(1) shall be adjusted based on the monthly weighted average of occupied floor area during the 12-month compliance period as documented in accordance with Section C409.3.3. For buildings with multiple use or occupancy designations in Table C409.2(1), the EUI_t shall be adjusted based on the weighted area average of the use or occupancy.

C409.2.2 Actual energy use intensity (EUIa). The actual energy use intensity (EUI_a) of the building and building site shall be calculated in accordance with Equation 4-12. On-site renewable energy generation shall be included in the calculation of the EUI_a.

$$EUI_a = (AEU_{bldg} – AEXP_{ren})/TCFA \qquad \text{(Equation 4-12)}$$

Where:

AEU_{bldg} = the annual energy consumed by the building and building site from all forms of energy including onsite renewable energy in Btus converted to source Btus. The source energy multiplier for electricity imported from the electricity grid shall be 3.15. The source energy multiplier for imported fuels other than electricity shall be 1.09.

$AEXP_{ren}$ = the annual energy produced by onsite renewable energy systems exported to the electricity grid in Btus converted to source Btus. The source energy multiplier for onsite renewable energy exported to the electricity grid shall be 3.15.

TCFA = the total conditioned floor area of the building.

C409.2.2.1 Measurement of AEUs. AEUs shall be determined from metering, utility billing or other form of measurement acceptable to the code official and converted into consistent units in accordance with Section C409.2.2.

C409.3 Compliance Compliance with Section C409.3 shall be determined in accordance with Sections C409.3.1 through C409.3.4.

C409.3.1 Demonstration of ability to comply with Section C409.3 requirements. In advance of plan approval by the code official, the design team shall demonstrate to the code official the ability of the design to meet the EUIt established in Section C409.2.1 utilizing Section C409.3.1.1 or C409.3.1.2.

C409.3.1.1 Modeled approach. The demonstration of the ability to comply with Section C409.3 using a modeling approach shall be determined in accordance with Sections C409.3.1.1.1 and C409.3.1.1.2.

C409.3.1.1.1 Energy model.
The design team shall develop a whole building energy model consistent with the requirements of this section using software and parameters approved by the code official.

C409.3.1.1.2 Design submittal. The results of the model and cut sheets of equipment and characteristics contained within the compliant model developed in accordance with Section C409.3.1.1 shall be provided to the code official for use in verification during inspections.

C409.3.1.2 Pre-approved specifications approach. The design team shall provide the code official with design documents containing prescriptive requirements for all building systems impacting energy use that are published or certified by an entity acceptable to the code official to meet the relevant EUI_t requirements.

C409.3.2 Issuance of temporary certificate of occupancy. Where the code official determines that a building and its site are in compliance with this code other than Section C409, the code official shall issue a *Temporary Certificate of Occupancy* as authorized in Section 111.3 of the *International Building Code*. Where the code official has issued a post occupancy verification permit in accordance with Section C409.3.4, the code official shall issue a *Certificate of Occupancy*.

C409.3.3 Reporting of energy use. Within 24 months of issuance of the *temporary certificate of occupancy*, the building owner shall provide the code official with documentation, certified by a *registered design professional*, of a continuous 12-month period where the building complies with Sections C409.2 utilizing a form approved by the code official. The occupancy or use type for the occupied period utilized in Section 409.2.2.3 shall be indicated in the documentation and include the time periods and square footage of the building occupied by all building tenants.

C409.3.4 Post occupancy verification permit. Within 24 months of issuance of a *post occupancy verification permit*, the building owner shall provide the code official with documentation in a form acceptable to the code official and certified by a registered design professional of a continuous 12-month period during which the building complied with Sections C409.2. The documentation shall include occupancy or use type for the occupied period, the beginning and ending dates of the 12-month period, and the total conditioned floor area of the building. The post occupancy verification permit shall remain in effect until the code official has received the documentation verifying compliance with Section C409.2.

Reason: This proposal establishes an alternative compliance path based on the actual, measured energy performance of a project. It is designed to address multiple challenges identified in the application of current code provisions and reflect the growing desire for more performance focused criteria. These challenges impact multiple participants in the design and construction process including code departments, designers, building owners and energy efficiency advocates. To address these diverse needs, stakeholders representing these segments of the industry have come together to develop this proposal.

Some of the challenges addressed by this proposal:

- Code departments have limited resources available to enforce building codes—particularly energy codes.
- Energy use is highly measurable yet current code pathways anticipate results from designs, not actual building performance.
- Designers often do not have the flexibility to use the latest technologies in achieving energy efficiency requirements.
- Effectively capture all energy saving strategies including those not currently covered under the IECC including building orientation.
- Reducing energy use at the systems level is required—particularly as current components are reaching their cost or thermodynamic limits—but this approach has not been handled effectively in the IECC.
- Energy uses not covered within the existing code framework (i.e., plug loads) are a growing percentage of energy use associated with buildings.

Across the U.S. and internationally, communities are increasingly interested in achieving energy use reduction targets. However, as currently written, energy codes do not provide an effective means of assuring achievement of these goals as the actual, measured energy use of a building within a jurisdiction is highly variable dependent on multiple factors both within and outside of the code. Such factors include building orientation, plug loads, operations and maintenance practices, quality of installation, and systems-level interactions. This proposal would establish a mechanism for codes and code departments to help support achievement of community-level goals and the code departments that would deliver on such results.

Currently, building energy codes do not consider how buildings actually perform—they only prescribe criteria on how they are to be designed and constructed. The provisions in virtually all energy codes and standards are based on a number of prescribed criteria that must be satisfied by specific products, materials and components of a building. For many reasons, some cited in the "challenges" above, prescriptive codes cannot be used to predict actual energy performance. Likewise, energy simulations are not intended to predict actual performance, but rather are intended to compare a proposed building to one assumed to just meet the provisions in the code. In effect, this creates a custom energy budget for each and every building based on a non-predictive prescriptive baseline.

Unfortunately, many of those criteria do not allow for application of new technologies such as innovative window materials or creative design approaches such as passive solar, building form and shape, and orientation. In order to establish an actual EUI (EUIa) for a building, the code must provide a methodology for measuring and expressing the energy use of a building and subsequently be able to compare it to the target reference EUI (EUIr) as part of the compliance verification process.

The purpose of this section is to allow the design team, in conjunction with the owner/developer, the flexibility to utilize the most cost-effective approach to achieve a common and uniform objective that applies equally, without exception, to all buildings of the same type and in the same climate zone—something not included in current energy codes and standards. The significance of actual validation of achieving that objective is through measurement of actual building operation as it is intended to be occupied.

This proposal recognizes the fact that many jurisdictions do not have the personnel or fiscal resources to adequately ensure compliance with energy requirements. By focusing on the outcome, code officials and communities can be assured that requirements are being met while not incurring additional enforcement burdens. If an owner and design team elect to pursue this path, they ultimately bear the burden of demonstrating compliance and achievement of the outcome.

Similarly, under traditional energy codes and standards, when the building is completed and is occupied there is no way to know whether the decisions for a specific design or material or orientation resulted in actual energy savings. This proposed outcome approach provides a real target, allows design options and flexibility and then provides real answers as to whether what was planned has been achieved.

The proposal offers the following benefits:

- Utilizes all potential opportunities to save energy while giving maximum flexibility to the design team
- Moves beyond component-based requirements to capture systems- level, energy-saving opportunities
- Allows for energy-efficiency results that recognize the fiscal, technical and personnel limitations of today's code departments
- Leads to actual energy results, in contrast to current energy code pathways that rely on inspections and accurate construction to achieve theoretical energy performance
- Supports quality installation; diligent design and construction; and effective operations and maintenance to achieve long-term energy performance
- Provides a framework to help communities, code departments, building owners and design teams to realize actual energy use results
- Accommodates actual conditions in existing buildings better than prescriptive or modeled-performance approaches by allowing investment in strategies that most cost-effectively achieve performance improvements desired under the code
- Allow for designs to incorporate operations and management or tenant behavior to achieve energy performance result

The U.S. Department of Energy has acknowledged the need for increased focus on building operations and life-cycle energy performance through the recent release of "A Common Definition for Zero Energy Buildings" (http://www.energy.gov/sites/prod/files/2015/09/f26/bto_common_definition_zero_energy_buildings_093015.pdf). According to DOE, a Zero Energy Building is, "An energy-efficient An energy-efficient building where, on a source basis, the actual delivered energy is less than or equal to the on-site renewable exported energy."

Technical discussion on the basis for development of the tables and associated targets is available in the section-by-section description document.

This proposal builds off a compliance path currently incorporated into the 2015 International Green Construction Code.

SECTION-BY-SECTION ANALYSIS OF OUTCOME-BASED COMPLIANCE PATH

Edits in Existing Sections:

C202 POST OCCUPANCY VERIFICATION PERMIT. Adds definition for Post Occupancy Verification Permit to support compliance mechanisms established in C409.3.2..

C401.2 Establishes the outcome-based pathw ay as an acceptable method for compliance w ith the Commercial Energy Efficiency of the IECC including mandatory requirements of sections C402.5 (Air leakage-thermal envelope), C405.6 (Electrical energy consumption), and C408 (System Commissioning).

New Section C409 Establishing Outcome-Based Pathway Requirements

C409.1 Establishes the outcome-based pathw ay as an actual measurement of energy use once in full operation.

C409.2 Provides general methodology and requirements for compliance through the outcome-based provisions. For buildings w ith multiple occupancy types, the gross floor area of each type is used to determine compliance. If an occupancy type is not included in the table then this pathw ay cannot be used.

C409.2.1 Establishes that the building's actual source energy use (EUI_a) be less than or equal to the target source energy use (EUI_t) for the building based on building use and occupancy and climate zone as contained in Table C409.2(1). Table C409.2(1) values w ere calculated based on ANSI/ASHRAE Standard 105-2014 national conversion factors (Table J2-A) and ANSI/ASHRAE/IES Standard 100-2015 Appendix J supplemented by tables for the EUIs of the 25th percentile of the building stock based on the Energy Information Administration's 2003 Commercial Buildings Energy Consumption Survey (CBECS) provided by the Department of Energy's Oak Ridge National Laboratory in December 2015. The Table C409.2(1) targets w ere derived from the 25th Percentile numbers w ith the targeted reduction factor of 72.8%. These EUI_t values are a 5.5% improvement from ANSI/ASHRAE/IES Standard 90.1-2013.

Exception: For those locations w here HDD65 is significantly different than the reference city for a climate zone (as identified in ANSI/ASHRAE/IES Standard 90.1-2013, Appendix D), a more in-depth methodology is provided to support fairness and accuracy in appli-cation of the EUIt. The values to be applied in Equation 4-11 are provided in Table C402.2(2).The Table values are a derivative (base and slope) of quadratic regression curve fit of EUIt across climate zones based on Standard 100 Appendix J reference city HDD65 for each climate zone. ASHRAE's Building Energy Quotient (bEQ) Labeling Pro-gram uses the same methodology for its HDD adjustment factors.

C409.2.1.1 Provides methodology for calculating target for buildings w ith multiple occupancy types or changes in occupied floor area.

C409.2.2 Methodology for calculating the actual energy use (EUI_a). The building's actual energy use in equation 4-12 is calculated based on non-renew able source energy used onsite on a square foot basis minus renew able energy generated onsite. For consistent expression in source BTUs, imported electricity is multiplied by 3.15, other imported fuels by 1.09 and onsite renew able generation by 3.15.

C409.2.2.1 Metering, utility billing shall be used to determine teh annual energy consumption.

C409.3 The follow ing sections indicate how to demonstrate compliance w ith this section.

C409.3.1 The design team must provide assurance to the code official that the proposed design has the capability to meet the EUI_t.

C409.3.1.1 Modeling may be used to demonstrate capability to meet the target w ith the follow ing requirements:

C409.3.1.1.1 A w hole building energy model shall be developed using softw are and parameters approved by the code official.

C409.3.1.1.2 Results from the model shall be provided to the code official including demonstration that the modeled EUI_a is less than or equal to the EUI_t and the specifications of individual components that the code official can use during inspection.

C409.3.1.2 A prescriptive package of building components previously approved by the code official or a certifying entity to meet the EUI_t may be used to fulfill this requirement.

C409.3.2 Upon the satisfaction of the code official that all other code requirements are met, a temporary certificate of occupancy is issued.

Exception: The jurisdiction may issue a Post Occupancy Verification Permit as identified in C409.3.4 and a Certificate of Occupancy.

C409.3.3 The building owner will provide the code official with sufficient doucmentation that they have achieved the EUI_t within a 12 month period during the first 24 months of occupancy. The documentation will be certified by a registered design professional and reported to the code official in an acceptable format (which may include forms from ANSI/ASHRAE Standard 105-2014).

C409.3.4 Where the code official chooses to issue a post occupancy verification permit in leiu of a temporary certificate of occupancy, the building owner must still provide the code official with sufficient doucmentation that they have achieved the EUI_t within a 12 month period during the first 24 months of occupancy. The documentation will be certified by a registered design professional and reported to the code official in an acceptable format (which may include forms from ANSI/ASHRAE Standard 105-2014).

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"Rethinking Compliance Verification" by Colker, R.M.; D. Conover and T. Ryan. DesignIntelligence, September/October 2012. http://www.di.net/articles/rethinking-compliance-verification/

"Common Definition for Zero Energy Buildings." U.S. Department of Energy, September 2015.
http://www.energy.gov/sites/prod/files/2015/09/f26/bto_common_definition_zero_energy_buildings_093015.pdf

Cost Impact: Will not increase the cost of construction
The cost of compliance with this proposal varies by project. It is intended that this compliance path reduce the cost of compliance by providing designers with the opportunity to find the most cost effective method for achieving the intended results under the IECC.

CE37-16 : C401.2-COLKER12149

CE38-16

Part I:

IECC: C102.1.1, C401.2, C401.2 (New), C402.1, C402.4, C402.5, C403.2, C403.3, C403.4, C404, C404.10, C404.9, C405.1, C405.2, C405.3, C405.4, C405.5, C405.6, C405.7, C405.8, C407.2, C407.3, C502.2.

Part II:

R102.1.1 (IRC N1101.4) , R401.2 (IRC N1101.13), Table R401.2 (New) [IRC Table N1101.13 (New)], 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) , 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), R405.1 (IRC N1105.1), R405.2 (IRC N1105.2), R406.1 (IRC N1106.1), R406.2 (IRC N1106.2), R502.1.1 (IRC N1105.1.1)

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 ORDERS FOR THESE COMMITTEES.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

Part I

2015 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 in compliance with this code. The requirements ~~identified as "mandatory"~~ specified in ~~Chapter 4~~ Table C401.2 shall be met.

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. 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, C404, C405.2, C405.3, C405.5, C405.6~~ specified in Table C401.2 and Section C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

Add new text as follows:

TABLE C401.2
Requirements to be included under compliance with Sections C102.1.1 and C407

Section No.	Section Title	Subsections included
C402.5	Air leakage - thermal envelope	C402.5.1 through C402.5.8
C403.2	Provisions applicable to all mechanical systems	C403.2.1 through C403.2.17
C404	Service water heating	C404.1 through C404.11
C405.2	Lighting controls	C405.2 through C405.2.5
C405.3	Exit signs	C405.3
C405.5	Exterior lighting	C405.5 and c405.5.1
C405.6	Electrical energy consumption	C405.6
C405.7	Electrical transformers	C405.7
C405.8	Electrical motors	C405.8

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 C403.2.15 or C403.2.16.

C402.4 Fenestration ~~(Prescriptive)~~. *No change to text.*

C402.5 Air leakage—thermal envelope ~~(Mandatory)~~. *No change to text.*

C403.2 Provisions applicable to all mechanical systems ~~(Mandatory)~~. *No change to text.*

C403.3 Economizers ~~(Prescriptive)~~. Each cooling system shall include either an air or water economizer complying with Sections C403.3.1 through C403.3.4

Exceptions: Economizers are not required for the systems listed below.

1. In cooling systems for buildings located in Climate Zones 1A and 1B.
2. In climate zones other than 1A and 1B, where individual fan cooling units have a capacity of less than 54,000 Btu/h (15.8 kW) and meet one of the following:
   - 2.1. Have direct expansion cooling coils.
   - 2.2. The total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).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. 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.
4. Systems that serve residential spaces where the system capacity is less than five times the requirement listed in Table C403.3(1).
5. Systems expected to operate less than 20 hours per week.
6. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.
7. Where the cooling efficiency meets or exceeds the efficiency requirements in Table C403.3(2).
8. Chilled-water cooling systems that are passive (without a fan) or use induction where the total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).
9. Systems that include a heat recovery system in accordance with Section C403.4.5.

C403.4 Hydronic and multiple-zone HVAC systems controls and equipment. ~~(Prescriptive).~~ *No change to text.*

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

C404.9 Energy consumption of pools and permanent spas. ~~(Mandatory).~~ *No change to text.*

C404.10 Energy consumption of portable spas ~~(Mandatory)~~. *No change to text.*

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

Exception: Dwelling units within commercial buildings shall not be required to comply with Sections C405.2 through C405.5, provided that they comply with Section R404.1.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.2.15 or C403.2.16.

C405.2 Lighting controls ~~(Mandatory)~~. Lighting systems shall be provided with controls as specified in Sections C405.2.1, C405.2.2, C405.2.3, C405.2.4 and C405.2.5.

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 Exit signs ~~(Mandatory)~~. *No change to text.*

C405.4 Interior lighting power requirements ~~(Prescriptive)~~. *No change to text.*

C405.5 Exterior lighting ~~(Mandatory)~~. Where the power for exterior lighting is supplied through the energy service to the building, all exterior lighting shall comply with Section C405.5.1.

> **Exception:** Where *approved* because of historical, safety, signage or emergency considerations.

C405.6 Electrical energy consumption ~~(Mandatory)~~. *No change to text.*

C405.7 Electrical transformers ~~(Mandatory)~~. Electric transformers shall meet the minimum efficiency requirements of Table C405.7 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 at least 20 percent more than the lowest tap.
> 4. Drive transformers.
> 5. Rectifier transformers.
> 6. Auto-transformers.
> 7. Uninterruptible power system transformers.
> 8. Impendance transformers.
> 9. Regulating transformers.
> 10. Sealed and nonventilating transformers.
> 11. Machine tool transformers.
> 12. Welding transformers.
> 13. Grounding transformers.
> 14. Testing transformers.

C405.8 Electrical motors ~~(Mandatory)~~. *No change to text.*

C407.2 ~~Mandatory requirements~~ Requirements.to be included in proposed design. Compliance with ~~this section~~ Section C407 requires that the ~~criteria~~ provisions of ~~Sections C402.5, C403.2, C404 and C405~~ the sections specified in Table C401.2 be met and included in the proposed design. Such provisions shall not be traded off..

C407.3 Performance-based compliance. Compliance based on total building performance in accordance with Section C401.2 and this section requires that a proposed building (*proposed design)*be shown to have an annual energy cost that is equal to, or 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. Nondepletable energy collected off site shall be treated and priced the same as purchased energy. Energy from nondepletable energy sources collected on site shall be omitted from the annual energy cost of the *proposed design.*

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

C502.2 ~~Prescriptive compliance~~ Compliance. *No change to text.*

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 in compliance with this code. The requirements ~~identified as "mandatory"~~ specifed in ~~Chapter 4~~ Table C401.2 shall be met.

C502.2 ~~Prescriptive compliance~~ Compliance. *No change to text.*

Part II

2015 International Energy Conservation Code

Revise as follows:

R102.1.1 (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 in compliance with this code. The requirements identified ~~as "mandatory"~~ in ~~Chapter 4~~ Table R401.2 shall be met.

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

1. Sections R401 through R404.
2. Section R405 and the provisions ~~of Sections R401 through R404 labeled "Mandatory~~ specified in Table R401.2 applicable to Section R405.~~"~~
3. An energy rating index (ERI) ~~approach~~ in accordance with Section R406 and the provisions specified in Tabld R401.2 applicable to Section R406..

TABLE R401.2 (N1101.2)
REQUIREMENTS TO BE INCLUDED FOR COMPLIANCE WITH SECTIONS R102.1.1 [N1101.4], R405 [N1105] AND R406 [N1106]

Section No.	Section Title	Applicable to Sections R102.1.1 and R405	Applicable to Section R406
R401.3	Certificate	Yes	Yes

R402.4	Air leakage	Yes	Yes
R402.5	Maximum fenestration *U*-factor and SHGC	Yes	Yes
R403.1	Controls	Yes	Yes
R403.1.2	Heat pump supplementary heat	Yes	Yes
R403.3.2	Sealing	Yes	Yes
R403.3.3	Duct testing	Yes	Yes
R403.3.5	Building cavities	Yes	Yes
R403.4	Mechanical system piping insulation	Yes	Yes
R403.5.1	Heated water circulation and temperature maintenance systems	Yes	Yes
R403.5.3	Hot water pipe insulation	No	Yes
R403.6	Mechanical ventilaiotn	Yes	Yes
R403.7	Equipment sizing efficiency rating	Yes	Yes
R403.8	Systems serving multiple dwelling units	Yes	Yes
R403.9	Snow melt and ice system controls	Yes	Yes
R403.10	Pools and permanent spa energy consumption	Yes	Yes
R403.11	Portable spas	Yes	Yes
R404.1	Lighting equipment	Yes	Yes
R404.1.1	Lighting equipment	Yes	Yes

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

Exception: 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. Those with a peak design rate of energy usage less than 3.4 Btu/h • ft^2 (10.7 W/m^2) or 1.0 watt/ft^2 of floor area for space-conditioning purposes.
2. Those that do not contain *conditionedspace*.

R402.2 (N1102.2) Specific insulation requirements ~~(Prescriptive)~~. *No change to text.*

R402.3 (N1102.3) Fenestration ~~(Prescriptive)~~. *No change to text.*

R402.4 (N1102.4) Air leakage ~~(Mandatory)~~. *No change to text.*

R402.5 (N1102.5) Maximum fenestration *U*-factor and SHGC ~~(Mandatory)~~. *No change to text.*

R403.1 (N1103.1) Controls ~~(Mandatory)~~. *No change to text.*

R403.1.2 (N1103.1.2) Heat pump supplementary heat ~~(Mandatory)~~. *No change to text.*

R403.3.1 (N1103.3.1) Insulation ~~(Prescriptive)~~. Supply and return ducts in attics shall be insulated to a minimum of R-8 where 3 inches (76 mm) in diameter and greater and R-6 where less than 3 inches (76 mm) in diameter. Supply and return ducts in other portions of the building shall be insulated to a minimum of R-6 where 3 inches (76 mm) in diameter or greater and R-4.2 where less than 3 inches (76 mm) in diameter.

Exception: Ducts or portions thereof located completely inside the *building thermal envelope.*

R403.3.2 (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.

Exceptions:

1. Air-impermeable spray foam products shall be permitted to be applied without additional joint seals.
2. For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems shall not be required for continuously welded joints and seams, and locking-type joints and seams of other than the snap-lock and button-lock types.

R403.3.3 (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. All 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.

   Exception:A duct air leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.

A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*.

R403.3.4 (N1103.3.4) Duct leakage ~~(Prescriptive)~~. The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.
2. Postconstruction test: Total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.

R403.3.5 (N1103.3.5) Building cavities ~~(Mandatory)~~. *No change to text.*

R403.4 (N1103.4) Mechanical system piping insulation ~~(Mandatory)~~. *No change to text.*

R403.5.1 (N1103.5.1) Heated water circulation and temperature maintenance systems ~~(Mandatory)~~. *No change to text.*

R403.5.3 (N1103.5.3) Hot water pipe insulation ~~(Prescriptive)~~. Insulation for hot water pipe with a minimum thermal resistance (*R*-value) of 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 in piping.
7. Supply and return piping in recirculation systems other than demand recirculation systems.

R403.6 (N1103.6) Mechanical ventilation ~~(Mandatory)~~. *No change to text.*

R403.7 (N1103.7) Equipment sizing and efficiency rating ~~(Mandatory)~~. *No change to text.*

R403.8 (N1103.8) Systems serving multiple dwelling units ~~(Mandatory)~~. *No change to text.*

R403.9 (N1103.9) Snow melt and ice system controls ~~(Mandatory)~~. *No change to text.*

R403.10 (N1103.10) Pools and permanent spa energy consumption ~~(Mandatory)~~. *No change to text.*

R403.11 (N1103.11) Portable spas ~~(Mandatory)~~. *No change to text.*

R404.1 (N1104.1) Lighting equipment ~~(Mandatory)~~. Not less than 75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 75 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

Exception: Low-voltage lighting.

R404.1.1 (N1104.1.1) Lighting equipment ~~(Mandatory)~~. *No change to text.*

R405.1 (N1105.1) Scope. *No change to text.*

R405.2 (N1105.2) ~~Mandatory requirements.~~ Requirements.to be included in proposed design Compliance with ~~this section~~ Section R405 requires that the ~~mandatory~~ provisions ~~identified in~~ of Section R401.2 be met and therefore shall be included in the proposed design and shall not be traded off. ~~All supply~~

Supply and return ducts not completely inside the ~~*building thermal envelope*~~ *building thermal envelope* shall be insulated to ~~a minimum~~ an R-value of not less than R-6.

R406.1 (N1106.1) Scope. *No change to text.*

R406.2 (N1106.2) ~~Mandatory requirements.~~ Requirements to be included in proposed design Compliance with ~~this section~~ Section R406 requires that the provisions ~~identified~~ of the sections specifed in ~~Sections R401 through R404 labeled as "mandatory" and Section R40.5.3~~ Table R401.2 be met and therefor shall be included in the proposed design and are not permitted to be traded off. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table ~~402.1.1~~ 402.1.2 or ~~402.1.3~~ 402.1.4 of the 2009 *International Energy Conservation Code*.

> ~~**Exception:** Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.~~

Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

R502.1.1 (N1105.1.1) ~~Prescriptive compliance~~ Compliance. *No change to text.*

Reason: This proposal addresses three issues:

1. The appearance of conflict betw een C401.2 and C407.3 regarding the level of performance required.
2. The confusion resulting from the use of terms 'mandatory' and 'prescriptive' to w hen applied to various code provisions.
3. Discrepancy in the listing of 'mandatory' sections in C401.2.and C407.3. Discrepancies betw een the listing of mandatory sections and their designation in each section

The solution to issues 1 and 3 are the same, provide a single list in one location of each half of the code (Commercial and Residential) regarding w hat are 'mandatory' provisions. Refer to those lists from other locations of the code. This proposal places each list in the section of the code spelling out the compliance option (C401.2 and R401.2). Because the lists are already quite extensive (especially in Residential) and have a tendency to grow as the code evolves, the lists are proposed to be provided in a table format. The table format also makes the lists of sections more prominent visually to the code user. As the above code sections in Chapter 1 of each half of the code also refer to the mandatory provisions, those sections are also included in the title of the tables.

The SEHPCAC realized that the only reason for the presence of 'mandatory' designations are to support the Total Building Performance Option (C407) or Simulated Performance (R405) or ERI (R406) or the above code programs. In other w ords you have optional compliance paths driving the format of the balance of the code. The only use of the term 'prescriptive' other than in section titles is in Section C402.1 regarding commercial building envelope and in the addition sections of both parts of the code. If there w as ever provisions w hich said 'here is how your comply w ith the 'prescriptive' approach - such text is gone. Losing the w ord 'prescriptive' in the code has no impact on how one determines compliance.

The solution proposed in this series of changes for the mandatory vs prescriptive is to abandon both terms and to remove the designations from the individual code sections. The term mandatory confuses in tw o w ays. Users of other codes understand that all provisions are 'mandatory' w ithout the code saying so. With the IECC stating some sections are 'mandatory' the implication is other provisions are purely optional. But w hat is really the case is just like the other codes, provisions in the IECC must be complied w ith - if and w hen specific equipment, designs or installations are included. The intent behind 'mandatory' vs 'prescriptive' in the IECC is that for the alternate design options, the code still requires that certain provisions be met (mandatory) and that they can't be manipulated or substituted in the proposed design. Therefore this proposal removes the section by section designation in favor of a single listing in each part of the code and using the phrase – 'shall be included in the proposed design are not permitted to be traded off'.

Specific revision notes:

- Section C401.2, Item 3 requires a 85% energy cost savings over the reference design. Section C407 is the methodology for building performance evaluation and it doesn't mention the 85%. The amendment to C407.3 makes those tw o consistent.
- In section R406.2 the treatment of ducts not in the envelope is show n as an exception. In Section R405.2 the same phrase is not an exception. The latter format is correct and w ould be amended as part of this proposal. (yellow highlights)
- In Section C401.2 the code says "Commercial buildings shall comply...' In R401.2 the code says "Projects shall comply...' The format in C401.2 is preferable. Buildings must be in compliance... not 'projects'.
- Section C502.2 and R502.1.1 - in both sections the w ord prescriptive is removed from the title as it is not specified in the body of the sections how 'presciptive' affects application of the section.

This reformat of the code w ill make it clearer how the alternative pathw ays are to be used and in one location calls out w hich sections must be met regardless of the methodology. Having the information in a single location (for each half of the code) also makes future code amendments simpler w here new provisions are added. If such new provisions should not be traded off in a performance analysis, the proponent simply amends the table to include the new section.

The SEHPCAC is aw are that other proposals w ill alter the sections listed in the table. As w e can not anticipate the final organization of the code, it is assumed that staff w ill be able to adjust the tables in response to new provisions, deleted provisions or reorganized provisions.

This proposal w as submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC w as established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes w ith 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 2015, the SEHPCAC has held three tw o- or three-day open meetings and 25 w orkgroup calls, w hich included members of the SEHPCAC as w ell as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC w ebsite at: http://w w w .iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The proposal is editorial. It shifts the scattered references to mandatory provisions to the specific provisions w hich must be informed that certain requirements must be included in a design.

CE38-16 : C401.2-COLLINS11667

CE39-16

IECC: C401.2.

Proponent : Craig Conner, Building Quality, representing self (craig.conner@mac.com)

2015 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 with the requirements applied based on the Climate Zone desiganations specified in Section C301.
2. The requirements of Sections C402 through C405. 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, C404, C405.2, C405.3, C405.5, C405.6 and C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

Reason: This is an update to the current version of ASHRAE 90.1, but retains the existing IECC climate zones. In the ASHRAE climate zones about 10% of the locations changed climate zones from the 2013 to the 2016 version. We need to keep the using existing climate zones to keep consistency in the code, aschanges w ould cause confusion, to put it mildly.
The IECC climate zones are based in part on the Koppen system for climate classification. The Koppen Climate Classification System is the most w idespread system used to classify climates. It w as developed by a German climatologist w ho divided the w orld's climates into major categories based upon general temperature profiles and observable features. The Koppen system w as part of the basis for the existing IECC climate zones as developed by DOE / Pacific Northw est National Laboratory.

The Tropical Zone is distinguished by its lack of distinct temperature based seasons and by its lack of extreme high or low temperatures. This lack of extreme temperatures, as is seen in Haw aii, has a big impact on the energy solutions availalbe for buildings. There is a big difference betw een a climate w hich is so moderate that one can almost live outdoors and a climate w here one is focused on escaping from the heat much of the year. The Tropical Zone is used in the IECC as a subset of Climate Zone 1.

The IECC should retain its existing climate zones.

Cost Impact: Will not increase the cost of construction
Retaining the existing IECC climate zones w ill not increase cost.

CE39-16 : C401.2-CONNER12916

CE40-16

IECC: C202, C401.2.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Add new definition as follows:

<u>**INFORMATION TECHNOLOGY EQUIPMENT** Computers, data storage, servers, network equipment and communication equipment.</u>

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. <u>The requirements of ASHRAE 90.4 for buildings serving a total *information technology equipment* load greater than 10kW and greater than 20 watts per square foot of conditioned floor area.</u>
3. The requirements of Sections C402 through C405. 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, C404, C405.2, C405.3, C405.5, C405.6 and C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:
ASHRAE Standard 90.4 Energy Standard for Data Centers and Telecommunications Buildings

Reason: ASHRAE Standard 90.4P, Energy Standard for Data Centers and Telecommunications Buildings establishes the minimum energy efficiency requirements of data centers and telecommunications buildings for design and construction and for creation of a plan for operation and maintenance, and for utilization of on-site or off-site renew able energy resources.
Data center applications are unlike their commercial building counterparts in tw o significant w ays. First, they include significantly higher plug loads. And second, they employ rapidly changing technology for the IT equipment and associated pow er/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 pow er design. As a result, demonstrating compliance to the 90.1 Chapter 11 or energy cost budget (ECB) approaches may be impractical.

This standard is based on the principles of pow er use effectiveness (PUE), as defined by The Green Grid. How ever, because PUE is an operational measurement metric, and this is a design standard, PUE terminology is not a technically accurate usage.

Bibliography: ASHRAE Standard 90.4 Energy Standard for Data Centers and Telecommunications Buildings

Cost Impact: Will increase the cost of construction
In the current IECC there are no provisions for data center buildings. This w ill add requirements to those facilities and likely increase the cost of construction.

Analysis: A review of the standard(s) proposed for inclusion in the code, ASHRAE 90.4, w ith regard to the ICC criteria for
referenced standards (Section 3.6 of CP#28) w ill be posted on the ICC w ebsite on or before April 1, 2015.

CE41-16

IECC: 104.5 (New), 408.4 (New), C104.5, C104.6, C104.7, C104.7.1, C104.8 (New), C401.2, C402.5, C408.1, C408.4.1 (New), C408.4.1.1 (New), C408.4.1.2 (New), C408.4.1.3 (New), C408.4.1.4 (New), C408.4.2 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Add new text as follows:

104.5 Verification and commissioning reporting Where reporting is required, the *code official* or other approved agencies shall report to the contractor their findings of conformance and non-conformance for correction.

Revise as follows:

~~C104.5~~ C104.6 **Inspection requests.** *No change to text.*

~~C104.6~~ C104.7 **Reinspection and testing.** Where any work or installation does not pass an initial test or inspection, the non-conforming work or installation shall be reported in writing to the *code official* and design professional, and the necessary corrections shall be made to achieve compliance with this code. The work or installation shall then be resubmitted to the *code official* for inspection and testing.

Add new text as follows:

C104.8 Non-conformance. Where the non-conforming work is found not to be corrected within a predetermined time agreed upon with the contractor, the non-conforming work shall be reported in writing to the *code official* and design professional. At a time agreed upon by the *code official* or other approved agencies, a final report shall be submitted to the *code official* and the contractor that outlines the inspection findings and documents the correction of non-conforming work

Revise as follows:

~~C104.7~~ C104.9 **Approval.** *No change to text.*

~~C104.7.1~~ C104.9.1 **Revocation.** *No change to text.*

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. In addition, commercial buildings shall comply with Section C406 and Section C408 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C404, C405.2, C405.3, C405.5, C405.6, C407, and ~~C407~~ C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

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 or ASTM E 1827 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/ft^2 (0.2 L/s • m^2) with this air leakage rate normalized by the sum of the above and below grade building *thermal envelope* areas of the *conditioned space*. Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

Exceptions:

1.For buildings having over 50,000 ft^2 (5,000 m^2) of gross conditioned floor area, air leakage testing need not be conducted on the whole building provided that the following portions of the building are tested:

1.1. The entire floor area of all stories that have any spaces directly under a roof.

1.2. The entire floor area of all stories that have a building entrance or loading dock.

1.3. .Representative above-grade sections of the building totaling not less than 25% of the wall area enclosing the remaining conditioned space.

The measured air leakages shall be area-weighted by the surface areas of the building envelope in items 1.1 through 1.3 to determine a whole building value. The test(s) of the areas in item 1.3 shall be applied to the remainder of the building envelope surface area not included in items 1.1 and 1.2.

2.Where the measured air leakage rate exceeds 0.40 cfm/ft^2 (2.0 L/s•m^2) but does not exceed 0.60 cfm/ft^2 (3.0 L/s•m^2), a diagnostic evaluation, such as by smoke tracer or infra-red imaging shall be conducted while the building is pressurized and any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. A visual inspection of the air barrier shall be conducted and 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 satisfy the requirements of this section

C408.1 General. This section covers the commissioning of the building mechanical systems in Section C403 and electrical power and lighting systems in Section C405 and the inspection and verification of building envelope in Section C402.

Add new text as follows:

408.4 Building envelope inspection and verification In addition to the requirements of Section C104.2, the building shall be inspected and verified in accordance with Sections 408.4.1, and 408.4.2.

C408.4.1 Inspections. Envelope components and assemblies shall be inspected in accordance with Sections C408.4.1.1 through C408.1.4.

C408.4.1.1 Inspection of fenestration and door requirements. Fenestration and doors shall be inspected to ensure compliance with the requirements of Sections C402.5.2, C402.5.4, and C402.5.7. Where testing is required to demonstrate compliance with the air leakage requirements, it shall be conducted by an independent third party. Operation of the door and closer or operating mechanism shall be inspected for conformance with the manufacturer's instructions, and that the seals or gaskets are installed and in accordance with the manufacturer's instructions.

C408.4.1.2 Inspection of loading dock weatherseals. Where there is a loading dock, weatherseals shall be inspected to verify correct installation and that the seals are in servicable condition in accordance with Section C402.5.6.

C408.4.1.3 Inspection of opaque envelope air tightness requirements. Opaque roof, above and below grade walls, and floors, shall be subject to the following inspections during construction:

1. Inspection for the use of compliant materials and assemblies as indicated in Section C402.5.1.2.
2. Inspection for integration with adjoining fenestration and continuous air barrier elements.

C408.4.1.4 Fenestration inspections. Fenestration shall be subject to the following inspections during construction:

1. Skylights size and location in relation to the designed primary and secondary lighted areas below.
2. Rooftop monitors size and location in relation to the designed primary and secondary lighted areas below.
3. Dynamic glazing compliance in accordance with Section C402.4.3.3 and testing of the operation for conformance with the manufacturer's instructions.
4. Permanent fenestration projections installation and performance in accordance with Section C402.4.3 and the construction documents.

C408.4.2 Verification. Air leakage verification shall be determined in accordance with one of the following methods:

1. An air barrier design and installation verification program shall be implemented and shall include the following elements:
   - 1.1. A design review shall be conducted to assess compliance with the requirements in Section C402.5.1.
   - 1.2. Periodic field 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 Section C402.5.1.
   - 1.3. Reporting shall be in compliance with Section C104.5.
2. A whole building air leakage verification program shall be implemented and shall include the following elements:
   - 2.1. Whole building pressurization testing shall be performed in accordance with Section C402.5 and the application of any exceptions shall be documented.
   - 2.2. Reporting shall be in compliance with Section C104.5.

Reason: The purpose of this proposal is to verify proper installation and/or performance of installed air barriers. The proposal includes the following:

1. **C104:** Language is added to include reporting of verification and commissioning to the code official or other approved agency. This is something that has been missing even though commissioning is already in the code. Furthermore, it addresses how and to whom non-conforming work is to be reported and addressed.
2. **C401.2:** Section C408 is added to the Application section of the code. Again, this section previously existed. It was likely an oversight that it had not been added sooner. This insures that it is not missed or ignored when complying with the code.
3. **C402.5:** An additional test method and testing guidance is added the existing whole building air leakage section. ASTM E1827 is similar to ASTM E779 but allows orifice testing which is common with larger commercial buildings.
4. **C402.55:** Exceptions have been added to the whole building air leakage testing requirement. Exception 1 addresses the testing of large buildings where it may not be practical or feasible to test the entire building. Where it is not guidance is given as to how to test representative portions of the building. Exception 2 addresses non-conforming buildings. In this case instructions are given as to how to mitigate air leakage problems at this stage of construction. It gives an allowance to meet a higher air leakage rate if mitigation is performed.
5. **C408:** Envelope inspection and verification is added to section C408. Inspection requirement language is added for fenestration, doors, loading dock weather seals, and the opaque envelope to ensure good air leakage performance in the building. Verification language is also added. This section includes two options for compliance, option 1 requires an air barrier design and installation program, option 2 requires whole building air leakage testing in accordance with section C402.5. Reporting in accordance with Chapter 1 is required for both options.

This proposal mirrors the changes made to ASHRAE 90.1 via Addendum L that will be published in the 2016 standard.

Cost Impact: Will increase the cost of construction
Because of the compliance options in this proposal there is required increase in cost of construction

Analysis: A review of the standard(s) proposed for inclusion in the code, ASTM E1827, 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 1, 2015.

CE41-16 : C401.2-FERGUSON12471

CE42-16

IECC: C401.2.

Proponent : Charles Foster, representing self (cfoster20187@yahoo.com)

2015 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. 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, C404, C405.2, C405.3, C405.5, C405.6 and C407. The building energy cost shall be equal to or less than ~~85~~ 95 percent of the standard reference design building.

Reason: This proposal changes the existing 85% threshold to 95% in the performance path of the code.
There seems to be grow ing interest in promoting the performace aspects of building codes, including the IECC. And yet, as currently w ritten, users of the IECC that desire to demonstrate compliance through section 407 (performance) are required to construct a building that uses less energy than if that building w as contructed using the prescriptive path. This seems a disincentive.

To remedy this disincentive, this proposal w ould relax the builder penalty from 85% of the standard reference design building to 95%.

Additionally, it should be noted that DOE has determined that buildings are, indeed, becoming more efficient as the result of building energy codes and standards, including the IECC. For instance, from 2010 to 2013, ASHRAE Std. 90.1 resulted in saving show n below according to DOE:

TABLE IV.5—QUANTITATIVE ANALYSIS FINDINGS

Savings in w hole-building EUI (percent)

Site EUI	ECI (Energy Cost Intensity \$/ft^2 - yr)
7.6	8.7

Using the DOE determination, since the energy cost "floor" has been raised by 8.7%, that corresponds to changing the 85% to 92.4% (85 *1.087). Assuming that ASHRAE 90.1-2016 and IECC 2018 will improve energy efficiency by at least 3 percent, the new "floor" would be:

92.4 * 1.03 = 95.172

Source: 09/26/2014 Federal Register volume 79 Page 57900-57915

[Docket No. EERE–2014–BT–DET–0009]

RIN 1904–AD27

Determination Regarding Energy

Efficiency Improvements in ANSI/ ASHRAE/IES Standard 90.1–2013: Energy Standard for Buildings, Except Low-Rise Residential Buildings

Bibliography:

Cost Impact: Will not increase the cost of construction
This proposal relaxes the existing requirement and, as such, will not add to the cost of construction.

CE42-16 : C401.2-FOSTER12488

CE43-16

IECC: C401.2, C406.1.

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Harry Misuriello, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, representing Alliance to Save Energy; William Prindle, ICF International, representing Energy Efficient Codes Coalition

2015 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. 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, C404, C405.2, C405.3, C405.5, C405.6 and C407. The building energy cost shall be equal to or less than ~~85~~ 80 percent of the standard reference design building.

C406.1 Requirements. Buildings shall comply with at least ~~one~~ two of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power density system 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.

Reason: Section C406.1 establishes a set of additional efficiency option packages above base code requirements that the user must choose from to meet the code requirements – the current code requires compliance with one of these packages. The purpose of this code change proposal is to modify the requirement so that the user would have to comply with two packages instead of one. The alternative performance path compliance option from Section 401.2 is also modified to improve the performance path by 5% as compared to the 2009 IECC (from 85% to 80%) consistent with the prescriptive requirement to comply with two packages (which were estimated at 5% energy savings over the 2009 IECC by proponents during the 2012 IECC code cycle).

Cost Impact: Will increase the cost of construction
Unless the builder already planned to do two of these options, adding a second option would increase the cost of construction. The cost of these options would vary depending on many factors.

CE43-16 : C401.2-FAY12766

CE44-16

IECC: C401.2.

Proponent : Neil Leslie, Gas Technology Institute, representing Self (neil.leslie@gastechnology.org)

2015 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. 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, C404, C405.2, C405.3, C405.5, C405.6 and C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.
4. <u>The requirements of ANSI/ASHRAE/IESNA 90.1 Appendix G.</u>

Reason: In 2015, ASHRAE Standard 90.1 supplemented its prescriptive and energy cost budget performance pathw ays in Section 4.2.1 w ith a new ly approved performance path methodology in Appendix G. With the publication of the 2015 supplement that includes Addendum bm, Appendix G also shifted to a fixed baseline "Performance Cost Index" methodology. Addendum bm shifted to a fixed baseline building at 90.1-2004 level of performance to establish the target and set that baseline performance level at 1.00, including for the first time unregulated energy use along w ith regulated energy use in the calculation. It then applies a Building Performance Factor (e.g., .60 for Offices in Climate Zone 5A) to establish a PCI target for the proposed building. This allow s them to show more easily the PCI progress on the path to zero energy costs in subsequent versions of the standard. Previously in both ECB Section 11 and Appendix G, Standard 90.1 established an annual energy cost budget ($/year) for a building in its baseline configuration to compare w ith the annual energy cost ($/Yr) for the proposed configuration, including only regulated energy use. That made it difficult to evaluate progress over time w ithout additional interpretation or analysis. Referencing the Appendix G provisions rather than re-w riting them w ith a new IECC section w as considered a more useful approach to incorporating these new provisions explicitly w ithin IECC.

Cost Impact: Will not increase the cost of construction
Explicit additon of the new performance path option in the IECC does not increase the cost of compliance, but provides a parallel pathw ay in IECC aligned w ith the approaches adopted in Standard 90.1.

Analysis: A review of the standard(s) proposed for inclusion in the code, ASHRAE 90.1 appendix G supplement, w ith regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) w ill be posted on the ICC w ebsite on or before April 1, 2015.

CE44-16 : C401.2-LESLIE12619

CE45-16

IECC: C401.2, C407.1, C407.2, C407.3, C407.4, C407.4.1, C407.4.2, C407.5, C407.5.1, C407.5.2, C407.5.2.1, C407.5.2.2, C407.5.2.3, C407.6, C407.6.1, C407.6.2, C407.6.3.

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 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. 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, C404, C405.2, C405.3, C405.5, C405.6 and~~ Section C407. ~~The building energy cost shall be equal to or less than 85 percent of the standard reference design building.~~

C407.1 Scope. This section establishes criteria for compliance using the total building performance. ~~The following systems and loads~~ Buildings 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~~ use ANSI/ASHRAE/IESNA 90.1 to demonstrate compliance.

Delete without substitution:

~~**C407.2 Mandatory requirements.** Compliance with this section requires that the criteria of Sections C402.5, C403.2, C404 and C405 be met.~~

~~**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. Nondepletable energy collected off site shall be treated and priced the same as purchased energy. Energy from nondepletable energy sources collected on site shall be omitted from the annual energy cost of the *proposed design.*~~

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

~~**C407.4 Documentation.** Documentation verifying that the methods and accuracy of compliance software tools conform to the provisions of this section shall be provided to the *code official.*~~

~~**C407.4.1 Compliance report.** Permit submittals shall include a report documenting that the proposed design has annual energy costs less than or equal to the annual energy costs of the *standard reference design*. The compliance documentation shall include the following information:~~

1. ~~Address of the building.~~

~~2. An inspection checklist documenting the building component characteristics of the *proposed design* as specified in Table C407.5.1(1). The inspection checklist shall show the estimated annual energy cost for both the *standard reference design* and the *proposed design*.~~
~~3. Name of individual completing the compliance report.~~
~~4. Name and version of the compliance software tool.~~

~~**C407.4.2 Additional documentation.** The *code official* shall be permitted to require the following documents:~~

~~1. Documentation of the building component characteristics of the *standard reference design*.~~
~~2. Thermal zoning diagrams consisting of floor plans showing the thermal zoning scheme for *standard reference design* and *proposed design*.~~
~~3. Input and output reports from the energy analysis simulation program containing the complete input and output files, as applicable. The output file shall include energy use totals and energy use by energy source and end use served, total hours that space conditioning loads are not met and any errors or warning messages generated by the simulation tool as applicable.~~
~~4. An explanation of any error or warning messages appearing in the simulation tool output.~~
~~5. A certification signed by the builder providing the building component characteristics of the *proposed design* as given in Table C407.5.1(1).~~

~~**C407.5 Calculation procedure.** Except as specified by this section, the *standard reference design* and *proposed design* shall be configured and analyzed using identical methods and techniques.~~

~~**C407.5.1 Building specifications.** The *standard reference design* and *proposed design* shall be configured and analyzed as specified by Table C407.5.1(1). Table C407.5.1(1) shall include by reference all notes contained in Table C402.1.4.~~

TABLE ~~C407.5.1~~ C407.5.1(1) (1)
~~**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**~~

~~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 C403.3 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 C403.3.~~

~~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 unit efficiency · 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 unit efficiency · 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 unit efficiency · 0.26)].~~

~~4. Where Items 1 through 3 are not met, SWHF = 1.0.~~

TABLE ~~C407.5.1~~ C407.5.1(2) (2)
~~**HVAC SYSTEMS MAP**~~

~~a. Select "water/ground" where the proposed design system condenser is water or evaporatively cooled; select "air/none" where the~~

~~condenser is air cooled. Closed circuit dry-coolers shall be considered air cooled. Systems utilizing district cooling shall be treated as if the condenser water type were "water." Where no mechanical cooling is specified or the mechanical cooling system in the proposed design does not require heat rejection, the system shall be treated as if the condenser water type were "Air." For proposed designs with ground-source or groundwater-source heat pumps, the standard reference design HVAC system shall be water-source heat pump (System 6).~~

~~b. Select the path that corresponds to the proposed design heat source: electric resistance, heat pump (including air source and water source), or fuel fired. Systems utilizing district heating (steam or hot water) and systems with no heating capability shall be treated as if the heating system type were "fossil fuel." For systems with mixed fuel heating sources, the system or systems that use the secondary heating source type (the one with the smallest total installed output capacity for the spaces served by the system) shall be modeled identically in the standard reference design and the primary heating source type shall be used to determine *standard* reference design HVAC system type.~~

~~c. Select the standard reference design HVAC system category: The system under "single-zone residential system" shall be selected where the HVAC system in the proposed design is a single-zone system and serves a residential space. The system under "single-zone nonresidential system" shall be selected where the HVAC system in the proposed design is a single zone system and serves other than residential spaces. The system under "all other" shall be selected for all other cases.~~

TABLE ~~C407.5.1~~ C407.5.1(3) (3)
~~SPECIFICATIONS FOR THE STANDARD REFERENCE DESIGN HVAC SYSTEM DESCRIPTIONS~~

~~For SI: 1 foot = 304.8 mm, 1 cfm/ft^2 = 0.4719 L/s, 1 Btu/h = 0.293/W, °C = [(°F) -32/1.8].~~

~~a. **VAV with parallel boxes:** Fans in parallel VAV fan-powered boxes shall be sized for 50 percent of the peak design flow rate and shall be modeled with 0.35 W/cfm fan power. Minimum volume setpoints for fan-powered boxes shall be equal to the minimum rate for the space required for ventilation consistent with Section C403.4.4, Exception 4. Supply air temperature setpoint shall be constant at the design condition.~~

~~b. **VAV with reheat:** Minimum volume setpoints for VAV reheat boxes shall be 0.4 cfm/ft^2 of floor area. Supply air temperature shall be reset based on zone demand from the design temperature difference to a 10°F temperature difference under minimum load conditions. Design airflow rates shall be sized for the reset supply air temperature, i.e., a 10°F temperature difference.~~

~~c. **Direct expansion:** The fuel type for the cooling system shall match that of the cooling system in the proposed design.~~

~~d. **VAV:** Where the proposed design system has a supply, return or relief fan motor 25 hp or larger, the corresponding fan in the VAV system of the standard reference design shall be modeled assuming a variable speed drive. For smaller fans, a forward-curved centrifugal fan with inlet vanes shall be modeled. Where the proposed designs system has a direct digital control system at the zone level, static pressure setpoint reset based on zone requirements in accordance with Section C403.4.1 shall be modeled.~~

~~e. **Chilled water:** For systems using purchased chilled water, the chillers are not explicitly modeled and chilled water costs shall be based as determined in Sections C407.3 and C407.5.2. Otherwise, the standard reference designs chiller plant shall be modeled with chillers having the number as indicated in Table C407.5.1(4) as a function of standard reference building chiller plant load and type as indicated in Table C407.5.1(5) as a function of individual chiller load. Where chiller fuel source is mixed, the system in the standard reference design shall have chillers with the same fuel types and with capacities having the same proportional capacity as the proposed designs chillers for each fuel type. Chilled water supply temperature shall be modeled at 44°F design supply temperature and 56°F return temperature. Piping losses shall not be modeled in either building model. Chilled water supply water temperature shall be reset in accordance with Section C403.4.3.3. Pump system power for each pumping system shall be the same as the proposed design; where the proposed design has no chilled water pumps, the standard reference design pump power shall be 22 W/gpm (equal to a pump operating against a 75-foot head, 65-percent combined impeller and motor efficiency). The chilled water system shall be modeled as primary-only variable flow with flow maintained at the design rate through each chiller using a bypass. Chilled water pumps shall be modeled as riding the pump curve or with variable speed drives when required in Section C403.4.3.3. The heat rejection device shall be an axial fan cooling tower with two-speed fans where required in Section C403.4.3. Condenser water design supply temperature shall be 85°F or 10°F approach to design wet-bulb temperature, whichever is lower, with a design temperature rise of 10°F. The tower shall be controlled to maintain a 70°F leaving water temperature where weather permits, floating up to leaving water temperature at design conditions. Pump system power for each pumping system shall be the same as the proposed design; where the proposed design has no condenser water pumps, the standard reference design pump power shall be 19 W/gpm (equal to a pump operating against a 60-foot head, 60-percent combined impeller and motor efficiency). Each chiller shall be modeled with separate condenser water and chilled water pumps interlocked to operate with the associated chiller.~~

~~f. **Fossil fuel boiler:** For systems using purchased hot water or steam, the boilers are not explicitly modeled and hot water or steam costs shall be based on actual utility rates. Otherwise, the boiler plant shall use the same fuel as the proposed design and shall be natural draft. The standard reference design boiler plant shall be modeled with a single boiler where the standard reference design plant load is 600,000 Btu/h and less and with two equally sized boilers for plant capacities exceeding 600,000 Btu/h. Boilers shall be staged as required by the load. Hot water supply temperature shall be modeled at 180°F design supply temperature and 130°F return temperature. Piping losses shall not be modeled in either building model. Hot water supply water temperature shall be reset in accordance with Section C403.4.3.3. Pump system power for each pumping system shall be the same as the proposed design; where the proposed design has no hot water pumps, the standard reference design pump power shall be 19 W/gpm (equal to a pump operating against a 60-foot head, 60-percent combined impeller and motor efficiency). The hot water system shall be modeled as primary only with continuous variable flow. Hot water pumps shall be modeled as riding the pump curve or with variable speed drives when required by Section C403.4.3.3.~~

~~g. **Electric heat pump and boiler:** Water-source heat pumps shall be connected to a common heat pump water loop controlled to maintain temperatures between 60°F and 90°F. Heat rejection from the loop shall be provided by an axial fan closed-circuit evaporative fluid cooler with two-speed fans where required in Section C403.4.1. Heat addition to the loop shall be provided by a boiler that uses the same fuel as the proposed design and shall be natural draft. Where no boilers exist in the proposed design, the standard reference building boilers shall be fossil fuel. The standard reference design boiler plant shall be modeled with a single boiler where the standard reference design plant load is 600,000 Btu/h or less and with two equally sized boilers for plant capacities exceeding 600,000 Btu/h. Boilers shall be staged as required by the load. Piping losses shall not be modeled in either building model. Pump system power shall be the same as the proposed design; where the proposed design has no pumps, the standard reference design pump power shall be 22 W/gpm, which is equal to a pump operating against a 75-foot head, with a 65-percent combined~~

~~impeller and motor efficiency. Loop flow shall be variable with flow shutoff at each heat pump when its compressor cycles off as required by Section C403.4.3.3. Loop pumps shall be modeled as riding the pump curve or with variable speed drives when required by Section C403.4.3.3.~~

~~h. **Electric heat pump:** Electric air source heat pumps shall be modeled with electric auxiliary heat. The system shall be controlled with a multistage space thermostat and an outdoor air thermostat wired to energize auxiliary heat only on the last thermostat stage and when outdoor air temperature is less than 40°F.~~

~~i. **Constant volume:** Fans shall be controlled in the same manner as in the proposed design; i.e., fan operation whenever the space is occupied or fan operation cycled on calls for heating and cooling. Where the fan is modeled as cycling and the fan energy is included in the energy-efficiency rating of the equipment, fan energy shall not be modeled explicitly.~~

TABLE ~~C407.5.1~~ C407.5.1(4) (4)
~~NUMBER OF CHILLERS~~

~~For SI: 1 ton = 3517 W.~~

TABLE ~~C407.5.1~~ C407.5.1(5) (5)
~~WATER CHILLER TYPES~~

~~For SI: 1 ton = 3517 W.~~

~~**C407.5.2 Thermal blocks.** The *standard reference design* and *proposed design* shall be analyzed using identical thermal blocks as specified in Section C407.5.2.1, C407.5.2.2 or C407.5.2.3.~~

~~**C407.5.2.1 HVAC zones designed.** Where HVAC *zones* are defined on HVAC design drawings, each HVAC *zone* shall be modeled as a separate thermal block.~~

~~**Exception:** Different HVAC *zones* shall be allowed to be combined to create a single thermal block or identical thermal blocks to which multipliers are applied provided:~~

1. ~~The space use classification is the same throughout the thermal block.~~
2. ~~All HVAC *zones* in the thermal block that are adjacent to glazed exterior walls face the same orientation or their orientations are within 45 degrees (0.79 rad) of each other.~~
3. ~~All of the *zones* are served by the same HVAC system or by the same kind of HVAC system.~~

~~**C407.5.2.2 HVAC zones not designed.** Where HVAC *zones* have not yet been designed, thermal blocks shall be defined based on similar internal load densities, occupancy, lighting, thermal and temperature schedules, and in combination with the following guidelines:~~

1. ~~Separate thermal blocks shall be assumed for interior and perimeter spaces. Interior spaces shall be those located more than 15 feet (4572 mm) from an exterior wall. Perimeter spaces shall be those located closer than 15 feet (4572 mm) from an *exterior wall*.~~
2. ~~Separate thermal blocks shall be assumed for spaces adjacent to glazed exterior walls: a separate *zone* shall be provided for each orientation, except orientations that differ by not more than 45 degrees (0.79 rad) shall be permitted to be considered to be the same orientation. Each *zone* shall include floor area that is 15 feet (4572 mm) or less from a glazed perimeter wall, except that floor area within 15 feet (4572 mm) of glazed perimeter walls having more than one orientation shall be divided proportionately between *zones*.~~
3. ~~Separate thermal blocks shall be assumed for spaces having floors that are in contact with the ground or exposed to ambient conditions from *zones* that do not share these features.~~
4. ~~Separate thermal blocks shall be assumed for spaces having exterior ceiling or roof assemblies from *zones* that do not share these features.~~

~~**C407.5.2.3 Multifamily residential buildings.** Residential spaces shall be modeled using one thermal block per space except that those facing the same orientations are permitted to be combined into one thermal block. Corner units and units with roof or floor loads shall only be combined with units sharing these features.~~

~~**C407.6 Calculation software tools.** Calculation procedures used to comply with this section shall be software tools capable of calculating the annual energy consumption of all building elements that differ between the *standard reference design* and the *proposed design* and shall include the following capabilities.~~

1. ~~Building operation for a full calendar year (8,760 hours).~~
2. ~~Climate data for a full calendar year (8,760 hours) and shall reflect *approved* coincident hourly data for temperature, solar radiation, humidity and wind speed for the building location.~~
3. ~~Ten or more thermal zones.~~
4. ~~Thermal mass effects.~~
5. ~~Hourly variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads.~~
6. ~~Part load performance curves for mechanical equipment.~~
7. ~~Capacity and efficiency correction curves for mechanical heating and cooling equipment.~~
8. ~~Printed *code official* inspection checklist listing each of the *proposed design* component characteristics from Table C407.5.1(1) determined by the analysis to provide compliance, along with their respective performance ratings including, but not limited to, *R*-value, *U*-factor, SHGC, HSPF, AFUE, SEER, EF.~~

~~**C407.6.1 Specific approval.** Performance analysis tools complying with the applicable subsections of Section C407 and tested according to ASHRAE Standard 140 shall be permitted to be *approved.* Tools are permitted to be *approved* based on meeting a specified threshold for a jurisdiction. The *code official* shall be permitted to approve tools for a specified application or limited scope.~~

~~**C407.6.2 Input values.** Where calculations require input values not specified by Sections C402, C403, C404 and C405, those input values shall be taken from an *approved* source.~~

~~**C407.6.3 Exceptional calculation methods.** Where the simulation program does not model a design, material or device of the *proposed design*, an exceptional calculation method shall be used where approved by the *code official*. Where there are multiple designs, materials or devices that the simulation program does not model, each shall be calculated separately and exceptional savings determined for each. The total exceptional savings shall not constitute more than half of the difference between the baseline building performance and the proposed building performance. Applications for approval of an exceptional method shall include all of the following:~~

1. ~~Step-by-step documentation of the exceptional calculation method performed, detailed enough to reproduce the results.~~
2. ~~Copies of all spreadsheets used to perform the calculations.~~
3. ~~A sensitivity analysis of energy consumption where each of the input parameters is varied from half to double the value assumed.~~
4. ~~The calculations shall be performed on a time step basis consistent with the simulation program used.~~
5. ~~The performance rating calculated with and without the exceptional calculation~~

~~method.~~

Reason: This proposal would retain the ability to use Section C407 Total Building Performance but would direct the code user to the performance approaches contained in ASHRAE Standard 90.1. This option is already available to the code user under C401.2(1). Typically most code users that use the performance approach for demonstrating compliance with the code use the methodology contained in ASHRAE. There are no software tools available to implement C407 making quality control of the simulation a huge burden for the building official. There are numerous software tools implementing the ASHRAE methodology – Energy Gauge, eQuest, Bentley Systems, EnergyPro. This results in greater reliability and accuracy. Above code programs e.g. LEED for New Construction, also reference the performance approach contained in ASHRAE. The IECC performance path has not been changed to reflect the changes in the prescriptive since the 2009 IECC. When the 2012 IECC was developed there was no attempt by the proponents to change the reference building requirements in Table C407.5.1(1) to reflect the changes made to the prescriptive requirements of the code. The following provisions in the prescriptive approach of the code are not accounted for in C407:

a. 30% window to wall ratio limit C402.4.1
b. Variable speed fans on single zone systems C403.4.1.1
c. Skylights and daylighting controls for large high bay spaces
d. Heat recovery required for large service water heating systems C403.4.5
e. Boiler turndown requirements C403.4.2.5
f. Additional efficiency options C406
g. High input service water heating efficiency C404.2.1

In addition, any changes made to the prescriptive path during the current code update cycle other than lighting power, equipment efficiency, and R-values and U-values will not be reflected in C407. These inconsistencies create an inequality between the two compliance approaches. An attempt was made during the 2012 IECC development process to estimate the difference in building efficiency between the prescriptive approach and performance and reflect this difference Section C401.2 by requiring a building that complies with C407 to be 85% of the reference building budget. There was no analysis performed to develop this estimate and, given the changes to the provisions of the 2015 IECC and those expected for 2018, it is unclear if 85% reflects the difference between the two compliance methods.

Based on the code development process, it is very difficult to ensure that C407 reflects the changes that will occur to the prescriptive requirements. Changes are typically proposed to the prescriptive requirements and are not proposed to C407. Changes made to C407 are sometimes made during the next code cycle to reflect changes that were made during the previous code cycle resulting in a compliance approach that is at least a cycle behind. The ASHRAE standards development process ensures that the performance approach is in parity with the provisions contained in the prescriptive requirements in the ASHRAE Standard 90.1

Cost Impact: Will not increase the cost of construction
Demonstrating compliance for commerical buldings using a performance based approach is typically done using an ASHRAE protocol not by following Section C407 of the IECC. The simulation tools that are used to comply with performance based compliance are already designed to work with the ASHRAE process and not the C407 protocols. The cost to perform the analysis will not increase becasue current practice is to use ASHRAE and not C407. Therefore this change, while being editorial in nature, will not increase the cost of construction because is will be codifying current practice.

CE45-16 : C401.2-MAKELA12514

CE46-16

IECC: C401.2.

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

2015 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. 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, C404, C405.2, C405.3, C405.5, C405.6 and C407. The building energy cost shall be equal to or less than ~~85 percent~~ the energy cost of the ~~standard reference design~~*standard reference design* building.

Reason: Section C407, Total Building Performance, is an option that uses energy and energy cost simulation. As it is structured, Section C407 (and Section C401.2, #3) links to the current requirements in terms of minimum energy efficiency. As a result, and w ith other proposed changes, the standard reference design is a building that meets the 2015 IECC, and w ill meet the provisions of the 2018 IECC. It is not a path that is equivalent to a previous version of the IECC, such as the 2006 or 2009 version.
Since it is equivalent to the current code, there is no reason to have the energy cost reduction requirement. The only reason to have a reduction w ould be if Section C407 w as changed to be equivalent to a "locked" previous version of the IECC (or a previous version of ASHRAE 90.1).

The three options in Section C401.2 are structured to be equivalent in terms of energy efficiency. This proposal creates the equivalency.

Cost Impact: Will not increase the cost of construction
This proposal does not change any of the code requirements, but only changes the threshold for acceptance of the performance path.

CE46-16 : C401.2-ROSENSTOCK11861

CE47-16

IECC: C401.2.1.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

~~C401.2.1~~ <u>C503.3.4</u> ~~Application to replacement~~ <u>Replacement</u> 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: Chapter 5 is the location for provisions for existing buildings. Section C401.2.1 was added at the same time all other existing building provisions were moved to Chapter 5, so it wasn't possible to coordinate this proposal with the new Chapter 5 during the last cycle. The proposal simply moves Section C401.2.1 into Section C503.3. the later section is the Building envelope section of Alterations – C503. The text of C401.2.1 is as follows: There is no intent to change the text just to move it to Chapter 5.

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 C402.3.

> **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 C402.3 shall be permitted to satisfy the *U-factor* requirements for each fenestration product category listed in Table C402.3. Individual fenestration products from different product categories listed in Table C402.3 shall not be combined in calculating the area-weighted average *U-factor*.

This proposal was submitted by the ICC Sustainability 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). This includes both the technical aspects of the codes as well as the code content in terms of scope and application of referenced standards. In 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
This is an editorial relocation of existing text. It has no impact on technical standard and therefore should not have an impact on the cost of construction.

CE47-16 : C401.2.1-COLLINS11558

CE48-16

IECC: C401.2.1, C402.4.3.4, C503.3.4 (New).

Proponent : Thomas Culp, Birch Point Consulting LLC, representing Glazing Industry Code Committee and Aluminum Extruders Council (culp@birchpointconsulting.com)

2015 International Energy Conservation Code

Delete without substitution:

~~**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 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*.~~

Revise as follows:

C402.4.3.4 Area-weighted *U*-factor and SHGC. An area-weighted average ~~shall be permitted to satisfy~~ , using the ~~*U*-factor requirements~~ respective area for each fenestration product category listed in Table C402.4, satisfies the *U*-factor requirements. ~~Individual fenestration products from different fenestration product categories listed in Table C402.4~~ *Vertical fenestration* and *skylights* shall not be combined in calculating area-weighted average *U*-factor.

For fenestration facing the same direction, an area-weighted average satisfies the *SHGC* requirements. *Vertical fenestration* facing different directions and *skylights* shall not be combined in calculating area-weighted average *SHGC*.

Add new text as follows:

C503.3.4 Replacement fenestration. Where some or all of an existing *fenestration* unit is replaced with a new *fenestration* product, including sash and glazing, the replacement *fenestration* unit shall meet the applicable requirements for *U-factor* and *SHGC* in Table C402.3.

Exception: An area-weighted average satisfies the *U*-factor requirements, where using the respective area for each fenestration product category listed in Table C402.4. *Vertical fenestration* and *skylights* shall not be combined in calculating area-weighted average *U*-factor. For fenestration facing the same direction, an area-weighted average satisfies the *SHGC* requirements. *Vertical fenestration* facing different directions and *skylights* shall not be combined in calculating area-weighted average *SHGC*.

Reason: This proposal relocates the provisions for replacement fenestration from Section C401 for general provisions to the more appropriate Section C503 for alterations. This is also the location w here replacement fenestration is addressed in the residential IECC. There are no changes to the main requirement for replacement fenestration, but some improvements have been made in the exception regarding area-w eighted averaging to increase usability. Corresponding changes have also been made to section C402.4.3.4.

ASHRAE 90.1 allow s area-w eighted averaging of both U-factor and SHGC, as long as vertical fenestration and skylights are not mixed, nor products in fully conditioned and semi-heated spaces, because they affect building performance in different ways. The language in Section C402.4.3.4, which I helped draft for the 2012 IECC, also addressed this intent for U-factor, and does not allow skylights and vertical fenestration to be mixed (and the IECC does not have a semi-heated space category). However, ASHRAE 90.1 does specifically allow averaging across different categories of vertical fenestration, including fixed, operable, entrance door products. For example, in a section of window wall, higher U-factors of 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. In new construction, this can be done in the IECC using the envelope performance alternative of Section C402.1.5 or the performance path. However, while the current language in C402.4.3.4 and the exception to C401.2.1 does appropriately prevent vertical fenestration and skylights from being mixed, it also inappropriately prevents this type of compensation between fixed and operable products in both window replacements and in prescriptive new construction not using the full envelope alternative or performance paths. Not only does this restrict flexibility for the designer, it also potentially discourages 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, the modified language continues to prevent vertical fenestration and skylights from being mixed in area-weighted averaging, but does allow different types of vertical fenestration to be combined for evaluating compliance with U-factor requirements. For SHGC, the IECC code development body indicated in previous cycles that it would be inappropriate to average SHGC on different facades of the building, such as north and west. However, there is nothing incorrect about combining SHGC for different products on the same façade, so this language was also added.

Cost Impact: Will not increase the cost of construction
This proposal will not increase the cost of construction, as it is simply a relocation of the main requirement for replacement fenestration. Use of the modified language regarding area-weighted averaging could decrease construction costs by allowing more product flexibility for the designer while also satisfying the overall energy code requirements.

CE48-16 : C401.2.1-CULP12528

CE49-16

IECC: C402.1.

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

2015 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.
5. <u>Wall assemblies in the *building thermal envelope* shall comply with the vapor retarder requirements of Section R702.7 of the *International Residential Code* or Section 1405.3 of the *International Building Code*, as applicable.</u>

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 C403.2.15 or C403.2.16.

Reason: This change is consistent with a similar provision added last code cycle to Section R402.1.1 of the IECC-R. This change will help ensure that moisture control provisions in the building code are coordinated with building envelope requirements in the energy code. They are very much inter-related and vapor retarders and insulation strategies have inter-dependencies whereby the method of compliance with each code must be integrated. Also, some of the occupancy conditions overlap or are similar in the IBC and IRC; therefore, both are referenced in this proposal (for the same reason this was also done in the IECC-R last code cycle).

Cost Impact: Will not increase the cost of construction
This proposal merely provides an important reference to ensure the I-codes are properly coordinated in their implementation where the approach to compliance in one code affects how one must comply in the other.

CE49-16 : C402.1-CRANDELL12845

CE50-16

IECC: C402.1.1.

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

2015 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 • ft^2 (10.7 W/m^2) or 1.0 watt per square foot (10.7 W/m^2) of floor area for space conditioning purposes.
2. Those that do not contain *conditioned* space.
3. Greenhouses.
4. <u>Buildings that are less than 1,100 square feet in size and are used for electric distribution system purposes, where optional space conditioning is provided for equipment, with intermittent occupancy for maintenance or repair purposes only,</u>

Reason: This proposal adds a new and limited category of low -energy buildings.
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 ot prevent damage to equipment due to extreme w eather or storms. The amount of time that people w ork in these buildings (for maintenance or testing or repair) is minimal.

Based on feedback from EEI member companies, anyw here from 50% to 100% of utility vaults or enclosed sw itching stations or substations are <u>not</u> 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 low er in the w inter (60 degrees F or low er) 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 sized at 18 feet by 60 feet, or 1,080 square feet. The size limit of 1,100 square feet w ill ensure that the exemption is limited to these types of buildings.

Cost Impact: Will not increase the cost of construction
This proposal is adding an exemption to the requirements of Section C402, and as a result, w ill not increase the cost of construction for these low energy buildings.

CE50-16 : C402.1.1-ROSENSTOCK11747

CE51-16

IECC: C202, C402.1.1, C402.1.2 (New).

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

SECTION 202 DEFINITIONS

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.

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 • ft^2 (10.7 W/m^2) or 1.0 watt per square foot (10.7 W/m^2) of floor area for space conditioning purposes.
2. Those that do not contain *conditioned* space.
3. ~~Greenhouses.~~

Add new text as follows:

<u>**C402.1.2 Greenhouses** Greenhouses and greenhouses with accessory occupancies complying with Section 508.2 of the *International Building Code* shall be exempt from the building thermal envelope provisions of Section C402 provided that the primary use of the greenhouse is for the cultivation or maintenance of plants.</u>

Reason: The SEHPCAC recommends this proposal to eliminate a new conflict w ith the IBC. Approved in Cycle A w as a definition of greenhouse for the IBC as w ell as placement of greenhouses under various occupancies. The IBC definition w as different. To make the definitions consistent meant removing the w ord 'exclusively' from the definition. The SEHPCAC w as concerned that such deletion w ould open the IECC to allow ing any greenhouse to be exempt from envelope standards. Finally, the current placement of greenhouses under the low energy building category w as misleading at best. The proposal creates consistency of definitions and move the regulation of limited use from the definition to the body of the code in the new ly created Section C402.1.2.
This proposal w as submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC w as established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes w ith 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 2015, the SEHPCAC has held three tw o- or three-day open meetings and 25 w orkgroup calls, w hich included members of the SEHPCAC as w ell as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC w ebsite at: http://w w w .iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The intent is editorial. The intent is that greenhouses that w ere judged to be exempt from the envelope provisions in the 2015 IECC w ould continue to be exempt for such provisions in the 2018 edition.

CE51-16 : C402.1.2 (NEW)-COLLINS11556

CE52-16

IECC: C402.1.2, C402.1.3, C402.1.4, C402.3, C402.4, C402.4.1.1, C402.4.3.1, C402.4.3.2, C402.5.7, C403.2.4.3, C403.2.7, C403.2.9, C403.3, C403.3.3.3, C403.4.3.2, C403.4.3.2.1.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 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 square feet (50 m^2).
2. Are intended to house electronic equipment with installed equipment power totaling not less than 7 watts per square foot (75 W/m^2) 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 set point 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~~ 0 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* 0 and 1.

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a,]

CLIMATE ZONE	0 and 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	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	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal building 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	R-30 + 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-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, above grade																
Mass	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	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	R-13+ R-19.5ci	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-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
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	R13 + R-15.6ci or R-20 + R-10ci	R13 + R-15.6ci or R-20 + R-10ci
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	R-10ci	R-10ci	R-12.5ci
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	R-15ci	R-16.7ci
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 [f]	R-30 [f]	R-30 [f]	R-30 [f]
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	R-15 for 24″ below	R-15 for 24″ below	R-20 for 24″ below
Heated slabs	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-10 for 24″ below	R-10 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-15 for 36″ below	R-15 for 36″ below	R-15 for 36″ below	R-20 for 48″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 48²″below	R-20 for 48″ below
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	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m ^{2}, 1 pound per cubic foot = 16 kg/m ^{3}.

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD[a, b]

CLIMATE ZONE	0 and 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	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	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	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	U-0.021
Walls, above grade																
Mass	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-0.061	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-0.057	U-0.064	U-0.052	U-0.045	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
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	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-0.057	U-0.055	U-0.051	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	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	F-0.40	F-0.40
Heated slabs[f]	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.58	F-0.55	F-0.55	F-0.55	F-0.55
Opaque doors																
Swinging	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	U-0.37	U-0.37

For SI: 1 pound per square foot = 4.88 kg/m ^{2}, 1 pound per cubic foot = 16 kg/m ^{3}.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U* -factors, C-factors, and *F* -factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

C402.3 Roof solar reflectance and thermal emittance. Low-sloped roofs directly above cooled conditioned spaces in *Climate Zones*0, 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. 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/m^2] or 23 psf [117 kg/m^2] pavers.
4. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this section.

TABLE C402.4
BUILDING ENVELOPE FENESTRATION MAXIMUM *U*-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	0 and 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**	**SEW**	**N**	**SEW**	**N**	**SEW**	**N**	**SEW**	**N**
PF	0.25	0.33	0.25	0.33	0.25	0.33	0.40	0.53	0.40	0.53	0.40	0.53	0.45	NR	0.45	NR
0.2 ≤ PF	0.30	0.37	0.30	0.37	0.30	0.37	0.48	0.58	0.48	0.58	0.48	0.58	NR	NR	NR	NR
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.64	0.64	0.64	0.64	0.64	0.64	NR	NR	NR	NR
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.

C402.4.1.1 Increased vertical fenestration area with daylight responsive controls. In *Climate Zones* ~~1~~ 0 through 6, not more than 40 percent of the gross above-grade wall area shall be permitted to be vertical fenestration, provided 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.

C402.4.3.1 Increased skylight SHGC. In *Climate Zones* ~~1~~ 0 through 6, skylights shall be permitted a maximum SHGC of 0.60 where located above *daylight zones* provided with *daylight responsive controls*.

C402.4.3.2 Increased skylight *U*-factor. Where skylights are installed above *daylight zones* provided with *daylight responsive controls*, a maximum *U*-factor of 0.9 shall be permitted in *Climate Zones* ~~1~~ 0 through 3 and a maximum *U*-factor of 0.75 shall be permitted in *Climate Zones* 4 through 8~~.~~

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* 0, 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 m^2) 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.

C403.2.4.3 Shutoff dampers. 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/ft^2 (20.3 L/s • m^2) 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: Gravity (nonmotorized) dampers shall be permitted to be used as follows:

1. In buildings less than three stories in height above grade plane.
2. In buildings of any height located in *Climate Zones* 0, 1, 2, or 3.
3. Where the design exhaust capacity is not greater than 300 cfm (142 L/s).

Gravity (nonmotorized) dampers shall have an air leakage rate not greater than 20 cfm/ft^2 (101.6 L/s • m^2) where not less than 24 inches (610 mm) in either dimension and 40 cfm/ft^2 (203.2 L/s • m^2) 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.

C403.2.7 Energy recovery ventilation systems. Where the supply airflow rate of a fan system exceeds the values specified in Tables C403.2.7(1) and C403.2.7(2), the system shall include an energy recovery system. The energy recovery system shall have the capability 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 which permit operation of the economizer as required by Section C403.3.

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 at least one of the following features:
    2.1. Variable-air-volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values.
    2.2. Direct makeup (auxiliary) air supply equal to at least 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, 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 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 0, 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 C403.2.7(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.

TABLE C403.2.7 (1)
ENERGY RECOVERY REQUIREMENT (Ventilation systems operating less than 8,000 hours per year)

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	≥10% and	≥ 20% and	≥ 30% and	≥ 40% and 50%	≥ 50% and 60%	≥ 60% and 70%	≥ 70% and 80%	≥ 80%
	DESIGN SUPPLY FAN AIRFLOW RATE (cfm)							
3B, 3C, 4B, 4C, 5B	NR	NR	NR	NR	NR	NR	NR	NR
0B, 1B, 2B, 5C	NR	NR	NR	NR	≥ 26,000	≥ 12,000	≥ 5,000	≥ 4,000
6B	≥ 28,000	≥ 26,5000	≥ 11,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,500	≥ 1,500

0A, 1A, 2A, 3A, 4A, 5A, 6A	≥ 26,000	≥ 16,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,000	≥ 1,000	> 0
7, 8	≥ 4,500	≥ 4,000	≥ 2,500	≥ 1,000	> 0	> 0	> 0	> 0

For SI: 1 cfm = 0.4719 L/s.

NR = Not Required.

TABLE C403.2.7 (2)
ENERGY RECOVERY REQUIREMENT (Ventilation systems operating not less than 8,000 hours per year)

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	≥ 10% and	≥ 20% and	≥ 30% and	≥ 40% and	≥ 50% and	≥ 60% and	≥ 70% and	≥ 80%
	Design Supply Fan Airflow Rate (cfm)							
3C	NR	NR	NR	NR	NR	NR	NR	NR
0B, 1B, 2B, 3B, 4C, 5C	NR	≥ 19,500	≥ 9,000	≥ 5,000	≥ 4,000	≥ 3,000	≥ 1,500	> 0
0A, 1A, 2A, 3A, 4B, 5B	≥ 2,500	≥ 2,000	≥ 1,000	≥ 500	> 0	> 0	> 0	> 0
4A, 5A, 6A, 6B, 7, 8	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0

For SI: 1 cfm = 0.4719 L/s.

NR = Not required

C403.2.9 Duct and plenum insulation and sealing. Supply and return air ducts and plenums shall be insulated with a minimum of R-6 insulation where located in unconditioned spaces and where located outside the building with a minimum of R-8 insulation in *Climate Zones* ~~1~~ 0 through 4 and a minimum of 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 a minimum of R-8 insulation in *Climate Zones* ~~1~~ 0 through 4 and a minimum of 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*.

C403.3 Economizers (Prescriptive). Each cooling system shall include either an air or water economizer complying with Sections C403.3.1 through C403.3.4

Exceptions: Economizers are not required for the systems listed below.

1. In cooling systems for buildings located in Climate Zones 0A, 0B, 1A, and 1B.
2. In climate zones other than 0A, 0B, 1A, and 1B, where individual fan cooling units have a capacity of less than 54,000 Btu/h (15.8 kW) and meet one of the following:
   2.1. Have direct expansion cooling coils.
   2.2. The total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).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. 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.
4. Systems that serve residential spaces where the system capacity is less than five times the requirement listed in Table C403.3(1).
5. Systems expected to operate less than 20 hours per week.
6. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.
7. Where the cooling efficiency meets or exceeds the efficiency requirements in Table C403.3(2).
8. Chilled-water cooling systems that are passive (without a fan) or use induction where the total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).
9. Systems that include a heat recovery system in accordance with Section C403.4.5.

TABLE C403.3 (1)
MINIMUM CHILLED-WATER SYSTEM COOLING CAPACITY FOR DETERMINING ECONOMIZER COOLING REQUIREMENTS

CLIMATE ZONES (COOLING)	TOTAL CHILLED-WATER SYSTEM CAPACITY LESS CAPACITY OF COOLING UNITS WITH AIR ECONOMIZERS	
	Local Water-cooled Chilled-water Systems	Air-cooled Chilled-water Systems or District Chilled-Water Systems
0a, 1a	No economizer requirement	No economizer requirement
0b, 1b, 2a, 2b	960,000 Btu/h	1,250,000 Btu/h

3a, 3b, 3c, 4a, 4b, 4c	720,000 Btu/h	940,000 Btu/h
5a, 5b, 5c, 6a, 6b, 7, 8	1,320,000 Btu/h	1,720,000 Btu/h

For SI:1 British thermal unit per hour = 0.2931 W.

TABLE C403.3.3.3
HIGH-LIMIT SHUTOFF CONTROL SETTING FOR AIR ECONOMIZERS[b]

DEVICE TYPE	CLIMATE ZONE	REQUIRED HIGH LIMIT (ECONOMIZER OFF WHEN):	
		Equation	Description
Fixed dry bulb	0B, 1B, 2B, 3B, 3C, 4B, 4C, 5B, 5C, 6B, 7, 8	$T_{OA} > 75°F$	Outdoor air temperature exceeds 75°F
	5A, 6A	$T_{OA} > 70°F$	Outdoor air temperature exceeds 70°F
	0A, 1A, 2A, 3A, 4A	$T_{OA} > 65°F$	Outdoor air temperature exceeds 65°F
Differential dry bulb	0B, 1B, 2B, 3B, 3C, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8	$T_{OA} > T_{RA}$	Outdoor air temperature exceeds return air temperature
Fixed enthalpy with fixed dry-bulb temperatures	All	$h_{OA} > 28$ Btu/lb[a] or $T_{OA} > 75°F$	Outdoor air enthalpy exceeds 28 Btu/lb of dry air[a] or Outdoor air temperature exceeds 75°F
Differential enthalpy with fixed dry-bulb temperature	All	$h_{OA} > h_{RA}$ or $T_{OA} > 75°F$	Outdoor air enthalpy exceeds return air enthalpy or Outdoor air temperature exceeds 75°F

For SI: 1 foot = 305 mm, °C = (°F - 32)/1.8, 1 Btu/lb = 2.33 kJ/kg.

a. At altitudes substantially different than sea level, the fixed enthalpy limit shall be set to the enthalpy value at 75°F and 50-

percent relative humidity. As an example, at approximately 6,000 feet elevation, the fixed enthalpy limit is approximately 30.7 Btu/lb.

b. Devices with selectable setpoints shall be capable of being set to within 2°F and 2 Btu/lb of the setpoint listed.

C403.4.3.2 Fan speed control. The fan speed shall be controlled as provided in Sections C403.4.3.2.1 and C403.4.3.2.2.

C403.4.3.2.1 Fan motors not less than 7.5 hp. Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

Exception: The following fan motors over 7.5 hp (5.6 kW) are exempt:

1. Condenser fans serving multiple refrigerant circuits.
2. Condenser fans serving flooded condensers.
3. Installations located in *Climate Zones*0, 1, and 2.

Reason: This proposal updates the climate zones to correspond with the release of *ASHRAE Standard 169-2013, Climatic Data for Building Design Standards*. *Standard 169-2013* includes more-recent weather data and the creation of a new Climate Zone 0. Approximately 10% of the counties in the United States have a change in Climate Zone designation due to this change, with most of these changes resulting in a change to warmer climate zones. Generally, the new Climate Zone 0 is the hotter portion of the previous Climate Zone 1, which was the warmest climate zone. Cities in Climate Zone 0 include 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 hotter regions of Climate Zone 0.

Bibliography: ASHRAE Standard 169 - Climatic Data for Building Design Standards

Cost Impact: Will not increase the cost of construction
The addition of a new climate zone 0 does not increase the cost of construction. These areas were previously in cliamte zone 1. This proposal keeps the requirements the same as before.

CE52-16 : C402.1.2-FERGUSON12398

CE53-16

IECC: , C202 (New), C402.1.3, C402.1.4, C402.4.4, C407.5.1.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

NON-SWINGING DOOR. Roll-up, metal coiling, sliding, and other doors that are not swinging doors.

SECTION C202 DEFINITIONS

SWINGING DOOR. Operable opaque panels with hinges on one side and opaque revolving doors.

Revise as follows:

C402.1.3 Insulation component *R*-value-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. For opaque portions of the *building thermal envelope* intended to comply on an insulation component *R-value* basis, the *R*-values for insulation in framing cavities, where required, and for continuous insulation, where required, shall be not less than that specified in Table C402.1.3, based on the *climate zone* specified in Chapter 3. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *R*-values from the "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 from the "All other" column of Table C402.1.3. The thermal resistance or *R*-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope required in accordance with Table C402.1.3 shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below grade wall, whichever is less. Opaque ~~swinging~~ doors shall comply with Table C402.1.4 ~~and opaque nonswinging doors shall comply with Table C402.1.3~~.

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a],

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	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	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci

Metal building 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	R-30 + 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-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, above grade																
Mass	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	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	R-13+ R-19.5ci	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-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
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	R13 + R-15.6ci or R-20 + R-10ci	R13 + R-15.6ci or R-20 + R-10ci
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	R-10ci	R-10ci	R-12.5ci
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	R-15ci	R-16.7ci
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 f	R-30 f	R-30 f	R-30 f
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	R-15 for 24″ below	R-15 for 24″ below	R-20 for 24″ below
Heated slabs	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-10 for 24″ below	R-10 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-15 for 36″ below	R-15 for 36″ below	R-15 for 36″ below	R-20 for 48″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 48^{2}″below	R-20 for 48″ below
~~**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~~	~~R-4.75~~

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor-based method. 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. The C-factor for the below-grade exterior walls of the building envelope, as required in accordance with Table C402.1.4, shall extend to a depth of 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor, whichever is less. Opaque ~~swinging~~ doors shall comply with Table C402.1.4~~ and opaque nonswinging doors shall comply with Table C402.1.3~~.

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		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	All other	Grou 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	U-0.028	U-0.02
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	U-0.029	U-0.02
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	U-0.02
Walls, above grade																
Mass	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-0.061	U-0.061	U-0.06
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-0.03
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-0.057	U-0.064	U-0.052	U-0.045	U-0.04
Wood framed and otherc	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-0.03
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	C-0.092	C-0.09
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-0.057	U-0.055	U-0.051	U-0.055	U-0.05
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	U-0.033	U-0.03
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	F-0.4
Heated slabs[f]	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.58	F-0.55	F-0.55	F-0.55	F-0.5
Opaque doors																
Swinging	~~U-0.61~~U-0.370	~~U-0.61~~U-0.370	~~U-0.61~~U-0.370	U-0.61U-0.370	~~U-0.61~~U-0.370	~~U-0.61~~U-0.370	~~U-0.6~~1U-0.370	~~U-0.61~~U-0.370	U-0.370	U-0.370	U-0.370	U-0.370	U-0.370	U-0.370	U-0.370	U-0.37
Nonswinging[g]	U-0.310	U-0.310	U-0.310	U-0.310	U-0.310	U-0.310	U-0.310	U-0.310	U-0.310	U-0.310	U-0.310	U-0.310	U-0.310	U-0.310	U-0.310	U-0.31

For SI: 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U*-factors, C-factors, and *F*-factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

g. Nonswinging doors that are horizontally-hinged sectional doors having 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 that the *fenestrationarea* is not less than 14% and not more than 25% of the total *door area*

C402.4.4 Doors. *Opaque doors* shall comply with the applicable requirements for doors as specified in Tables C402.1.3 and C402.1.4 and be considered part of the gross area of above-grade walls that are part of the building *thermal envelope*. Other doors shall comply with the provisions of Section C402.4.3 for vertical fenestration.

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 interior side 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 <u>and Nonswinging</u>	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 glazing area; where the proposed glazing area is less than 40 percent of above-grade wall area. 2.40 percent of above-grade wall area; where the proposed glazing 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	Area 1.The proposed skylight area; where the proposed skylight area is less than 3 percent of gross area of roof assembly. 2.3 percent of gross area of roof assembly; where the proposed skylight area is 3 percent or more of gross area of roof assembly	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
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.4.2. 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 C405.5.2(2). Areas and dimensions of tradable and nontradable surfaces shall be the same as proposed.	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. All 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	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 C403.2.6.
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 C403.2.3(4) and C403.2.3(5)	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 C403.2.3(1), C403.2.3(2) and C403.2.3(3)	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	As proposed

	factors are provided than in the proposed design.	
	Economizerd : same as proposed, in accordance with Section C403.3.	As proposed
Service water heatinge	Fuel type: same as proposed	As proposed
	Efficiency: as specified in Table C404.2	For Group R, as proposed multiplied by SWHF. For other than Group R, 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 C403.3 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 C403.3.

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 unit efficiency · 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 unit efficiency · 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 unit efficiency · 0.26)].

4. Where Items 1 through 3 are not met, SWHF = 1.0.

Reason: This addendum revises the prescriptive criteria for doors in Tables C402.1.3 & C402.1.4. These criteria were developed using publicly available generic cost data and U-factors for this industry. Energy savings estimates and life cycle costing analysis were performed using the methodology used by the ASHRAE SSPC 90.1 envelope subcommittee. The U-factors in this proposal were proven to be cost effective using a scalar ratio of 21 for both high-rise residential and commercial (non-residential) space types.
The nonswinging door criteria was moved from the R-value criteria table, C402.1.3, to the U-factor criteria table, C402.1.4, to better prescribe the performance of the doors. The U-factor criteria format is better than the added R-

value format for doors that are metal with an insulated core. This format and the values are consistent with what will be in *ASHRAE 90.1-2016*.

The text related to moving the nonswinging door requirements from an R-value requirement to a U-factor requirement was changed in Sections C402.1.3 C402.1.4, and C402.4.4. The text in Table C407.5.1(1) was also changed to account for nonswinging doors.

Definitions for swinging and nonswinging doors were added for clarity.

Cost Impact: Will increase the cost of construction
There are now provisions for a product that were not covered in the IECC, which will increase the cost of construction.

CE53-16 : C402.1.3-FERGUSON12414

CE54-16

IECC: C402.1.3, C402.1.4.

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, ICF International, representing Energy Efficient Codes Coalition

2015 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a,]

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	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	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal building[b]	~~R-19 + R-11 LS~~ R-10 + R19 FC	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	R-30 + R-11 LS	R-30 + R-11 LS	~~R-30 + R-11 LS~~ R-25 + R-11 + R-11 LS	~~R-30 + R-11 LS~~ R-25 + R-11 + 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	~~R-49~~ R-60	~~R-49~~ R-60	~~R-49~~ R-60
Walls, above grade																
Mass	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
	R-13+	R-13 +	R13 +	R-13 +	R-13 +	R-13 +	R-13 +	~~R-13 + R-13ci~~	~~R-13 + R-~~	~~R-13 + R-13ci~~	~~R-13 + R-~~	~~R-13 + R-13ci~~	~~R-13 + R-~~	R-13+	~~R-13 + R-13ci~~	R-13+

Metal building	R-6.5ci	R-6.5ci	R-6.5ci	R-13ci	R-6.5ci	R-13ci	R-13ci	R-0 + R-19ci	~~13ci~~ R-0 + R-19ci	R-0 + R-19ci	~~13ci~~ R-0 + R-19ci	R-0 + R-19ci	~~13ci~~ R-0 + R-22.1ci	R-19.5ci	R-0 + R-25ci	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-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	R-13 + R-15.6ci	~~R-13 + R-7.5ci~~ R-13 + R-18.8ci	~~R-13+ R17.5ci~~ R-13 + R-18.8ci
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-19 + R-5ci	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	~~R13 + R-15.6ci or R-20 + R-10ci~~ R-13 + R-18.8ci	~~R13 + R-15.6ci or R-20 + R-10ci~~ R-13 + R-18.8ci
Walls, below grade																
Below-grade wall [d]	NR	NR	NR	NR	NR	NR	R-7.5ci	~~R-7.5ci~~ R-10ci	R-7.5ci	~~R-7.5ci~~ R-10ci	~~R-7.5ci~~ R-10ci	~~R-7.5ci~~ R-15ci	~~R-10ci~~ R-15ci	~~R-10ci~~ R-15ci	~~R-10ci~~ R-15ci	~~R-12.5ci~~ R-15ci
Floors																
Mass [e]	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	~~R-10ci~~ R-14.6ci	~~R-10.4ci~~ R-16.7ci	~~R-10ci~~ R-14.6ci	~~R-12.5ci~~ R-16.7ci	~~R-12.5ci~~ R-16.7ci	~~R-12.5ci~~ R-16.7ci	~~R-15ci~~ R-20.9ci	~~R-16.7ci~~ R-20.9ci	~~R-15ci~~ R-23ci	~~R-16.7ci~~ R-23ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	~~R-30~~ R-38	~~R-30 [f]~~ R-38	~~R-30 [f]~~ R-38	~~R-30 [f]~~ R-38	~~R-30 [f]~~ R-38	~~R-30 [f]~~ R-38

Slab-on-grade floors																
Unheated slabs	NR	NR	NR	NR	NR	~~NR~~ R-10 for 24" below	~~R-10 for 24″ below~~ R-15 for 24" below	~~R-10 for 24″ below~~ R-15 for 24" below	~~R-10 for 24″ below~~ R-15 for 24" below	~~R-10 for 24″ below~~ R-20 for 24" below	~~R-10 for 24″ below~~ R-20 for 24" below	~~R-15 for 24″ below~~ R-20 for 48" belwo	~~R-15 for 24″ below~~ R-20 for 24" below	~~R-15 for 24″ below~~ R-20 for 48" below	~~R-15 for 24″ below~~ R-20 for 48" below	~~R-20 for 24″ below~~ R-25 for 48" below
Heated slabs	R-7.5 for 12″ below	R-7.5 for 12″ below	~~R-7.5 for 12″ below~~ R-10 for 24" below	~~R-7.5 for 12″ below~~ R-15 for 24" below	~~R-10 for 24″ below~~ R-15 for 24" below	~~R-10 for 24″ below~~ R-15 for 24" below	~~R-15 for 24″ below~~ R-20 for 24" below	~~R-15 for 24″ below~~ R-20 for 48" below	~~R-15 for 36″ below~~ R-20 for 48" below	~~R-15 for 36″ below~~ R-20 for 48" below	~~R-15 for 36″ below~~ R-20 for 48" below	~~R-20 for 48″ below~~ R-25 for 48" below	~~R-20 for 24″ below~~ R-25 for 48" below	~~R-20 for 48″ below~~ R-25 for 48" below	~~R-20 for 48″below~~ R-25 for 48" below	~~R-20 for 48″ below~~ R-20 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	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

ci = Continuous insulation, NR = No requirement, LS = Liner system, FC = Filled cavity.

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or
2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

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		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	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	U-0.028	U-0.028
Metal buildings	~~U-0.044~~ U-0.041	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	~~U-0.029~~ U-0.026	~~U-0.029~~ U-0.026
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	~~U-0.021~~ U-0.017	~~U-0.021~~ U-0.017
Walls, above grade																
Mass	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-0.061	~~U-0.061~~ U-0.048	~~U-0.061~~ U-0.048
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-0.050	~~U-0.052~~ U-0.050	~~U-0.052~~ U-0.050	~~U-0.052~~ U-0.050	~~U-0.052~~ U-0.050	~~U-0.052~~ U-0.044	U-0.039	~~U-0.052~~ U-0.039	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-0.055	~~U-0.064~~ U-0.055	~~U-0.064~~ U-0.049	~~U-0.057~~ U-0.049	~~U-0.064~~ U-0.049	~~U-0.052~~ U-0.042	~~U-0.045~~ U-0.037	~~U-0.045~~ U-0.037
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-0.051	~~U-0.064~~ U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	~~U-0.036~~ U-0.032	~~U-0.036~~ U-0.032
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-0.092	C-0.119	~~C-0.119~~ C-0.092	~~C-0.119~~ C-0.092	~~C-0.119~~ C-0.063	~~C-0.092~~ C-0.063	~~C-0.092~~ C-0.063	~~C-0.092~~ C-0.063	~~C-0.092~~ C-0.063
Floors																

Mass[d]	U-0.322[e]	U-0.322[e]	U-0.107	U-0.087	~~U-0.076~~ U-0.074	~~U-0.076~~ U-0.074	~~U-0.076~~ U-0.057	~~U-0.074~~ U-0.051	~~U-0.074~~ U-0.057	~~U-0.064~~ U-0.051	~~U-0.064~~ U-0.051	~~U-0.057~~ U-0.051	~~U-0.055~~ U-0.042	~~U-0.051~~ U-0.042	~~U-0.055~~ U-0.038	~~U-0.051~~ U-0.038
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-0.027[g]	~~U-0.033~~ U-0.027[g]	~~U-0.033~~ U-0.027[g]	~~U-0.033~~ U-0.027[g]	~~U-0.033~~ U-0.027[g]	~~U-0.033~~ U-0.027[g]
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~~ F-0.54[e]	~~F-0.54~~ F-0.52	~~F-0.54~~ F-0.52	~~F-0.54~~ F-0.52	~~F-0.54~~ F-0.51	~~F-0.54~~ F-0.51	~~F-0.52~~ F-0.434	F-0.40	F-0.40	F-0.40	F-0.40
Heated slabs[f]	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.58	F-0.55	F-0.55	F-0.55	~~F-0.55~~ F-0.373
Opaque doors																
Swinging	U-0.61	~~U-0.61~~ U-0.50	U-0.61	~~U-0.61~~ U-0.50	U-0.61	~~U-0.61~~ U-0.50	~~U-0.61~~ U-0.50	~~U-0.61~~ U-0.50	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37

For SI: 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U*-factors, C-factors, and *F*-factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

g. Steel floor joist systems shall be insulated to U-0.032.

Reason: The purpose of this proposed code change is to improve energy efficiency by making the commercial building opaque envelope as efficient as under ASHRAE 90.1-2013 in instances where ASHRAE 90.1 requirements are more stringent than the 2015 IECC. As a result, we have compared the 90.1 and IECC requirements and replaced the IECC requirements with ASHRAE values where the IECC values are less stringent. In cases where the IECC values are already equal to or more stringent, we have retained the IECC values to avoid any rollbacks.

U.S. DOE has evaluated the costs of compliance with ASHRAE 90.1-2013 and found that the improvements were cost-effective. *See* R. Hart, et. al., *National Cost-Effectiveness of ANSI/ASHRAE/IES Standard 90.1-2013* (Jan. 2015), https://www.energycodes.gov/sites/default/files/documents/Cost-effectiveness_of_ASHRAE_Standard_90-1-2013-Report.pdf.

Cost Impact: Will increase the cost of construction
The improvement to U-factors, F-factors, and R-values will increase the cost of construction. However, the values selected represent efficiencies used in ASHRAE 90.1-2013 that have been found to be cost-effective by the U.S. DOE in code determinations.

CE54-16 : C402.1.3-FAY12804

CE55-16

IECC: C402.1.3, C402.1.4, C402.2.4 (New), C402.4.4.

Proponent : Hope Medina, representing Colorado Chapter of ICC (hmedina@coloradocode.net)

2015 International Energy Conservation Code

Revise as follows:

C402.1.3 Insulation component *R*-value-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. For opaque portions of the *building thermal envelope* intended to comply on an insulation component *R-value* basis, the *R*-values for insulation ~~in framing cavities, where required, and for continuous insulation, where required,~~ shall be not less than that specified in Table C402.1.3~~, based on the *climate zone* specified in Chapter 3~~. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *R*-values from the "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 from the "All other" column of Table C402.1.3.~~ The thermal resistance or *R*-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope required in accordance with Table C402.1.3 shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below-grade wall, whichever is less. Opaque swinging doors shall comply with Table C402.1.4 and opaque nonswinging doors shall comply with Table C402.1.3.~~

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor-based method. 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.~~ The C-factor for the below-grade exterior walls of the building envelope, as required in accordance with Table C402.1.4, shall extend to a depth of 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor, whichever is less. Opaque swinging doors shall comply with Table C402.1.4 and opaque nonswinging doors shall comply with Table C402.1.3.~~

Add new text as follows:

<u>**C402.2.4 Below-grade walls** The C-factor for the below grade exterior walls shall be in accordance with Table C402.1.4. The R-value of the insulating material installed continuously within or on the below grade exterior walls of the building envelope shall be in accordance with Table C402.1.3. The C- factor or R-value required shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below grade wall, whichever is less.</u>

Revise as follows:

C402.4.4 Doors. ~~*Opaque doors*~~<u>Opaque swinging doors</u> shall comply with ~~the applicable requirements for doors as specified in Tables C402.1.3 and~~ <u>Table</u> C402.1.4 and<u> *opaque roll-up or sliding doors* shall comply with Table C402.1.3. All opaque doors shall </u>be considered part of the gross area of above-grade walls that are part of the building *thermal envelope*. Other doors shall comply with the provisions of Section C402.4.3 for vertical fenestration.

Reason: Prior to the 2015 edition fo the Energy Code it was understood by the code user that each component of the building's thermal envelope that is found in current Tables C402.1.3 and C402.1.4 had their own code section in addition to the table so you knew to find all additional requirements for the components in those individual code sections. In the 2015 the code section for below grade walls went away and is buried deep within Sections C402.1.3 and C402.1.4 along with some duplicative information for opaque doors. No other envelope components are dealt with in these sections so why did we do away with the code section on below grade walls all together and bury it in a code section that just covers general information.
This proposal is intended to take the code back to the way it was in previous version where you could find all of the requirements for a building envelope component by looking in the table plus the component's corresponding code sections. As it reads now, very few people will find what they are looking for regarding below grade walls because the section was removed and they would not think to look in the general "method" section, which just tells people which table to be used based on which method they chose.

The information on opaque doors was removed because it was duplicative. The code section on doors, C402.4.4, already specified the requirement for the opaque doors. We did change C402.4.4 to include the wording from C402.1.3 and C402.1.4 as it was a little more specific.

When you look for the requirements of a building envelope component you should be able to find a code section specifically addressing that component, as has always been the case in past editions. It should not be buried in a code section that is addressing something else.

Our Theme: A Code for the End User

Is the code section completely understandable to the end user?

Is the code section or requirement easy to find?

Is the code requirement even doable in the real world?

Will the code requirement really save energy or only on paper?

Cost Impact: Will not increase the cost of construction
This is just a reorganization of requirements that are already in the code, so there for would not cause an increase of cost.

CE55-16 : C402.1.3-MEDINA12921

CE56-16

IECC: C402.1.3, C402.1.4, C402.2.4 (New).

Proponent : Hope Medina, Cherry Hills Village, representing Colorado Chapter of ICC (hmedina@coloradocode.net)

2015 International Energy Conservation Code

Revise as follows:

C402.1.3 Insulation component *R*-value-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. For opaque portions of the *building thermal envelope* intended to comply on an insulation component *R-value* basis, the *R*-values for insulation in framing cavities, where required, and for continuous insulation, where required, shall be not less than that specified in Table C402.1.3, based on the *climate zone* specified in Chapter 3. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *R*-values from the "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 from the "All other" column of Table C402.1.3.~~ The thermal resistance or *R*-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope required in accordance with Table C402.1.3 shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below grade wall, whichever is less. Opaque swinging doors shall comply with Table C402.1.4 and opaque nonswinging doors shall comply with Table C402.1.3.~~

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor-based method. 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.~~ The C-factor for the below-grade exterior walls of the building envelope, as required in accordance with Table C402.1.4, shall extend to a depth of 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor, whichever is less. Opaque swinging doors shall comply with Table C402.1.4 and opaque nonswinging doors shall comply with Table C402.1.3.~~

Add new text as follows:

<u>**C402.2.4 Below-grade walls** The C-factor for the below grade exterior walls shall be in accordance with Table C402.1.4. The R-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope shall be in accordance with Table C402.1.3. The C-factor or R-value required shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below grade wall, whichever is less.</u>

Reason: Prior to the 2015 edition of the Energy Code it was understood by the code user that each component of the building's thermal envelope that is found in current Tables C402.1.3 and C402.1.4 had their own code section in addition to the table so you knew to find all additional requirements for the components in those individual code sections. In the 2015 the code section for below grade walls went away and is buried deep within Sections C402.1.3 and C402.1.4 along with some duplicative information for opaque doors. No other envelop components are dealt with in these sections so why did we do away with the code section on below grade walls all together and bury it in a code section that just covers general information.

This proposal is intended to take the code back to the way it was in previous version where you could find all of the requirements for a building envelope component by looking in the table plus the component's corresponding code section. As it reads now, very few people will find what they are looking for regarding below grade walls because the section was removed and they will not think to look in the general "method" section, which just tells people which tables to be used based on which method they choose.

Cost Impact: Will not increase the cost of construction
reorganizing existing text

CE56-16 : C402.1.3-MEDINA13126

CE57-16
IECC: C402.1.3, C402.1.4.

Proponent : Tom Kositzky, Coalition for Fair Energy Codes, representing Coalition for Fair Energy Codes; Mark Halverson, representing APA (mark.halverson@apawood.org); Loren Ross, representing American Wood Council (LRoss@awc.org); Greg Johnson, representing Coalition for Fair Energy Codes (gjohnsonconsulting@gmail.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a,]

CLIMATE ZONE		5 AND MARINE 4	
		All other	Group R
Walls, above grade			
Metal framed		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-7.5ci or R-20 + R-3.8ci~~ <ins>R-13 + R-3.8ci or R-20</ins>

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m ^{2} , 1 pound per cubic foot = 16 kg/m ^{3} .

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD[a, b]

CLIMATE ZONE		5 AND MARINE 4	
		All other	Group R
Walls, above grade			
Metal framed		U-0.064	U-0.064
Wood framed and otherc		U-0.064	U-0.064

For SI: 1 pound per square foot = 4.88 kg/m ^{2} , 1 pound per cubic foot = 16 kg/m ^{3} .

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U* -factors, C-factors, and *F* -factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

Reason: The above-grade metal framed and wood framed wall U-factors are identical for Climate Zone 5 and Marine 4. However, there is one cell for Climate Zone 5 and Marine 4 in table C402.1.3 that is not in alignment with the U-factors for this climate zone. This proposal simply corrects that discrepancy and brings the R-value requirements for Group R wood buildings into alignment with the other seven cells of metal and wood framed U-factors and R-values in Climate Zone 5 and Marine 4 in Table C402.1.3.

Cost Impact: Will not increase the cost of construction
The change is only to align the R-value with the already established U-factors.

CE57-16 : TABLE C402.1.3-KOSITZKY12444

CE58-16

IECC: C402.1.3, C402.1.4.

Proponent : Tom Kositzky, Coalition for Fair Energy Codes, representing Coalition for Fair Energy Codes; Greg Johnson, representing Coalition for Fair Energy Codes (gjohnsonconsulting@gmail.com); Loren Ross, representing American Wood Council (LRoss@awc.org); Mark Halverson, representing APA (mark.halverson@apawood.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a,]

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	All other	Group R
Walls, above grade																
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-10.3ci	~~R-13 + R-7.5ci~~ R-13 + R-10.3ci	~~R-13 + R-7.5ci~~ R-13 + R-15.6ci	R-13 + R-15.6ci	~~R-13 + R-7.5ci~~ R-13 + R-17.5ci	R-13+ R17.5ci
Wood framed and other	~~R-13 + R-3.8ci or R-20~~ R-13 + R-2.0ci or R-18	~~R-13 + R-3.8ci or R-20~~ R-13 + R-2.0ci or R-18	~~R-13 + R-3.8ci or R-20~~ R-13 + R-2.0ci or R-18	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-3.8ci or R-	~~R-13 + R-7.5ci or R-20 + R-3.8ci~~ R-13 + R6ci or R-18 + R2.0ci	~~R-13 + R-7.5ci or R-20 + R-3.8ci~~ R-13 + R6ci or R-18 + R2.0ci or R24	~~R-13 + R-7.5ci or R-20 + R-3.8ci~~ R-13 + R-7.5ci or R-20 + R3.0ci	~~R-13 + R-7.5ci or R-20 + R-3.8ci~~ R-13 + R-7.5ci or R-20 + R3.0ci or R-	~~R13 + R-15.6ci or R-20 + R-10ci~~ R-13 + R-10ci or R-18 + 6.0ci	~~R13 + R-15.6ci or R-20 + R-10ci~~ R-13 + R-10ci or R-18 + 6.0ci

										20	or R24		or R-26	26	or R-30	or R-30

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

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		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	All other	Group R
Walls, above grade																
~~Metal framed~~ Metal and wood framed walls and other[c]	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-0.057	U-0.057	~~U-0.064~~ U-0.052	U-0.052	U-0.045	U-0.045
~~Wood framed and other~~	~~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/m^2, 1 pound per cubic foot = 16 kg/m^3.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U*-factors, C-factors, and *F*-factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

Reason: The preface of the IECC states (emphasis added): "This code is founded on principles intended to establish provisions consistent with the scope of an energy conservation code that **adequately conserves energy**; provisions that **do not unnecessarily increase construction costs**; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that **do not give preferential treatment to particular types or classes of materials, products or methods of construction**."

Tables C402.1.3 and C402.1.4 of the IECC prescribe less energy efficient requirements for metal framed walls than for wood framed and other above grade walls. This bias is found in the higher U-factors in Climate Zones 1-2 and 6-8 in Table C402.1.4 and, correspondingly, in the lower R-value requirements for Climate Zones 1-2 and Zones 5 Group R through 8 in Table C402.1.3. In order to eliminate this preferential treatment for a specific material class, the proposal assigns all above grade framed walls within the same climate zone the same U-factors in Table C402.1.4 and adjusts the corresponding insulation components in Table C402.1.3 accordingly.

This proposal establishes a single U-factor row for "Framed and Other" above grade walls that covers both wood and metal framing in Table C402.1.4. According to the Pacific Northwest National Laboratory's (PNNL) methodology used to determine the energy cost savings of the 2015 IECC, the proposal results in a slight improvement in national energy savings. Also, according to PNNL's methodology, metal frame buildings constitute the majority of the framed wall commercial building stock, so a change in energy performance for metal framed walls has more impact and is therefore more heavily weighted.

To maintain material neutrality, and because of the greater weighted impact on energy savings, the proposed values are closer to the metal values than the wood values, especially in climate zones where little wood is used. For the three metal frame cell changes in Climate Zones 6-7, the more conservative (Group R) U-factors are used in order to maintain a slightly better than energy-neutral performance. See table below for changes in overall UA for each climate zone weighted by construction volume. (Positive percentages represent an increase in total UA. Negative percentages represent a decrease in total UA and in increase in energy efficiency.)

The R-values in Table C402.1.3 are adjusted to match the U-factors. Both continuous insulation (c.i.) and new cavity insulation-only R-values are provided in Table C402.1.3 for wood frame walls where they previously didn't exist, so that there is now a c.i. *and* cavity-only insulation option for every climate zone. The insulation for metal framed walls in Climate Zone 8 was also adjusted to match the existing Climate Zone 8 U-factor.

Total UA Analysis Using PNNL Methodology[1]

Climate Zone	U-Factors			%ΔUA weighted by construction volume[2]
	Current Wood	Current Metal	Proposed	
1	0.064	0.077	0.077	0.1%
2A – All Other	0.064	0.077	0.077	0.4%
2B – All Other	0.064	0.077	0.077	0.5%
3-5	0.064	0.064	0.064	0.0%
6A	0.051	0.064 or 0.057	0.057	-10.6%
6B	0.051	0.064 or 0.057	0.057	-10.6%
7	0.051	0.064 or 0.052	0.052	-18.5%
8	0.036	0.045	0.045	0.3%
National Weighted Average %ΔUA				-0.4%

[1]Energy and Energy Cost Saving Analysis of the 2015 IECC for Commercial Buildings the Pacific Northwest National Laboratory J Zhang, et al. Aug 2015.

(https://www.energycodes.gov/sites/default/files/documents/2015_IECC_Commercial_Analysis.pdf)

[2]Positive percentages represent an increase in total UA. Negative percentages represent a decrease in total UA and an increase in energy efficiency.

Cost Impact: Will increase the cost of construction
The proposal will increase the cost of construction in some climate zones and decrease constructions costs in others. Buildings constructed with wood framed and other walls in Climate Zones 1,2, and 6-8 will likely see a minimal cost savings due to small reductions in continuous insulation or cavity insulation. Metal framed walls in Climate Zone 6 will have minimal cost increases due to only small increases of continuous insulation. Only in Climate Zones 7 and in 8 Other (where a much smaller number of buildings are constructed) is significantly thicker and more costly continuous insulation required.

CE58-16 : TABLE C402.1.3-KOSITZKY12624

CE59-16

IECC: C402.1.3, C402.1.4.

Proponent : Tom Kositzky, Coalition for Fair Energy Codes, representing Coalition for Fair Energy Codes; Mark Halverson, representing APA (mark.halverson@apawood.org); Loren Ross, representing American Wood Council (LRoss@awc.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a],

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	All other	Group R
Walls, above grade																
Wood framed and other	~~R-13 + R-3.8ci or R-20~~ R-13 + 2.0ci or R-18	~~R-13 + R-3.8ci or R-20~~ R-13 + R2.0ci or R-18	~~R-13 + R-3.8ci or R-20~~ R-13 + 2.0ci or R-18	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-3.8ci or R-20	~~R-13 + R-7.5ci or R-20 + R-3.8ci~~ R-13 + R-3.8ci or R-20	~~R-13 + R-7.5ci or R-20 + R-3.8ci~~ R-13 + R6.0ci or R-18 + R2.0ci or R24	~~R-13 + R-7.5ci or R-20 + R-3.8ci~~ R-13 + R-3.8ci or R-20	~~R-13 + R-7.5ci or R-20 + R-3.8ci~~ R-13 + R7.0ci or R-20 + 3.0ci or R26	~~R13 + R-15.6ci or R-20 + R-10ci~~ R-13 + R10ci or R-18 + 6.0ci or R30	~~R13 + R-15.6ci or R-20 + R-10ci~~ R-13 + R10ci or R-18 +6.0ci or R30

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

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		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	All other	Group R
Walls, above grade																
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-0.057	U-0.064	U-0.052	U-0.045	U-0.045
Wood framed and other	~~U-0.064~~ U-0.077	~~U-0.064~~ U-0.077	~~U-0.064~~ 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-0.051~~ U-0.064	~~U-0.051~~ U-0.057	~~U-0.051~~ U-0.064	~~U-0.051~~ U-0.052	~~U-0.036~~ U-0.045	~~U-0.036~~ U-0.045

For SI: 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U*-factors, C-factors, and *F*-factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

Reason: The preface of the IECC states (emphasis added): "This code is founded on principles intended to establish provisions consistent with the scope of an energy conservation code that **adequately conserves energy;** provisions that **do not unnecessarily increase constructions costs**; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that **do not give preferential treatment to particular types or classes of materials, products or methods of construction**.

Tables C402.1.3 and C402.1.4 of the IECC prescribe requirements for metal framed w alls that are less energy efficient than those for w ood framed and other above grade w alls. This unfair bias is found in the higher U-factors in Climate Zones 1,2 and 6 through 8 in Table C402.1.4 and correspondingly as minimum insulation components in Climate Zones 1,2 and 5 Group R through 8. In order to eliminate this preferential treatment for a class of material, w e propose that w ood framed and other above grade w alls be assigned the same U-factors w ithin the same climate zone in Table C402.1.4 as metal framed above grade w alls and that the corresponding insulation components in Table C402.1.3 be adjusted accordingly.

This proposal adjusts the U-factors in Climate Zones 1,2A and 6-8 of w ood framed and other w all to the same U-factors as metal framed w alls. The corresponding insulation components listed in Table C402.1.3 reflect the changes in the U-factors.

1. In the mild climate zones of 1 and 2A, insulation is reduced from R-13 + 3.8ci to R-13 + 2.0ci.
2. In Climate Zone 6A insulation is reduced from R-20 + 3.8ci to R-20 and in 6R from R-20 + 3.8ci to R-18 + 2.0ci.
3. In Climate Zone 7A insulation is reduced from R-20 + 3.8ci to R-20 and in 7R from R20 + 3.8ci to R-20 + 3.0ci.
4. In Climate Zone 8 insulation is reduced from R-20 + 10.0ci to R-18 + 6.0ci.

This code change eliminates the preferential treatment of a particular material and returns equity to the treatment of all **above grade** frame w alls w hile maintaining the level of energy efficiency established for metal framed w alls. Consistent w ith the principles of the code, requirements for metal frame w alls that adequately save energy w ill adequately save energy w hen applied to w ood frame and other w alls as w ell. The requirements for metal framed above grade w alls remain unchanged in both Tables C402.1.3 and C402.1.4.

Total UA Analysis Using PNNL Methodology[1]

Climate Zone	U-Factors			%ΔUA weighted by construction volume[2]
	Current Wood	Current Metal	Proposed	
1	0.064	0.077	0.077	0.1%
2A – All Other	0.064	0.077	0.077	0.4%
2B – All Other	0.064	0.077	0.077	0.5%
3-5	0.064	0.064	0.064	0.0%
6A	0.051	0.064 or 0.057	0.057	2.3%
6B	0.051	0.064 or 0.057	0.057	2.1%
7	0.051	0.064 or 0.052	0.052	0.3%
8	0.036	0.045	0.045	0.3%
National Weighted Average %ΔUA				0.16%

[1]Energy and Energy Cost Saving Analysis of the 2015 IECC for Commercial Buildings the Pacific Northwest National Laboratory J Zhang, et al. Aug 2015

(https://www.energycodes.gov/sites/default/files/documents/2015_IECC_Commercial_Analysis.pdf)

[2]Positive percentages represent an increase in total UA. Negative percentages represent a decrease in total UA and in increase in energy efficiency.

Cost Impact: Will not increase the cost of construction
This proposal w ill not increase the cost of construction as w ood framed and other w alls w ill likely see a minimal cost savings due to small reductions in continuous insulation or cavity insulation. In Climate Zones 1 and 2A, the insulation requirements decreased from R20 to R18 maintaining 2x6 framing w hich w ould have a small reduction in materials costs. In Climate Zones 6 and 7, there is a reduction of continuous insulation by R-3.7 in continuous

insulation in "all other" buildings and only R-1.5 in "residential" buildings. In Climate Zone 8, there was a reduction of R-5.6 in continuous insulation for all buildings.

CE59-16 : TABLE C402.1.3-KOSITZKY12697

CE60-16

IECC: C402.1.3, C402.1.4, R402.1.2.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a, g]

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	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	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal building 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	R-30 + 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-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, above grade																
Mass	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	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	R-13+ R-19.5ci	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-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
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	R13 + R-15.6ci or R-20 + R-10ci	R13 + R-15.6ci or R-20 + R-10ci
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	R-10ci	R-10ci	R-12.5ci
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	R-15ci	R-16.7ci
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 [f]	R-30 [f]	R-30 [f]	R-30 [f]
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	R-15 for 24″ below	R-15 for 24″ below	R-20 for 24″ below
Heated slabs	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-10 for 24″ below	R-10 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-15 for 36″ below	R-15 for 36″ below	R-15 for 36″ below	R-20 for 48″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 48[2]″below	R-20 for 48″ below
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	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

g. 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		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	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	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	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	U-0.021

Walls, above grade																
Mass	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-0.061	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-0.057	U-0.064	U-0.052	U-0.045	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
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	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-0.057	U-0.055	U-0.051	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	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	F-0.40	F-0.40
Heated slabs[f]	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.58	F-0.55	F-0.55	F-0.55	F-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	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	U-0.31	U-0.31

For SI: 1 pound per square foot = 4.88 kg/m ^{2}, 1 pound per cubic foot = 16 kg/m ^{3}.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U* -factors, C-factors, and *F* -factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

TABLE R402.1.2
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT WHERE PART OF THE THERMAL ENVELOPE[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR [b]	SKYLIGHT [b] *U*-FACTOR	GARAGE DOOR *U*-FACTOR <14% glazing	GLAZED FENESTRATION SHGC [b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE [i]	FLOOR *R*-VALUE	BASEMENT [c] WALL *R*-VALUE	SLAB [d] *R*-VALUE & DEPTH	CRAWL SPACE [c] WALL *R*-VALUE
1	NR	0.75	0.31	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.31	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.31	0.25	38	20 or 13+5 [h]	8/13	19	5/13 [f]	0	5/13
4 except Marine	0.35	0.55	0.31	0.40	49	20 or 13+5 [h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	0.31	NR	49	20 or 13+5 [h]	13/17	30 [g]	15/19	10, 2 ft	15/19
6	0.32	0.55	0.31	NR	49	20+5 or 13+10 [h]	15/20	30 [g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	0.31	NR	49	20+5 or 13+10 [h]	19/21	38 [g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

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

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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

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

g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

Reason: The purpose of this proposal is primarily aimed at establishing appropriate *U*-Factors for garage doors.
* Garage doors should be subjected to assembly U-factor requirements, therefore component R-value should not apply to such doors - This is accomplished, in part, by the proposed footnote to Table C402.1.3..

* Window and glass door U-factors should be separated from garage door U-factors - this is accomplished in Table C402.1.4 by establishing 2 separate rows.

* The new garage door maximum U-factor values with the glazing percentage limitation are intended to address garage doors without glazing, in their own category separate and distinct from windows and glass doors. The 0.31 maximum value encompasses the common use of either polystyrene or polyurethane foam insulation in garage door sections, and is based on ASHRAE and DASMA research testing conducted since 2004. Garage doors with one full row or more of door section glazing typically constitute 14% or more in door glazing and should be subject to the fenestration U-factor requirements.

* The title change to Table R402.1.2 (N1102.1.2) is to clarify the application of the entire Table content as charged in Section R402.1 (N1102.1). The title change is also intended for consistency with non-residential applications.

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
No effect on cost, because the affected products will simply have a better and more reliable means of complying with code requirements.

CE60-16 : TABLE C402.1.3-COLLINS11779

CE61-16

IECC: C402.1.3, C402.1.4.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a,]

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	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	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal building 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	R-30 + 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-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, above grade																
Mass	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	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	R-13+ R-19.5ci	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-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
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	R13 + R-15.6ci or R-20 + R-10ci	R13 + R-15.6ci or R-20 + R-10ci
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	R-10ci	R-10ci	R-12.5ci

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	R-15ci	R-16.7ci
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 [f]	R-30 [f]	R-30 [f]	R-30 [f]
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	R-15 for 24″ below	R-15 for 24″ below	R-20 for 24″ below
Heated slabs	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-10 for 24″ below	R-10 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-15 for 36″ below	R-15 for 36″ below	R-15 for 36″ below	R-20 for 48″ below	R-20 for ~~24~~48″ below	R-20 for 48″ below	R-20 for 48^2″below	R-20 for 48″ below
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	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

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		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	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	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	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	U-0.021
Walls, above grade																
Mass	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-0.061	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-0.057	U-0.064	U-0.052	U-0.045	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
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	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-0.057	U-0.055	U-0.051	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	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~~ 0.52	F-~~0.40~~ 0.52	F-~~0.40~~ 0.52	F-~~0.40~~ 0.51
Heated slabs[f]	F-1.02 ~~0.70~~	F-1.02 ~~0.70~~	F-1.02 ~~0.70~~	F-1.02 ~~0.70~~	F-0.90 ~~0.70~~	F-0.90 ~~0.70~~	F-0.86 ~~0.65~~	F-0.86 ~~0.65~~	F-0.79 ~~0.65~~	F-0.79 ~~0.65~~	F-0.79 ~~0.58~~	F-0.69 ~~0.58~~	F-0.69 ~~0.55~~	F-0.69 ~~0.55~~	F-0.69 ~~0.55~~	F-0.69 ~~0.55~~
Opaque doors																
Swinging	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	U-0.37	U-0.37

For SI: 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U* -factors, C-factors, and *F* -factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

~~f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.~~

Reason: The R-value criteria in Table C402.1.3 for heated slab-on-grade floor insulation requirements for Climate Zone 7, all other, is being corrected to make it consistent with the other values for Climate Zones 7 and 8. It is being changed from R-20 for 24 in. to R-20 for 48 in.

The F-factors for unheated slabs and heated slabs in Table C402.1.4 have been corrected.

- For unheated slabs, the values for R-15 for 24 in. from Table C402.1.3 have been corrected to 0.52. Note that for Climate Zone 6, Group R this was correct. For R-20 for 24 in. in Table C402.1.3 the value has been corrected to 0.51.
- For heated slabs, all of the F-factors were incorrect when compared to the R-value requirements in Table C402.1.3. Note that footnote (f) indicated that unheated slab F-factors shall be used rather than heated slab F-factors. This is not technically correct and is therefore confusing; heated slab F-factors should be used for heated slabs. Therefore, footnote (f) is being deleted. The corrected values are the heated slab F-factors that match the heated slab R-values in Table C402.1.3. Note that these values had to be corrected with or without footnote (f); they were incorrect either way. Heated slab F-factors are greater than unheated slab F-factors due to the greater heat loss through heated slabs.

R-values and their corresponding F-factors can be found in Table A6.3.1 in ASHRAE 90.1-2013. The values used here are for vertical insulation. This is consistent with the requirements in C402.2.5 which explains slab-on-grade perimeter insulation requirements.

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will increase the cost of construction

To the extent that the existing values were incorrect and the corrected values result in more insulation, then construction costs would be slightly higher.

CE61-16 : TABLE C402.1.3-COLLINS11892

CE62-16

IECC: C402.1.3, C402.1.4, C402.2.5, C402.2.6.

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

2015 International Energy Conservation Code

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a],

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	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	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal building [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	R-30 + 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-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, above grade																
Mass	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	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	R-13+ R-19.5ci	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-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
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	R13 + R-15.6ci or R-20 + R-10ci	R13 + R-15.6ci or R-20 + R-10ci
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	R-10ci	R-10ci	R-12.5ci

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	R-15ci	R-16.7ci
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 [f]	R-30 [f]	R-30 [f]	R-30 [f]
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	R-15 for 24″ below	R-15 for 24″ below	R-20 for 24″ below
Heated slabs	~~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-7.5 full slab	~~R-15 for 24″ below~~ R-7.5 full slab	~~R-15 for 36″ below~~ R-7.5 full slab	~~R-15 for 36″ below~~ R-7.5 full slab	~~R-15 for 36″ below~~ R-10 full slab	~~R-20 for 48″ below~~ R-10 full slab	~~R-20 for 24″ below~~ R-10 full slab	~~R-20 for 48″ below~~ R-10 full slab	~~R-20 for 48²″below~~ R-10 full slab	~~R-20 for 48″ below~~ R-10 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	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m ^{2}, 1 pound per cubic foot = 16 kg/m ^{3}.

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 C 90, 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~~ above-grade mass walls.

e. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

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		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	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	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	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	U-0.021
Walls, above grade																
Mass	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-0.061	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-0.057	U-0.064	U-0.052	U-0.045	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
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	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-0.057	U-0.055	U-0.051	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	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	F-0.40	F-0.40
Heated slabs~~f~~	~~F-0.70~~ F-0.74	~~F-0.70~~ F0.74	~~F-0.70~~ F-0.74	~~F-0.70~~ F-0.74	~~F-0.70~~ F-0.74	~~F-0.70~~ F-0.74	~~F-0.65~~ F-0.64	~~F-0.65~~ F-0.64	~~F-0.65~~ F-0.64	~~F-0.65~~ F-0.64	~~F-0.58~~ F-0.55	~~F-0.58~~ F-0.55	F-0.55	F-0.55	F-0.55	F-0.55
Opaque doors																
Swinging	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	U-0.37	U-0.37

For SI: 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U* -factors, C-factors, and *F* -factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 ~~F-factor~~ U-factor requirements for ~~heated slabs~~ above-grade mass walls.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

Revise as follows:

C402.2.5 Slabs-on-grade~~ perimeter insulation~~. ~~Where the slab on grade is in contact with the ground, the~~
The minimum thermal resistance (*R*-value) o~~f the insulation around the perimeter of 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~~ Where required for unheated slabs, 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 a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least 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 required for heated slabs, the full slab insulation shall be continuous under the entire area of the slab-on-grade floor, except at structural column locations and service penetrations. Perimeter insulation and full slab insulation shall be continuous with above-grade wall or below-grade wall insulation or otherwise positioned to minimize heat loss through the slab edge and foundation wall intersection.

> **Exception:** Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.

C402.2.6 Insulation of radiant heating systems. *Radiant heating system* panels, and their associated components that are installed in interior or exterior assemblies shall be insulated with a minimum of R-3.5 (0.62 $m^2/K \cdot W$) on all surfaces not facing the space being heated. *Radiant heating system* panels that are installed in the *building thermal envelope* shall be separated from the exterior of the building or unconditioned or exempt spaces by not less than the *R*-value of insulation installed in the opaque assembly in which they are installed or the assembly shall comply with Section C402.1.4.

> ~~**Exception:** Heated slabs on grade insulated in accordance with Section C402.2.5.~~

Heated slabs on grade shall be insulated in accordance with Section C402.2.5.

Reason: The current provisions are technically flawed and the R-values are not consistent with F-factors for heated slabs-on-grade in the two tables. This provisions corrects R-values for heated slabs such that they agree with the performance intent of the F-factors for heated slabs. The F-factors are adjusted slightly in some cases to agree with common nominal R-values for insulation in accordance with data in Appendix A of ASHRAE 90.1. Heat loss for heated slabs is much greater than that for unheated slabs, all other factors equal, and the current R-value for heated slabs are woefully inadequate (and inconsistent with the F-factors) and result in much greater heat loss for heated slabs than unheated slabs in the present code which does not make sense and is not good practice. The use of full slab insulation for heated slabs is far more effective than perimeter insulation and thus permits the use of a lesser thickness of insulation under the slab than is currently required around the perimeter of the slab or building. Finally, coordinating changes are made to a footnote in each table and in Sections C402.2.5 and C402.2.6.

Cost Impact: Will not increase the cost of construction
This proposal is a correction of heated slab R-values to agree with the performance basis in the code for heated slabs (F-factors). Thus, relative to the performance basis of the code, there is no cost impact. For cases where the current incorrect R-values for heated slabs are being used, there will be a cost impact with this correction of the code. However, at least some states require similar solutions for heated slabs and, as a matter of good practice, many designers already use full sub-slab insulation when a heated (radiant) slab is specified.

CE62-16 : TABLE C402.1.3-CRANDELL12858

CE63-16

IECC: C402.1.3.

Proponent : Ben Ferguson, representing Pacific Insulation Products (ben.f@pacificinsulationproducts.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a,]

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	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	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal building 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	R-30 + 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-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, above grade																
Mass	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~~	~~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~~	~~R-13+ R-19.5ci~~	~~R-13 + R-13ci~~	~~R-13+ R-19.5ci~~
Metal building g	R-15ci	R-15ci	R-15ci	R-15ci	R-15ci	R-19ci	R-19ci	R-19ci	R-19ci	R-19ci	R-19ci	R-19ci	R-19ci	R-26ci	R-19ci	R-26ci
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-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
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-13 + R-7.5ci or R-20 +	R-13 + R-7.5ci or R-20	R-13 + R-7.5ci or R-20	R-13 + R-7.5ci or R-20	R13 + R-15.6ci or R-20	R13 + R-15.6ci or R-20

										+ R-3.8ci	R-3.8ci	+ R-3.8ci	+ R-3.8ci	+ R-3.8ci	+ R-10ci	+ R-10ci
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	R-10ci	R-10ci	R-12.5ci
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	R-15ci	R-16.7ci
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 f	R-30 f	R-30 f	R-30 f
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	R-15 for 24″ below	R-15 for 24″ below	R-20 for 24″ below
Heated slabs	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-10 for 24″ below	R-10 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-15 for 36″ below	R-15 for 36″ below	R-15 for 36″ below	R-20 for 48″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 48″below	R-20 for 48″ below
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	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

g. Exposed Continuous insulation shall comply with the International Building Code provisions for exposed foam plastic or shall be provided with a thermal barrier.

Reason: Revise the prescriptive requirements for metal building walls in Table C402.1.3 "Opaque Thermal Envelope Insulation Component Minimum Requirements, R-Value Method" to match ASHRAE 90.1-2013. All climate zones in ASHRAE 90.1 2013 references Continuous Insulation solely to meet the prescriptive Metal Building wall insulation requirements. It is a simpler, more cost effective, more practical, and more efficient insulation system which also passes air barrier requirements easier than the current double layer prescriptive path.

This would simplify the insulation installation, changing from the current double layer of Continuous Insulation and batt insulation, to a single layer of Continuous Insulation. There is much confusion about the current prescriptive assembly regarding where the respective layers are supposed to be installed and how to seal the rigid when it is installed over the batt insulation. This will also save plan review time by clarifying the location and installation of the metal building wall insulation. Currently there are many ways that the prescriptive R13 + R13 Ci is drawn on architectural plans resulting in confusion which takes time to sort out.

Of serious life/safety concern is that non-exposure rated continuous insulation is being installed in violation of the IBC 2012 instead of continuous insulation that meets 2603.10 "Special Approval" w hich requires testing exposed foam in an actual end-use configuration. Without this approval the board needs to be covered w ith an approved thermal barrier per 2603.4. Specifiers and building officials often erroneously assume that the R-13 fiberglass provides this barrier but fiberglass is not an approved thermal barrier.

Further the R13 (4") batt insulation doesn't w ork w ell w ith metal building framing w hich is normally 8", 8.5", or 10" deep. Therefore the insulation is insufficient to fill the cavity and the insulation sags from lack of support. The other option is the install on the outside of the framing w hich results in compressed insulation. Per ASHRAE 90.1-2013 R13 Metal Building Insulation has a U-Value of U=0.162 or a installed R-Value of R-6.17 (1/0.162). Installing on the outside of the framing also makes it difficult to install continuous insulation layer over the top and seal the Ci w ell enough to pass air barrier testing (See pictures). Sw itching to an all rigid solution solves these issues w hile supporting the air barrier requirements in C402.5(Air Leakage)

This same proposal w as presented to the Washington State 2015 Energy Code

TAG (Technical Advisory Group) and w as unanimously approved. The only modification w as to apply to Group R w hen the proposal w as only for "All other". It is now approved by the State Building Code Council and R-19 rigid insulation w ill be the prescriptive w all insulation for Metal Buildings starting July 1, 2016.

This change also supports the Net Zero Energy Building goals of the AIA, DOE, ASHRAE, etc. by simplifying the insulation package into a single layer that is easily sealed, preventing air leakage, and has a consistent R-Value of the w all assembly w hich minimizes thermal bridging.

Prescriptive Example:

Proposed Prescriptive Example (Single layer Ci):

Proposed Prescriptive From Interior:

Cost Impact: Will not increase the cost of construction

The initial cost impact will result in over-all lower cost for code compliant installed insulation. The additional thickness of continuous insulation is offset by eliminating the fiberglass layer. In addition to the cost savings there labor savings as the installer only has to make two passes over the building envelope, instead of four or five, to install the wall insulation. Labor cost is very dependent on the location of the project but here is an example based on worst case situation (Climate Zones 1 through 3) where the rigid insulation thickness doubles:

Current Prescriptive: (R13 MBI $.40/sq ft + Installation $.25/sq ft)+(R6.5 Ci $1.00/sq ft +

Fasteners \$.03/sq ft + Seam Tape \$.15/sq ft + Installation \$.50/sq ft)=\$2.33 installed
Proposed Prescriptive: R19 Ci ranges from \$2.00/sq ft to \$2.50/sq ft installed.

The proposed change also benefits the owner by calling out an installation system that is more affordable, as well as easier to install and more efficient in the real world, than the prescriptive path. It also provides access to the girt cavity for sub trades to run plumbing, conduit, wiring, cables, etc., without impacting the integrity of the vapor barrier. For the majority of metal building projects, which are over 50% of low rise construction nationally, this is important since they are used for many industrial/manufacturing/warehouse/storage applications where access to the girt cavity is required.

CE63-16 : TABLE C402.1.3-FERGUSON12271

CE64-16

IECC: C402.1.3, C402.1.4, C402.3, C402.3.1 (New), C402.3.2 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a],

CLIMATE ZONE	0		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	Group R	All othe
Roofs																	
Insulation entirely above roof deck	R-25ci	R-30ci	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	R-35ci	R-35c
Metal building b	R-19 + R-11 LS	R-19 + R-11 LS	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	R-30 + R-11 LS	R-30 + R-11 L
Attic and other	R-38	R-38	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	R-49	R-49
Walls, above grade																	
Mass	R-5.7ci c	R-5.7ci c	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-25c
Metal building	R-13+ R-6.5ci	R-13+ R-6.5ci	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	R-13+ R-19.5ci	R-13 + R-13c
Metal framed	R-13 + R-5ci	R-13 + R-5ci	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-15.6ci	R-13 + R-7.5c
	R-13 +	R-13 +	R-13 +	R-13 +	R-13 +	R-13 +	R-13 +	R-13 +	R-13 +	R-13 +	R-13 +	R-13 +	R-13 + R-7.5ci	R-13 +	R-13 +	R-13 +	R13 +

Wood framed and other	R-3.8ci or R-20	R-3.8ci or R-20	R-3.8ci or R-20	R-3.8ci or R-20	R-3.8ci or R-20	R-3.8ci or R-20	R-3.8ci or R-20	R-3.8ci or R-20	R-3.8ci or R-20	R-3.8ci or R-20	R-3.8ci or R-20	R-7.5ci or R-20 + R-3.8ci	or R-20 + R-3.8ci	R-7.5ci or R-20 + R-3.8ci	R-7.5ci or R-20 + R-3.8ci	R-7.5ci or R-20 + R-3.8ci	R-15.6 or R-2 + R-10
Walls, below grade																	
Below-grade wall [d]	NR	NR	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	R-10ci	R-10c
Floors																	
Mass [e]	NR	NR	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	R-15c
Joist/framing	NR	NR	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 [f]	R-30 [f]	R-30 [f]
Slab-on-grade floors																	
Unheated slabs	NR	NR	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	R-15 for 24″ below	R-15 fo 24″ belo
Heated slabs	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-10 for 24″ below	R-10 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-15 for 36″ below	R-15 for 36″ below	R-15 for 36″ below	R-20 for 48″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 fo 48″belo
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	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD[a, b]

CLIMATE	0	1	2	3	4	5	6	7	

ZONE									EXCEPT MARINE		AND MARINE 4						
	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	Group R	Al oth
Roofs																	
Insulation entirely above roof deck	U-0.039	U-0.032	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-0.0
Metal buildings	U-0.044	U-0.035	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	U-0.0
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-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.0
Walls, above grade																	
Mass	U-0.151	U-0.151	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-0.061	U-0.0
Metal building	U-0.079	U-0.079	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-0.0
Metal framed	U-0.077	U-0.077	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-0.057	U-0.064	U-0.052	U-0.0
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-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.0
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-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	C-0.0
Floors																	
Mass[d]	U-0.322[e]	U-0.322[e]	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-0.057	U-0.055	U-0.051	U-0.0
Joist/framing	U-0.066[e]	U-0.066[e]	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	U-0.0
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-0.73[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-0.4

Heated slabs[f]	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.58	F-0.55	F-0.55	F-0.5
Opaque doors																	
Swinging	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-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.3

For SI: 1 pound per square foot = 4.88 kg/m ^{2} , 1 pound per cubic foot = 16 kg/m ^{3} .

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U* -factors, C-factors, and *F* -factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

Revise as follows:

C402.3 ~~Roof solar~~ Solar reflectance and thermal emittance. ~~Low-sloped~~ For roofs ~~directly above cooled conditioned spaces in *Climate Zones* 1~~, ~~2~~ the solar reflectance and ~~3~~ thermal emmittane shall comply with ~~one or more of~~ Section C402.3.1. For walls, the ~~options in Table C402.3~~ solar reflectance shall comply with Section C402.3.2.

> ~~**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. 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/m^2] or 23 psf [117 kg/m^2] pavers.~~
>
> ~~4. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this section.~~

Add new text as follows:

C402.3.1 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. 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/m^2] or 23 psf [117 kg/m^2] pavers.
4. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this section.

C402.3.2 Wall solar reflectance
For Climate Zone 0, above-grade walls shall comply with one of the following:

1. For east and west walls, not less than 75% of the opaque wall area shall have a minimum SRI of 29 determined in accordance with ASTM E1980 and a convection coefficient of 2.1 Btu/h▪ft2▪°F. Where determined in accordance with NFRC 300 or ISO 9050, the portion of the opaque that is glass spandrel area shall have a minimum solar reflectance of 29%.
2. For east and west walls, not less than 30% of the above grade wall area shall be shaded through the use of shade-providing plants, manmade structures, existing buildings, hillsides, permanent building projections, on-site renewable energy systems or a combination of such. Shade coverage shall be calculated at 10 a.m. for the east walls and 3 p.m. for the west walls on the summer solstice

For the purposes of calcuattions and showing compliance with this section, the building shall not be rotated more than 45 degrees to the nearest cardinal orientation.

Reason: This proposal updates the climate zones to correspond with the release of *ASHRAE Standard 169-2013, Climatic Data for Building Design Standards*. *Standard 169-2013* includes more-recent weather data and the creation of a new Climate Zone 0. Approximately 10% of the counties in the United States have a change in Climate Zone designation due to this change, with most of these changes resulting in a change to warmer climate zones. Generally, the new Climate Zone 0 is the hotter portion of the previous Climate Zone 1, which was the warmest climate zone. Cities in Climate Zone 0 include 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 hotter regions of Climate Zone 0.

Roof insulation was increased in Climate Zone 0 due to a cost-effectiveness study performed as part of a similar proposal developed for ASHRAE 90.1. Which will increase the cost of construction. For this change, a new column is being proposed. In that column, all of the values are the same as before except for insulation entirely above deck.

Shading or an SRI requirement w as added to w alls in Climate Zone 0 to reduce solar heat gain on these surfaces. This text is from ASHRAE 90.1. Surfaces meeting the SRI requirements are available for commonly used w all systems. This could increase the cost of construction if the shading is done by new ly planted trees.

Bibliography: ASHRAE Standard 169-2013 Climatic Data for Building Design *Standards*

Cost Impact: Will increase the cost of construction
There is an increase in insulation proposed for climate zone 0, w hich previously w ould have had to have met the criteria for climate zone 1. There may also be an increase in cost depending on the choice someone uses in complying w ith the new w all SRI requirements.

Analysis: A review of the standard(s) proposed for inclusion in the code, ISO 9050, ASTM E1980 and NFRC 300, w ith regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) w ill be posted on the ICC w ebsite on or before April 1, 2015.

CE64-16 : TABLE C402.1.3-FERGUSON12410

CE65-16

Part I:
IECC: C402.1.3.
Part II:
R402.2.6 (IRC N1102.2.6)

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 ORDERS FOR THESE COMMITTEES.

Proponent : Michael Gieszler, City of Hillsboro, Oregon Building Dept., representing Oregon Building Officials Association (mike.gieszler@hillsboro-oregon.gov)

Part I

2015 International Energy Conservation Code

C402.1.3 Insulation component *R*-value-based method. *Building thermal envelope* opaque assemblies shall ~~meet~~ 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 for insulation in framing cavities, where required, and for continuous insulation, where required, shall be not less than that specified in Table C402.1.3, based on the *climate zone* specified in Chapter 3. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *R*-values from the "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 from the "All other" column of Table C402.1.3. The thermal resistance or *R*-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope required in accordance with Table C402.1.3 shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below grade wall, whichever is less. Opaque swinging doors shall comply with Table C402.1.4 and opaque nonswinging doors shall comply with Table C402.1.3.

Part II

2015 International Energy Conservation Code

R402.2.6 (N1102.2.6) Steel-frame ceilings, walls and floors. Steel-frame ceilings, walls, and floors shall ~~meet~~ comply with the insulation requirements of Table R402.2.6 or~~ shall meet ~~ the *U*–factor requirements of Table R402.1.4. The calculation of the *U*–factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.

Reason: The use of the word "comply" interjects code language more often found throughout the codes and clarifies the intent in a slightly stronger tone. The term "comply" infers something that has to be done or obeyed. The word "meet" establishes an expectation.
There is no additional cost

Cost Impact: Will not increase the cost of construction
The proposal only clarifies the intent of the code section and does not cause any increases in materials or labor for constructing the building.

CE65-16 : C402.1.3-GIESZLER10910

CE66-16

IECC: C402.1.3.

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

2015 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[~~a,~~ a,g]

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m ^{2} , 1 pound per cubic foot = 16 kg/m ^{3} .

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

g. *R-value* of insulation to be measured at the lowest value from ASTM C 518 testing at 40°F, 75°F and 110°F.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:
ASTM C518-15 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

Reason: R-Values of insulation should be reported and engineered into buildings at their lowest performance level rather than at their highest values. Otherwise, the decreased insulation performance will reduce the energy efficiency of the building. The National Roofing Contractors Association and Canadian Roofing Contractors Association have researched and found that the R-value of insulation varies, decreasing at both high (above 100F) and low (below 40F) temperatures.
It makes sense that the building owner and manager be able to judge insulations based on their performance in the environment expected to occur throughout the building life cycle.

Cost Impact: Will increase the cost of construction
This proposal may increase the cost of construction due to current insulation thicknesses based on most efficent temperature for insulation performance for some insulations. Some insulatoins will have no increase in cost due to consistent R Value through the range of temperature referenced in the proposal.

CE66-16 : TABLE C402.1.3-MCHUGH13228

CE67-16

IECC: C402.1.3.

Proponent : Mark Nowak, representing Steel Framing Alliance

2015 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a],

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	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	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal building 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	R-30 + 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-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, above grade																
Mass	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	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	R-13+ R-19.5ci	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-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
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	R13 + R-15.6ci or R-20 + R-10ci	R13 + R-15.6ci or R-20 + R-10ci
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	R-10ci	R-10ci	R-12.5ci
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	R-15ci	R-16.7ci
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 f	R-30 f	R-30 f	R-30 f
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	R-15 for 24″ below	R-15 for 24″ below	R-20 for 24″ below
Heated slabs	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-10 for 24″ below	R-10 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-15 for 36″ below	R-15 for 36″ below	R-15 for 36″ below	R-20 for 48″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 48²″below	R-20 for 48″ below
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	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m ^{2}, 1 pound per cubic foot = 16 kg/m ^{3}.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

~~a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.~~

<u>a. Assembly descriptions can be found in ASHRAE 90.1 Appendix A. Framed wall assemblies in Table 402.1.3 correspond to assemblies in ASHRAE 90.1, Appendix A with 3-1/2 studs spaced 16 inches apart measured center to center. Where using the R-value compliance method for building design, wall assemblies having other stud spacings and depths and having equivalent U-factors in ASHRAE 90.1, Appendix A shall be an alternative.. Claddings and exterior or interior wall sheathing materials having equivalent or greater R-values are an alternative for such framed wall assemblies.</u>

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 C 90, 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 include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or
2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

Reason: The current table entries for framed walls and the specific reference to ASHRAE 90.1, Appendix A in footnote "a" is problematic for multiple reasons that are addressed in this proposal.
First, the current entries for framed assemblies in Table C402.1.3 were derived based on 16-inch stud spacing and 3.5-inch deep studs. However, six-inch deep studs are commonly used in commercial buildings, with either 16 or 24 inch spacing of the studs. The table is thus limited to assemblies that represent a minority of assemblies used in commercial construction. Because the R-value method and U-factor methods are separate compliance paths, this basically would push a designer to the U-factor tables for the entire building's compliance if using deeper or wider-spaced studs. This defeats the purpose of having a simple prescriptive R-value compliance path for conventional and common assemblies.

Second, although the reference to the assemblies in ASHRAE standard 90.1 was inserted in part to address the first concern above, footnote "a" is incomplete as written to achieve this objective. It doesn't identify the base assembly used for the R-values in Table 402.1.3, yet the 90.1 Appendix A tables for framed assemblies address a variety of configurations. This proposal appropriately clarifies that the 16 inch on center, 3.5 inch deep stud assembly is the base assembly. Further, it allows use of an equivalent assembly without requiring the entire building envelope to be designed by the U-factor method.

Third, the assembly descriptions in ASHARE 90.1, Appendix A are based on very specific cladding, interior sheathing, and exterior sheathing. Buildings that are not built exactly as defined in 90.1 Appendix A would not necessarily qualify under the current text in footnote "a." This severely limits the number of assemblies that can use the IECC R-value method. This was not the intent of footnote "a" when it was inserted. This proposal addresses this issue and expands on the assemblies that can use the R-value method.

Last, the proposal modifies the reference to ASHRAE 90.1 in the footnote to be consistent with the reference as written in Chapter 6.

Cost Impact: Will not increase the cost of construction
This proposal will not incrrease the cost of construction but will decrease it in many cases by allowing altaernate assemblies with equivalent performance to be used. Wider spacing and deeper studs can be less expensive than the base assemblies descriped in the reference standard ASHRAE 90.1.

CE67-16 : TABLE C402.1.3-NOWAK11300

CE68-16

IECC: C402.1.4.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 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		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	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	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	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	U-0.021
Walls, above grade																
Mass	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-0.061	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-0.057	U-0.064	U-0.052	U-0.045	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
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	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-0.057	U-0.055	U-0.051	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	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	F-0.40	F-0.40
Heated slabs[f]	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.58	F-0.55	F-0.55	F-0.55	F-0.55
Opaque doors																
Swinging	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	U-0.37	U-0.37

For SI: 1 pound per square foot = 4.88 kg/m ^{2} , 1 pound per cubic foot = 16 kg/m ^{3} .

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. ~~Use of Opaque~~ Where assembly *U* -factors, C-factors, and *F* -factors ~~from~~ are established in ANSI/ASHRAE/IESNA 90.1 Appendix A such opaque assemblies shall be ~~permitted~~ 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. ~~Opaque assembly U-factors based on designs tested~~ Where *U* -factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be ~~permitted~~ 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

Reason: The SEHPCAC found that footnotes a and b to Table C402.1.4 are written in a confusing manner and should be clarified. The clarification is that the intent of these footnotes is that, when found in ASHRAE 90.1 Appendix A or per test results in accordance with ASTM C1363, an assembly which meets the thermal requirements of the like assembly in the IECC, then such assemblies comply. The intent is within the same type of assembly, for example comparing a mass wall to a mass wall – and not a mass wall to a cavity wall.
This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The intent of the proposal is as an editorial clarification of these 2 footnotes. There should be no impact on the cost of construction.

CE68-16 : TABLE C402.1.4-COLLINS11520

CE69-16

IECC: C402.1.4.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

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		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	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	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	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	U-0.021
Walls, above grade																
Mass	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 ~~0.061~~	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 ~~0.057~~	U-0.064	U-0.052	U-0.064 ~~0.045~~	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
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	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 ~~0.057~~	U-0.055	U-0.051	U-0.055	U-0.051
	U-															

Joist/framing	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	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	F-0.40	F-0.40
Heated slabs[f]	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.58	F-0.55	F-0.55	F-0.55	F-0.55
Opaque doors																
Swinging	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	U-0.37	U-0.37

For SI: 1 pound per square foot = 4.88 kg/m ^{2} , 1 pound per cubic foot = 16 kg/m ^{3} .

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U* -factors, C-factors, and *F* -factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

Reason: This proposal corrects U-factor requirements in Table C402.1.4 to consistent with the R-value requirements in Table C402.1.3. Table C402.1.3 is shown in the reason statement, below
The U-factor criteria in Table C402.1.4 for mass wall requirements for Climate Zone 7, Group R, is being corrected to make it consistent with the other values for R-15.2 c.i. in Table C402.1.3. It should be 0.71 as can be seen from the other cases where R-15.2 c.i. is prescribed.

The U-factor criteria in Table C402.1.4 for metal framed wall requirements for Climate Zone 6, Group R, is being corrected to make it consistent with the other values for R-13+7.5 c.i. in Table C402.1.3. It should be 0.64 as can be seen from the other cases where R-13+7.5 c.i. is prescribed.

The U-factor criteria in Table C402.1.4 for mass floor requirements for Climate Zone 6, Group R, is being corrected to make it consistent with the other values for R-12.5 c.i. in Table C402.1.3. It should be 0.64 as can be seen from the other cases where R-12.5 c.i. is prescribed.

TABLE C402.1.3

OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a]

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**	**All other**	**Gro R**
Walls, above grade																
Mass	R-5.7cic	R-5.7cic	R-5.7cic	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-2
	R-13+	R-13 +	R13 +		R-13		R-13		R-13		R-13		R-13	R-13+	R-13	R-1

Metal building	R-6.5ci	R-6.5ci	R-6.5ci	R-13 + R-13ci	+ R-6.5ci	R-13 + R-13ci	+ R-13ci	R-13 + R-13ci	+ R-13ci	R-13 + R-13ci	+ R-13ci	R-13 + R-13ci	+ R-13ci	R-19.5ci	+ R-13ci	R-19.
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-15.6ci	R-13 + R-7.5ci	R-1 R1
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	R13 + R-15.6ci or R-20 + R-10ci	R1 R-15. or F + R 10c
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	R-15ci	R-16.
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30f	R-30f	R-30f	R-30f	R-3

This proposal w as submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC w as established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes w ith 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 2015, the SEHPCAC has held three tw o- or three-day open meetings and 25 w orkgroup calls, w hich included members of the SEHPCAC as w ell as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC w ebsite at: http://w w w .iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The proposal is an editorial correlation betw een Tables C402.1.3 and C402.1.4. There w ill be no impact on the cost of construction.

CE69-16 : TABLE C402.1.4-COLLINS11895

CE70-16

IECC: C402.1.4.

Proponent : Jay Johnson, Thomas Associates, Inc., representing Metal Building Manufacturers Association (jjohnson@thomasamc.com)

2015 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		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	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	U-0.028	U-0.028
Metal buildings	U-0.044	~~U-0.035~~ U-0.037	~~U-0.035~~ U-0.037	~~U-0.035~~ U-0.037	~~U-0.035~~ U-0.037	~~U-0.035~~ U-0.037	~~U-0.035~~ U-0.037	~~U-0.035~~ U-0.037	~~U-0.035~~ U-0.037	~~U-0.035~~ U-0.037	U-0.031	U-0.031	U-0.029	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	U-0.021
Walls, above grade																
Mass	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-0.061	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-0.057	U-0.064	U-0.052	U-0.045	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
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	C-0.092	C-0.092
Floors																
Mass[d]	U-	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-0.057	U-0.055	U-0.051	U-0.055	U-0.051

	0.322[e]															
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	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	F-0.40	F-0.40
Heated slabs[f]	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.58	F-0.55	F-0.55	F-0.55	F-0.55
Opaque doors																
Swinging	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	U-0.37	U-0.37

For SI: 1 pound per square foot = 4.88 kg/m ^{2}, 1 pound per cubic foot = 16 kg/m ^{3}.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U* -factors, C-factors, and *F* -factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

Reason: Footnote "a" in the IECC Tables C402.1.3 and C402.1.4 references the insulation assemblies in Appendix A of ASHRAE 90.1. The U-Factor performance for the R-19+R-11 Liner System (LS) in the IECC differs from the U-Factor listed in ASHRAE 90.1 for the last two versions. The Metal Building Roof U-Factor of U-0.035 shown in Table C402.1.4 for the R-19+R11 LS should be revised to U-0.037, as it is in the referenced standard 90.1 to prevent confusion.
The purpose of this proposal is NOT to make the IECC 2018 align with ASHRAE 90.1 for alignment's sake. The goal is to fix a technical flaw in the IECC that was introduced when ASHRAE 90.1 changed the U-Factor for the insulation system noted above. The ground for this flaw was laid when the IECC deleted the assembly descriptions in Table 502.2(2) of IECC 2009 going to the 2012 version of the code and instead referred to ASHRAE 90.1 footnote "a", which points to a referenced standard. Once ASHRAE 90.1 changed the performance of the referenced assembly to U-0.037, the U-0.035 in the IECC became purely arbitrary.

Cost Impact: Will not increase the cost of construction
This code change proposal will not increase the cost of construction since the same insulation assembly is being referenced (i.e. R19+R11 Liner System).

CE70-16 : TABLE C402.1.4-JOHNSON12112

CE71-16

IECC: C402.1.4.

Proponent : Martha VanGeem, self, representing Masonry Alliance for Codes and Standards; Emily Lorenz, self, representing self (emilyblorenz@gmail.com)

2015 International Energy Conservation Code

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		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	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	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	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	U-0.021
Walls, above grade																
Mass	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 ~~0.061~~	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-0.057	U-0.064	U-0.052	U-0.045	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
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	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 ~~0.057~~	U-0.055	U-0.051	U-0.055	U-0.051
Joist/framing	U-	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	U-0.033	U-0.033

	0.066[e]															
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	F-0.40
Heated slabs[f]	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.58	F-0.55	F-0.55	F-0.55	F-0.55
Opaque doors																
Swinging	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	U-0.37	U-0.37

For SI: 1 pound per square foot = 4.88 kg/m ^{2} , 1 pound per cubic foot = 16 kg/m ^{3} .

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U* -factors, C-factors, and *F* -factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or

2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

Reason: This proposal corrects U-factor requirements for mass walls and mass floors in Table C402.1.4 to be consistent with the R-value requirements in Table C402.1.3. R-value requirements are generally used for compliance and it is confusing to the users when they are not consistent with the U-factor requirements.
The U-factor criteria in Table C402.1.4 for mass wall requirements for Climate Zone 7, Group R, is being corrected to make it consistent with the other values for R-15.2 c.i. in Table C402.1.3. It should be 0.71 as can be seen from the other cases where R-15.2 c.i. is prescribed.

The U-factor criteria in Table C402.1.4 for mass floor requirements for Climate Zone 6, Group R, is being corrected to make it consistent with the other values for R-12.5 c.i. in Table C402.1.3. It should be 0.64 as can be seen from the other cases where R-12.5 c.i. is prescribed.

See R-value table below.

TABLE C402.1.3

OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a]

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**	**All other**	**Gro**
Walls, above grade																
Mass	R-5.7cic	R-5.7cic	R-5.7cic	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-2
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	R-13+ R-19.5ci	R-13 + R-13ci	R-1 R-19.
	R-13		R-13	R-13 +	R-13	R-13 +	R-13	R-13 +	R-13	R-13 +	R-13	R-13 +	R-13	R-13 +	R-13	

Metal framed	+ R-5ci	R-13 + R-5ci	+ R-5ci	R-7.5ci	+ R-7.5ci	R-7.5ci	+ R-7.5ci	R-7.5ci	+ R-7.5ci	R-7.5ci	+ R-7.5ci	R-7.5ci	+ R-7.5ci	R-15.6ci	+ R-7.5ci	R-1 R17
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	R13 + R-15.6ci or R-20 + R-10ci	R1 R-15. or R + R 10c
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	R-15ci	R-16.
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30f	R-30f	R-30f	R-30f	R-3

Cost Impact: Will not increase the cost of construction
This is a correction of the U-factor to make it consistent with the R-value and does not affect the cost of construction.

CE71-16 : TABLE C402.1.4-VANGEEM8607

CE72-16

IECC: C402.1.5, C502, C502.2, C502.2.1, C502.2.2, C503, C503.3, C503.3.1, C503.3.2, C503.3.3.

Proponent : Thomas Culp, Birch Point Consulting LLC, representing the Glazing Industry Code Committee and Aluminum Extruders Council (culp@birchpointconsulting.com)

2015 International Energy Conservation Code

Revise as follows:

C402.1.5 Component performance alternative. Building envelope values and fenestration areas determined in accordance with Equation 4-2 shall be permitted in lieu of compliance with the *U*-, *F*- and *C*-factors in Tables C402.1.3, C402.1.4, and ~~C402.1.4~~ C402.4 and the maximum allowable fenestration areas in Section C402.4.1. *Fenestration* shall meet the applicable SHGC requirements of Section C402.4.3.

A + B + C + D + E ≤ Zero **(Equation 4-2)**

where:

A	=	Sum of the (UA Dif) values for each distinct assembly type of the building thermal envelope, other than slabs on grade and below-grade walls.		
		UA Dif	=	UA Proposed - UA Table.
		UA Proposed	=	Proposed *U* -value · Area.
		UA Table	=	*U* -factor from ~~Table~~ Tables C402.1.3, C402.1.4, or ~~Table C402.1.4~~ C402.4) · Area.
B	=	Sum of the (FL Dif) values for each distinct slab-ongrade perimeter condition of the building thermal envelope.		
		FL Dif	=	FL Proposed - FL Table.
		FL Proposed	=	Proposed *F* -value · Perimeter length.
		FL Table	=	(F-factor specified in Table C402.1.4) · Perimeter length.
C	=	Sum of the (CA Dif) values for each distinct belowgrade wall assembly type of the building thermal envelope.		
		CA Dif	=	CA Proposed - CA Table
		CA Proposed	=	Proposed *C* -value · Area.
		CA Table	=	(Maximum allowable *C* -factor specified in Table C402.1.4) · Area.

Where the proposed vertical glazing area is less than or equal to the maximum vertical glazing area allowed by Section C402.4.1, the value of D (Excess Vertical Glazing Value) shall be zero. Otherwise:

D	=	(DA · UV) - (DA · U_{Wall}), but not less than zero.		
		DA	=	(Proposed Vertical Glazing Area) - (Vertical Glazing Area allowed by Section C402.4.1).
		UA Wall	=	Sum of the (UA Proposed) values for each opaque assembly of the exterior wall.
		U_{Wall}	=	Area-weighted average *U* -value of all above-grade wall assemblies.
		UAV	=	Sum of the (UA Proposed) values for each vertical glazing assembly.
		UV	=	UAV/total vertical glazing area.

Where the proposed skylight area is less than or equal to the skylight area allowed by Section C402.4.1, the value of E (Excess Skylight Value) shall be zero. Otherwise:

E = $(EA \cdot US) - (EA \cdot U_{Roof})$, but not less than zero.

EA	=	(Proposed Skylight Area) - (Allowable Skylight Area as specified in Section C402.4.1).
U_{Roof}	=	Area-weighted average *U* -value of all roof assemblies.
UAS	=	Sum of the (UA Proposed) values for each skylight assembly.
US	=	UAS/total skylight area.

SECTION C502 ADDITIONS

C502.2 Prescriptive compliance. *Additions* shall comply with Sections C502.2.1 through C502.2.6.2.

C502.2.1 Vertical fenestration. New *vertical fenestration* area that results in a total building *fenestration* area less than or equal to that specified in Section C402.4.1 shall comply with Section ~~C402.4~~ C402.4.3, C402.1.5, or C407. *Additions* with *vertical fenestration* that result in a total building *fenestration* area greater than Section C402.4.1 or *additions* that exceed the fenestration area greater than Section C402.4.1 shall comply with Section C402.4.1.1 for the *addition* only. *Additions* that result in a total building ~~vertical glass~~ *verticalfenestration* area exceeding that specified in Section C402.4.1.1 shall comply with Section C407 or C402.1.5.

C502.2.2 Skylight area. New *skylight* area that results in a total building *fenestration* area less than or equal to that specified in Section C402.4.1 shall comply with Section C402.4, C402.1.5, or C407. *Additions* with *skylight* area that result in a total building *skylight* area greater than C402.4.1 or additions that exceed the *skylight* area shall comply with Section C402.4.1.2 for the *addition* only. *Additions* that result in a total building *skylight* area exceeding that specified in Section C402.4.1.2 shall comply with Section C407 or C402.1.5.

SECTION C503 ALTERATIONS

C503.3 Building envelope. New building envelope assemblies that are part of the *alteration* shall comply with Sections C402.1 through C402.5.

C503.3.1 Roof replacement. *Roof replacements* shall comply with ~~Table~~ Section C402.1.3, C402.1.4, C402.1.5, or ~~C402.1.4~~ C407 where the existing roof assembly is part of the *building thermal envelope* and contains insulation entirely above the roof deck.

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 ~~C402.4~~ C402.4.3, C402.1.5, or C407. The addition of *verticalfenestration* 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 glass~~ *vertical fenestration* area exceeding that specified in Section C402.4.1.1 shall comply with Section C407 or C402.1.5.

C503.3.3 Skylight area. ~~The addition of~~
New *skylight* area that results in a total building *skylight* area less than or equal to that specified in Section C402.4.1 shall comply with Section C402.4, C402.1.5, or C407. The addition of *skylight* area that results in a total building skylight area greater than Section C402.4.1 shall comply with Section C402.4.1.2 for the space adjacent to the new skylights. *Alterations* that result in a total building skylight area exceeding that specified in Section C402.4.1.2 shall comply with Section C407 or C402.1.5.

Reason: This proposal corrects an editorial oversight in Section C402.1.5, which allows compliance of the overall envelope based on the component U, C, and F-factors and areas. Although it includes all envelope components, the reference to Table C402.4 was inadvertently left out. Additionally, a statement is added to make it clear that fenestration must still meet the applicable SHGC requirements.

Furthermore, references to C402.1.5 are added in the additions and alterations section as the current language only references the prescriptive values and the performance path, but not the component envelope performance alternative. Some editorial changes are also made to make the language consistent regarding new skylights in sections C502.2.2 and C503.3.3. (Note: similar to the other parts of the additions and alterations, these sections do not require existing windows or skylights to replaced, but if they are replaced, new fenestration must be up to code through one of the compliance paths.)

Cost Impact: Will not increase the cost of construction
Because this proposal is clarifying current language, it does not impact the cost of construction. Furthermore, adding the envelope performance alternative to the additions and alterations sections could allow options to decrease cost of construction for those cases.

CE72-16 : C402.1.5-CULP12533

CE73-16

IECC: C402.1.5, C402.1.5 (New).

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 International Energy Conservation Code

Revise as follows:

C402.1.5 Component performance alternative. Building envelope values and fenestration areas determined in accordance with Equation 4-2 shall be permitted in lieu of compliance with the *U*-, *F*- and *C*-factors in Tables ~~C402.1.3~~ C402.1.4 and ~~C402.1.4~~ C402.4 and the maximum allowable fenestration areas in Section C402.4.1.

A + B + C + D + E ≤ Zero **(Equation 4-2)**

where:

A = Sum of the (UA Dif) values for each distinct assembly type of the building thermal envelope, other than slabs on grade~~ and below-grade walls~~.

UA Dif	=	UA Proposed - UA Table.
UA Proposed	=	Proposed *U* -value · Area.
UA Table	=	*U* -factor from Table ~~C402.1.3~~ C402.1.4, C402.1.5 or ~~Table C402.1.4)~~ C402.4 · Area.

B = Sum of the (FL Dif) values for each distinct slab-ongrade perimeter condition of the building thermal envelope.

FL Dif	=	FL Proposed - FL Table.
FL Proposed	=	Proposed *F* -value · Perimeter length.
FL Table	=	(F-factor specified in Table C402.1.4) · Perimeter length.

~~C = Sum of the (CA Dif) values for each distinct belowgrade wall assembly type of the building thermal envelope.~~

~~CA Dif~~	~~=~~	~~CA Proposed - CA Table~~
~~CA Proposed~~	~~=~~	~~Proposed *C* -value · Area.~~
~~CA Table~~	~~=~~	~~(Maximum allowable *C* -factor specified in Table C402.1.4) · Area.~~

The maximum allowed prescriptive vertical fenestration area, not including opaque doors and opaque spandrel panels, as a percent of the gross above wall area ratio is either 30 percent or where the building complies with Section C402.4.1.1, 40 percent.

Where the proposed vertical ~~glazing~~ fenestration area, not including opaque doors and opaque spandrel panels, is less than or equal to the maximum allowed prescriptive vertical ~~glazing~~ fenestration area~~ allowed by Section C402.4.1~~, the value of ~~D~~ C (Excess Vertical Glazing Value) shall be zero. Otherwise:

~~D = (DA · UV) - (DA · U_{Wall}), but not less than zero.~~

~~DA~~	~~=~~	~~(Proposed Vertical Glazing Area) - (Vertical Glazing Area allowed by Section C402.4.1).~~
~~UA Wall~~	~~=~~	~~Sum of the (UA Proposed) values for each opaque assembly of the exterior wall.~~
~~U_{Wall}~~	~~=~~	~~Area-weighted average *U* -value of all above-grade wall assemblies.~~
~~UAV~~	~~=~~	~~Sum of the (UA Proposed) values for each vertical glazing assembly.~~
~~UV~~	~~=~~	~~UAV/total vertical glazing area.~~

C = (CA · UV) - (CA · U_{Wall}), but not less than zero.

CA	=	(Proposed Vertical Fenestration Area) - (Maximum Allowed Prescriptive Vertical Fenestration Area).

U_{Wall} = Area-weighted average U-value of all above-grade wall assemblies.

UAV = Sum of the (UA Proposed) values for each vertical glazing assembly.

UV = UAV/total vertical glazing area.

Where the proposed skylight area is less than or equal to the skylight area allowed by Section C402.4.1, the value of E (Excess Skylight Value) shall be zero. Otherwise:

~~E = (EA · US) - (EA · U~~$\cancel{U_{Roof}}$~~), but not less than zero.~~

~~EA = (Proposed Skylight Area) - (Allowable Skylight Area as specified in Section C402.4.1).~~

$\cancel{U_{Roof}}$ ~~= Area-weighted average~~ ~~*U*-value of all roof assemblies.~~

~~UAS = Sum of the (UA Proposed) values for each skylight assembly.~~

~~US = UAS/total skylight area.~~

D = (DA · US) - (DA · U_{Roof}), but not less than zero.

DA = (Proposed Skylight Area) - (Allowable Skylight Area as specified in Section C402.4.1).

U_{Roof} = UAR / sum of roof area (excludes skylight area) Area-weighted average U-value of all roof assemblies.

UAR = Sum of the (UA Proposed) values for each roof assembly

UAS = Sum of the (UA Proposed) values for each skylight assembly.

US = UAS/total skylight area.

Add new text as follows:

TABLE C402.1.5
Nonswinging Door Maximum U-factor

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	All Other	Group R
Non-Swinging	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21	U-0.21

Reason: This code change proposal corrects table references which incorrectly reference Table R402.1.3 the Opaque Envelope R-value Table. Only U-, C- and F-values are appropriate for use in this calculation. The proposal also adds Table3 C402.1.5 which is the U-value equivalent of the non-swinging door R-values listed in Table C402.1.3. Again, R-values are not appropriate for use in this equation. The proposal also clarifies the meaning of some of the proposed calculations.
The calculation allows buildings to "trade-off" to higher than 40% window to wall ratio but buildings with additional glazing must comply with the daylight zone requirements as described in Section C402.4.1.1.

Restore ability to utilize component performance equations with high performance glazing option. Correct table references which are incorrect in IECC, clarify equations (a tiny bit), and establish a non-swinging door U- value so doors can be properly handled in the equation.

Cost Impact: Will not increase the cost of construction
None. The code change proposal provides corrections to the current calculation. The UA alternative is an alternative compliance approach as such the code user can choose another compliance approach.

CE73-16 : C402.1.5-MAKELA13181

CE74-16

IECC: C402.2.1.

Proponent : Hope Medina, representing Colorado Chapter of ICC (hmedina@coloradocode.net)

2015 International Energy Conservation Code

Revise as follows:

~~C402.2.1~~ C303.2.2 Multiple layers of continuous insulation board. *No change to text.*

Reason: Section C402.2.1 is referencing how to install more than one layer of rigid insulation. Why is it in a prescriptive code section that now can be traded off? Section C303.2 deals with actual install requirements and that is where this section belongs. Can you just see a contractor installing insulation without staggering the joints or without following manufacturer's install instructions because they used a trade-off path and now can say that they don't have to do it? It wouldn't happen but this still belongs in the install section and not the prescriptive requirements section.

Cost Impact: Will not increase the cost of construction
This is an existing section within the code already, but where it was originally placed did not make sense. The entire section was moved to a section that it relates to.

CE74-16 : C402.2.1-MEDINA13005

CE75-16

IECC: C402.2.2.

Proponent : Mike Fischer, Kellen Company, representing Polyisocyanurate Insulation Manufacturers Association (mfischer@kellencompany.com)

2015 International Energy Conservation Code

Revise as follows:

C402.2.2 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. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

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 <u>average area-weighted</u> *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. 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.

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

Reason: The IECC contains an arbitrary 1" thickness limitation to apply R-Value requirements for tapered insulation. The higher roof insulation levels required in recent versions of the IECC has triggered a need to update this section with clarifying language. Insulation manufacturers typically provide the roof installer with an area-weighted average roof insulation layout showing how the tapered insulation should be installed to provide appropriate drainage, as well as providing the correct average R-Value.

The proposal makes it clear that it it is permissible to use the average area-weighted R-Value- which is in common commercial use- as a way to meet the prescriptive requirements in the code. With the increased focus on roof replacement requirements, removing the 1" thickness variation will provide additional flexibility so that roofing and insulation installers can manage the increased insulation thickness on existing buildings. The proposal will allow more options for the use of tapered insulation to meet the energy efficiency upgrades required by the code.

Cost Impact: Will not increase the cost of construction

The proposal provides additional flexibility on methods of installation to meet the code.

CE75-16 : C402.2.2-FISCHER13361

CE76-16

IECC: C402.2.2.

Proponent : Mike Fischer, Kellen Company, representing Polyisocyanurate Insulation Manufacturers Association (mfischer@kellencompany.com)

2015 International Energy Conservation Code

Revise as follows:

C402.2.2 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. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

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. <u>The assembly shall comply with the vapor retarder requirements of the *International Building Code*.</u>
3. 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.

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

Reason: The proposal adds a pointer to the IBC vapor retarder requirements to help ensure that appropriate consideration is given w hen designing roof insulation layouts using tapered insulation. Other proposals w ill address clarifications to the actual requirements for tapered insulation; this is a companion proposal.

Cost Impact: Will not increase the cost of construction
The proposal provides a reference to requirements in the base building code but does not increase the stringency of the code.

CE76-16 : C402.2.2-FISCHER13375

CE77-16

IECC: C402.2.2, C402.2.3.

Proponent : Casey Harkins, representing Thermal Design, Inc.

2015 International Energy Conservation Code

Revise as follows:

C402.2.2 Roof assembly. The ~~minimum~~ thermal ~~resistance (*R*~~properties, consisting of component R-values or assembly U~~-value)~~ , C-, or F-factors, of ~~the insulating material installed either between the~~ roof ~~framing or continuously on the roof assembly~~ assemblies shall be as specified in Table C402.1.3~~,~~ or C402.1.4 based on the construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

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. 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.

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

C402.2.3 ~~Thermal resistance of above-grade~~ Above-grade walls. The ~~minimum~~ thermal ~~resistance (*R*~~properties, consisting of component R-values or assembly U~~-value)~~ , C-, or F-factors, of ~~materials installed in the~~ above-grade wall ~~cavity between framing members and continuously on the walls~~ assemblies shall be as specified in Table C402.1.3~~,~~ or C402.1.4 based on ~~framing type and~~ the construction materials used in the above-grade 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.

"Mass walls" shall include walls:

1. Weighing not less than 35 psf (170 kg/m^2) of wall surface area.
2. Weighing not less than 25 psf (120 kg/m^2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m^3).
3. Having a heat capacity exceeding 7 Btu/ft^2• °F (144 kJ/m^2• K).
4. Having a heat capacity exceeding 5 Btu/ft^2• °F (103 kJ/m^2• K), where the material weight is not more than 120 pcf (1900 kg/m^3).

Reason: The text in sections C402.2.2 and C402.2.3 implies that the minimum R-value requirements in Table C402.1.3 are required, regardless of whether the maximum U-, C- or F-factor compliance path from C402.1.4 is being used. This is likely an oversight when the U-, C-, F-factor compliance path was added to the IECC. The next section, C402.2.4 uses more general language to account for either compliance path. The change in this proposal uses the language from C402.2.4 as a template for updating the language in C402.2.2 and C402.2.3.

As an example, if a designer opted to demonstrate compliance for a metal building wall in climate zone 1 using the maximum U-Factor compliance path allowed in C402.1.4 and specified in Table C402.1.4 (U-0.079), section C402.2.3 as written would imply that the continuous insulation specified in Table C402.1.3 would still be required.

Cost Impact: Will not increase the cost of construction
The proposed change is a clarification and does not change the intended requirements.

CE77-16 : C402.2.2-HARKINS12808

CE78-16

IECC: C402.2.2.

Proponent : James Kirby, representing Center for Environmental Innovation in Roofing, representing Center for Environmental Innovation in Roofing (jkirby@kellencompany.com)

2015 International Energy Conservation Code

Revise as follows:

C402.2.2 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. <u>Where the roof assembly contains insulation entirely above deck and the R-value is greater than 17, continuous insulation board shall be installed in not less than 2 layers and the edge joints between each layer of insulation shall be staggered.</u> Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

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. 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.

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

Reason: The joints between boards in a single-layer rigid insulation board installation are gaps in the thermal layer and reduce energy efficiency. A 3/8" gap between 2" thick (3ft x 4ft) boards results in a >10% loss of resistance. Data from "Thermal Evaluation of the Effects of Gaps Between Adjacent Roof Insulation Panels," by J. E. Lewis, Research and Development Division, Owens Corning. Adding a "greater than" R-value allows single layer insulation around drains for drain sumps and for other localized situations that may require a single layer of insulation.

Cost Impact: Will increase the cost of construction
This will increase the cost of roofs intended to only use a single layer of rigid board insulation. However, because most roofs are currently installed with two-layers of insulation, the cost increases are negligible; eliminating less energy efficient roofs (those with single layer insulation) is desirable for the long-term outlook of energy efficiency of America's building stock.

CE78-16 : C402.2.2-KIRBY13282

CE79-16

IECC: C402.2.2, C402.2.2.1 (New).

Proponent : Jason Wilen AIA CDT RRO, National Roofing Contractors Association (NRCA), representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net)

2015 International Energy Conservation Code

Revise as follows:

C402.2.2 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. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

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. 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.

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

Add new text as follows:

C402.2.2.1 Determination of R-value for above deck tapered insulation. Where continuous above deck tapered roof insulation varies by more than 1 inch in thickness, the *R*-value specified in Table C402.1.3 shall be determined where the insulation thickness is 1 inch (25 mm) greater than the minimum tapered insulation thickness.

Reason: The purpose of this change is to clarify the intent of the code.
Exception 2 is not an exception to C402.2.2, rather it attempts to describe a calculation method for determining R-value for a specific kind of roof insulation system w here R-value varies over the area of a roof. This change deletes exception 2 and adds a subsection that provides a clear method for determining code compliance for above deck tapered roof insulation systems. The method is based on language that has appeared in the IECC commentary since the 2006 edition. The stringency of the code is not reduced.

Cost Impact: Will not increase the cost of construction
The proposed change is a clarification and does not change the stringency of existing code requirements so the cost of construction w ill be unchanged.

CE79-16 : C402.2.2-WILEN AIA CDT RRO11510

CE80-16

IECC: C402.2.2.

Proponent : Jason Wilen AIA CDT RRO, National Roofing Contractors Association (NRCA), representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net)

2015 International Energy Conservation Code

Revise as follows:

C402.2.2 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~~ the minimum *R*-value specified in Table C402.1.3 or the maximum *U*-factor specified in Table C402.1.4, based on construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

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. 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.~~

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 from the minimum thickness of tapered insulation shall comply with the *R*-value specified in Table C402.1.3.
2. 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.

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

Reason: The purpose of this change is to clarify and simplify the code. Exception 1 permits the use of the U-factor method for determining required thermal resistance for roof assemblies. Table C402.1.4, "Opaque thermal envelope assembly maximum requirements, U-factor Method" already exists in IECC and can be used. This change eliminates Exception 1 and adds a pointer to Table C402.1.4 as a permitted method for demonstrating code compliance.

Cost Impact: Will not increase the cost of construction
The proposed change does not change the stringency of existing code requirements so the cost of construction w ill be unchanged.

CE80-16 : C402.2.2-WILEN AIA CDT RRO12259

CE81-16

IECC: C402.2.2.

Proponent : Jason Wilen AIA CDT RRO, National Roofing Contractors Association (NRCA), representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net)

2015 International Energy Conservation Code

Revise as follows:

C402.2.2 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. <u>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.</u> Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

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. 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.

~~Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation~~.

Reason: The purpose of this code change is to fix odd formatting in the code. The current section contains an additional provision after the exceptions. This type of formatting is not found elsewhere in the code and is easily fixed by moving the provision into the charging paragraph of Section C402.2.2.

Cost Impact: Will not increase the cost of construction
The proposed change is a clarification and does not change the stringency of existing code requirements so the cost of construction will be unchanged.

CE81-16 : C402.2.2-WILEN AIA CDT RRO12264

CE82-16

IECC: C402.2.2, C402.2.2.1 (New).

Proponent : Jason Wilen AIA CDT RRO, National Roofing Contractors Association (NRCA), representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net)

2015 International Energy Conservation Code

Revise as follows:

C402.2.2 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.~~ Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.~~

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. ~~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.~~

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

Add new text as follows:

C402.2.2.1 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 purpose of this code change is to reorganize existing code language to improve clarity. By moving skylight requirments into its ow n subsection and the coorisponding exception below it, clarity is improved by grouping like subjects together.

Cost Impact: Will not increase the cost of construction
The proposed change is a reorganization of existing code language and does not change the stringency of existing code requirements so the cost of construction w ill be unchanged.

CE82-16 : C402.2.2-WILEN AIA CDT RRO12460

CE83-16

IECC: C402.2.3.

Proponent : Martha VanGeem, self, representing Masonry Alliance for Codes and Standards

2015 International Energy Conservation Code

Add new text as follows:

C402.2.3 ~~Thermal resistance of above-grade~~ 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 not be prohibited.
"Mass walls" shall include walls:

1. Weighing not less than 35 psf (170 kg/m^2) of wall surface area.
2. Weighing not less than 25 psf (120 kg/m^2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m^3).
3. Having a heat capacity exceeding 7 Btu/ft^2• _°F (144 kJ/m^2• _K).
4. Having a heat capacity exceeding 5 Btu/ft^2• °F (103 kJ/m^2• K), where the material weight is not more than 120 pcf (1900 kg/m^3).

Reason: This is a clarification of the use of Table C402.1.3 on R-values and Table C402.1.4 on U-Factors.
First, "except as noted in the table" is added to the first sentence because integral insulation is allow ed in Climate Zones 1 and 2 w here there is a footnote "c" w hen it complies w ith footnote "c".

Second, the existing sentence is applicable to C402.1.3 on R-values. Since the code is silent on integral insulation in concrete masonry units in Table C402.1.4 on U-factors, this can be confusing. In reality, the U-factor of integral insulation in concrete masonry units can be included w hen determining the U-factor of w alls w hen complying w ith Table C402.1.4.

Third, the title of the section w as changed to remove "Thermal resistance of" and just read, "Above-grade w alls." This is consistent w ith the sections on roofs and floors, sections C402.2.2 and C402.2.4, immediately before and after this section. This is required because the new sentence applies to U-factors and the mass w all definitions pertain to both R-values and U-factors.

Cost Impact: Will not increase the cost of construction
This is a clarification of the use of Tables C402.1.3 and C402.1.4 and w ill not afffect the cost of construction.

CE83-16 : C402.2.3-VANGEEM11403

CE84-16

Part I:
IECC: C402.1.3, C402.1.4, C402.2.3, C402.2.4.
Part II:
R402.2.5 (IRC N1102.2.5), Table R402.1.2 (IRC Table N1102.1.2), Table R402.1.4 (IRC Table N1102.1.4)

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 ORDERS FOR THESE COMMITTEES.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

Part I

2015 International Energy Conservation Code

Revise as follows:

C402.2.3 Thermal resistance of 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 noted in the table. "Mass walls" where used as a component in the thermal envelope of a building shall ~~include walls:~~ comply with one of the following:

1. ~~Weighing~~ Weigh not less than 35 psf (170 kg/m^2) of wall surface area.
2. ~~Weighing~~ Weigh not less than 25 psf (120 kg/m^2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m^3).
3. ~~Having~~ Have a heat capacity exceeding 7 Btu/ft^2• °F (144 kJ/m^2• K).
4. ~~Having~~ Have a heat capacity exceeding 5 Btu/ft^2• °F (103 kJ/m^2• K), where the material weight is not more than 120 pcf (1900 kg/m^3).

C402.2.4 Floors. The thermal properties (component R-values or assembly *U*-, *C*- or *F*-factors) of floor assemblies over outdoor air or unconditioned space shall be as specified in Table C402.1.3 or C402.1.4 based on the construction materials used in the floor assembly. Floor framing cavity insulation or structural slab insulation shall be installed to maintain permanent contact with the underside of the subfloor decking or structural slabs.

"Mass floors" where used as a component of the thermal envelope of a building shall provide one of the following weights:
1. 35 pounds per square foot of floor surface area.
2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

Exceptions:
1. The floor framing cavity insulation or structural slab insulation shall be permitted to be in contact with the top side of sheathing or continuous insulation installed on the bottom side of floor assemblies where combined with insulation that meets or exceeds the minimum R-

value in Table C402.1.3 for "Metal framed" or "Wood framed and other" values for "Walls, Above Grade" and extends from the bottom to the top of all perimeter floor framing or floor assembly members.

2. Insulation applied to the underside of concrete floor slabs shall be permitted an airspace of not more than 1 inch (25 mm) where it turns up and is in contact with the underside of the floor under walls associated with the *building thermal envelope.*

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a,]

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	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	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal building 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	R-30 + 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-38	R-38	R-49	R-49	R-49	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	R-15.2ci	R-25ci	R-25ci
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	R-13+ R-19.5ci	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-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
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	R13 + R-15.6ci or R-20 + R-10ci	R13 + R-15.6ci or R-20 + R-10ci
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	R-10ci	R-10ci	R-12.5ci
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	R-15ci	R-16.7ci
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 [f]	R-30 [f]	R-30 [f]	R-30 [f]
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	R-15 for 24″ below	R-15 for 24″ below	R-20 for 24″ below
Heated slabs	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-7.5 for 12″ below	R-10 for 24″ below	R-10 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-15 for 36″ below	R-15 for 36″ below	R-15 for 36″ below	R-20 for 48″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 48^{2}″below	R-20 for 48″ below
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	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

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 C 90, 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 ~~include floors weighing not less than:~~be in accordance with Section C402.2.4.

~~1~~ f. ~~35 pounds per square foot of surface area; or~~

~~2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.~~

f. Steel floor joist systems shall be insulated to R-38.

g. "Mass walls" shall be in accordance with Section C402.2.3.

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		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	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	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	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	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-0.061	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-0.057	U-0.064	U-0.052	U-0.045	U-0.045
Wood framed and otherc	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
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	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-0.057	U-0.055	U-0.051	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	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	F-0.40	F-0.40
Heated slabs[f]	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.58	F-0.55	F-0.55	F-0.55	F-0.55
Opaque doors																
Swinging	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	U-0.37	U-0.37

For SI: 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U*-factors, C-factors, and *F*-factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. 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 F-factor requirements for heated slabs.

d. "Mass floors" shall ~~include floors weighing not less than:~~be in accordance with Section C402.2.4
~~1. 25 pounds per square feet of floor surface area; or~~
~~2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic feet~~

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

g. "Mass walls" shall be in accordance with Setion C402.2.3.

Part II

2015 International Energy Conservation Code

Revise as follows:

R402.2.5 (N1102.1.4) Mass walls. Mass walls ~~for~~ where used as a component of the ~~purposes~~ thermal envelope of ~~this chapter~~ a building shall be ~~considered above-grade~~ one of the following:

1. Above-grade walls of concrete block, concrete, insulated concrete form ~~(ICF)~~, masonry cavity, brick ~~(~~other than brick veneer~~)~~, ~~earth (~~adobe, compressed earth block, rammed earth~~) and~~ , solid timber~~/~~ or solid logs, ~~or any other walls~~ _
2. Any wall having a heat capacity greater than or equal to 6 Btu/ft$^{\cancel{2}2}$ × °F (123 kJ/m$^{\cancel{2}2}$ × K).

TABLE R402.1.2 (N1102.1.2)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR [b]	SKYLIGHT [b] *U*-FACTOR	GLAZED FENESTRATION SHGC [b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE [i]	FLOOR *R*-VALUE	BASEMENT [c] WALL *R*-VALUE	SLAB [d] *R*-VALUE & DEPTH	CRAWL SPACE [c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 [h]	8/13	19	5/13 [f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 [h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 [h]	13/17	30 [g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 [h]	15/20	30 [g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 [h]	19/21	38 [g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

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

b. The fenestration *U* -factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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

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

g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

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

TABLE R402.1.4 (N1102.1.4)
EQUIVALENT *U*-FACTORS[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.045	0.057	0.028	0.050	0.055

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

b. Mass walls shall be in accordance with – Section R402.2.5. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. Basement wall *U*- factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

Reason: The IECC as a result of changes approved for the 2015 addressed mass walls and mass floors differently. For one the details were found in a footnote to a table, for the other the details were found in the section text. One could read what was in either location as a definition of the terms. This proposal covers both Commercial and Residential portions and would treat the information on mass walls and mass floors as technical requirements and not as definitions. Therefore the proposal removes the technical requirements from the footnotes; and places each in the proper envelope section on floors or walls. The footnotes in the tables are reduced to being pointers to the regulating text. Finally while the existing text may appear to be a definition of the terms, mass floors and mass walls can be a variety of weights and densities, but the IECC requires specific weights when the mass wall or mass floor is going to be an element of the building's thermal envelope.
This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
These revisions are strictly editorial in nature. They place the technical requirements for both mass walls and mass

floors in the appropriate code sections.

CE85-16

IECC: C402.2.5.

Proponent : Don Davies, representing Utah Chapter of ICC (don.davies@slcgov.com)

2015 International Energy Conservation Code

C402.2.5 Slabs-on-grade perimeter insulation. <u>(Mandatory)</u> 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 designed in accordance with the *R*-value method of Section C402.1.3 shall be as specified in Table C402.1.3. The insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The insulation shall extend downward from the top of the slab for a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least 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.

Reason: Reason: During the life expectancy of a building insulation can be added to envelope portions of the building. Doors and w indow s have a life expectancy of about 30 years so they w ill be replaced w ith more energy efficient items. Insulation on the roof can be added w hen the building is reroofed in 20 years, w hen the building gets exterior upgrades insulation can be added as EFIS or the w alls can be furred out and insulation can be added. One envelope element w hich w ill not be changed or upgraded w ill be at the slab on grade location. Adding the insulation later at the interior of the slab w ould be cost prohibited and at the exterior w ould require removing the w alks, landings and landscaping w hich is not going to happen. During construction the cost of the slab-on-grade insulation is minimal and is factored into the overall performance of the envelope. Slab on grade insulation is alw ays needed as a thermal break and should not be traded off for insulation elsew here.

Cost Impact: Will not increase the cost of construction
Cost: There is no additional cost since the cost of the insulation at the slab-on-grade location is factored into the calculation of the overall envelope requiring less insulation elsew here w hich can be upgraded at some later date.

CE85-16 : C402.2.5-DAVIES13450

CE86-16
Part I:
IECC: C402.2.5.1 (New).
Part II:
R402.2.10.1 (New) [IRC N1102.2.10.1 (New)]

THIS IS A 2 PART CODE CHANGE. PART I WILL BE HEARD BY THE IECC COMMERCIAL ENERGY COMMITTEE. PART II WILL BE HEARD BY THE IECC RESIDENTIAL ENERGY COMMITTEE.

Proponent : Brent Ursenbach (bursenbach@slco.org)

Part I

2015 International Energy Conservation Code

Add new text as follows:

C402.2.5.1 Radiant-heated slab-on-grade insulation Where radiant heating piping will be installed in a slab-on-grade, insulating materials having an R-value of not less than R-5 shall be installed beneath the entire slab to be heated.

Part II

2015 International Energy Conservation Code

Add new text as follows:

R402.2.10.1 (N1102.2.10.1) Radiant-heated slab-on-grade insulation. Where radiant heating piping will be installed in a slab-on-grade, insulating materials having an R-value of not less than R-5 shall be installed beneath the entire slab to be heated.

Reason: This proposal simply completes the relocation IMC 1209.5.1 to IECC commercial Chapter 4. As stated in the reason statement for M153-15 in Group A: Design professionals, code officials, contractors, developers, virtually all involved in the building process, look to the IECC for specific thermal performance values. Locating an insulation R-value in the IMC has created considerable confusion, as R-values and U-factors are expected to be found in the IECC.

Cost Impact: Will not increase the cost of construction
This proposal w ill not increase the cost of construction, as it simply relocates existing requirements from the IMC 1209.5.1 to IECC commercial Chapter 4.

CE86-16 : C402.2.5.1 (NEW)-URSENBACH12923

CE87-16

Part I:
IECC: C402.2.7 (New).
Part II:
R402.2.14 (New) [IRC N1102.2.14 (New)]

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 ORDERS FOR THESE COMMITTEES.

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

Part I

2015 International Energy Conservation Code

Add new text as follows:

C402.2.7 Airspaces. Where the thermal properties of airspaces are used to comply with this code in accordance with Section C401.2, such airspaces 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. Air spaces of not less than 1/2-inch thick (12.7 mm) that are located on the exterior side of the continuous air barrier and are adjacent to and behind the exterior wall covering material shall be assigned an R-value of not greater than R-0.7, provided that the R-values of the cladding material and the exterior air film are not included in the calculations demonstrating compliance with this code.

Part II

2015 International Energy Conservation Code

Add new text as follows:

R402.2.14 (N1102.2.14) Airspaces. Where the thermal properties of airspaces are used to comply with this code in accordance with Section R401.2, such airspaces shall be enclosed in an unventilated cavity constructed to minimize 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. Air spaces of not less than 1/2-inch thick (12.7 mm) that are located on the exterior side of the continuous air barrier and are adjacent to and behind the exterior wall covering material shall be assigned an R-value not greater than R-0.7, provided that the R-values of the cladding material and the exterior air film are not included in the calculations demonstrating compliance with Section R402.1.4.

Reason: This proposal is consistent with recent limitations placed on the thermal resistance application of reflective and non-reflective airspaces in ASHRAE 90.1-2013 (Addenda Supplement, Addendum AC). The R-values of airspaces are based on the assumption of "no air leakage" (see 2013 ASHRAE *Handbook of Fundamentals*, Chapter 25, Table 3, footnote b). Air leakage into and out of an airspace can significantly degrade its R-value, yet there is currently no standard calculation method or test method to discern this impact. Until such a time that this effect is quantified (for which there is an ASHRAE research project request under consideration), Addendum AC to ASHRAE 90.1 has provided a rational interim solution based on extensive review of available research data and consensus regarding that data. To also provide an interim solution for the common case of enclosed airspaces located behind cladding or outside of the air barrier layer of the building, an allowance is provided to consider such airspaces as being roughly equivalent to that of an indoor air film (e.g., R-0.7). This is also needed because some cladding R-values used in design are based on the assumption of an ideal air space (no air leakage or airflow) which is unrealistic and inappropriate and results in inflated R-values for airspaces that are necessarily leaky and/or intended to provide ventilation behind claddings.

Cost Impact: Will not increase the cost of construction
The energy code is currently silent on this matter. Consequently, this proposal provides guidance and options which can result in reduced construction costs where airspaces are appropriately used to help comply with the code.

CE87-16 : C402.2.7 (NEW)-CRANDELL12852

CE88-16

IECC: C202 (New), C402.3.

Proponent : Tim Earl, representing GBH International (tearl@gbhinternational.com)

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

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. ~~Roof gardens or landscaped~~ Vegetative 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/m^2] or 23 psf [117 kg/m^2] 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: "Vegetative roof" is the accepted term used throughout codes and standards, not "landscaped roof" or "roof garden." "Vegetative roof" is defined in Chapter 2 of the IBC, and there is no definition for "landscaped roof" or "roof garden." This proposal brings in the definition of "vegetative roof" from the IBC (as modified by a proposal this cycle from NRCA, consistent with the definition approved by ASTM Committee D08 on Roofing and Waterproofing) and replaces "landscaped roof" with the proper term. It also elminated the undefined term "roof garden."

Cost Impact: Will not increase the cost of construction
This is simple clarification.

CE88-16 : C402.3-EARL11835

CE89-16

IECC: C402.3.

Proponent : Jason Wilen AIA CDT RRO, National Roofing Contractors Association (NRCA), representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net)

2015 International Energy Conservation Code

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. ~~Roof gardens or landscaped~~ Vegetative 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/m^2] or 23 psf [117 kg/m^2] 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 change is to use terminology consistently throughout the I-Codes. The term "vegetative roof" is often used within the I-Codes and is defined in Chapter 2 of IBC. Other undefined terms are used in the I-Codes such as: "roof garden", "vegetated roof" and "landscaped roof".
This change is one of three (the other two address IBC and IFC) and will remove undefined terms in IECC where "vegetative roof" is appropriate.

Cost Impact: Will not increase the cost of construction
The proposed change is a clarification and does not change the stringency of existing code requirements so the cost of construction will be unchanged.

CE89-16 : C402.3-WILEN AIA CDT RRO11601

CE90-16

IECC: C402.3.1.

Proponent : James Kirby, representing Roof Coating Manufacturers Association, representing Center for Environmental Innovation in Roofing (jkirby@kellencompany.com)

2015 International Energy Conservation Code

Revise as follows:

C402.3.1 Aged roof solar reflectance. Where an aged solar reflectance required by Section C402.3 is not available, it shall be determined in accordance with Equation 4-3 or ASTM D7897.

$R_{aged} = [0.2+0.7(R_{initial} - 0.2)]$ **(Equation 4-3)**

where:

R_{aged}	=	The aged solar reflectance.
$R_{initial}$	=	The initial solar reflectance determined in accordance with CRRC-1 Standard.

Reference standards type: This reference standard is new to the ICC Code Books

Add new standard(s) as follows:

D7897-15, "Standard Practice for Laboratory Soiling and Weathering of Roofing Materials to Simulate Effects of Natural Exposure on Solar Reflectance and Thermal Emittance"

Reason: This proposal provides a consensus-developed ASTM laboratory test to determine aged solar reflectance of roofing materials in addition to the calculation.

Cost Impact: Will not increase the cost of construction
This adds an additional method to determine aged solar reflectance.

Analysis: A review of the standard(s) proposed for inclusion in the code, ASTM D7897, 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 1, 2015.

CE90-16 : C402.3.1-KIRBY13275

CE91-16

IECC: C402.4, C402.4 (2) (New), C402.4.3, C407.5.1.

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, representing Alliance to Save Energy; William Prindle, ICF International, representing Energy Efficient Codes Coalition

2015 International Energy Conservation Code

Revise as follows:

C402.4 Fenestration (Prescriptive). Fenestration shall comply with Sections C402.4 through C402.4.4~~ and Table C402.4~~. Daylight responsive controls shall comply with this section and Section C405.2.3.1.

C402.4.3 Maximum U-factor and SHGC. The maximum *U*-factor and solar heat gain coefficient (SHGC) for fenestration in commercial buildings more than three stories in height above grade plane shall be as specified in Table ~~C402.4~~ C402.4(1). The maximum U-factor and solar heat gain coefficient (SHGC) for fenestration in commercial buildings three stories or less in height above grade plane shall be as specified in Table C402.4(2).

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 furthest 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.

TABLE C402.4 (1)
BUILDING ENVELOPE FENESTRATION MAXIMUM *U*-FACTOR AND SHGC REQUIREMENTS FOR BUILDINGS MORE THAN THREE STORIES IN HEIGHT ABOVE GRADE PLANE

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	SEW	N	SEW	N	SEW	N	SEW	N
PF	0.25	0.33	0.25	0.33	0.25	0.33	0.40	0.53	0.40	0.53	0.40	0.53	0.45	NR	0.45	NR

0.2 ≤ PF	0.30	0.37	0.30	0.37	0.30	0.37	0.48	0.58	0.48	0.58	0.48	0.58	NR	NR	NR	NR
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.64	0.64	0.64	0.64	0.64	0.64	NR	NR	NR	NR
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.

TABLE C402.4 (2)
BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS FOR BUILDINGS THREE STORIES AND LESS IN HEIGHT ABOVE GRADE PLANE

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
***U*-factor**								
Curtainwall and StoreFront	0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29
Other Fixed and Operable Fenestration [a]	0.50	0.40	0.35	0.35	0.32	0.32	0.32	0.32
Entrance doors	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77
SHGC								
SHGC	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
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.

a. This category of Other Fixed and Operable Fenestration includes all vertical fenestration except Curtainwall, Storefront and Entrance Doors.

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
	Type: Mass wall	As proposed

Walls, below-grade	Gross area: same as proposed	As proposed
	U-Factor: as specified in Table C402.1.4 with insulation layer on interior side 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 glazing area; where the proposed glazing area is less than 40 percent of above-grade wall area. 2.40 percent of above-grade wall area; where the proposed glazing area is 40 percent or more of the above-grade wall area.	As proposed
	U-factor: as specified in Table C402.4<ins>(1) or C402.4(2), in accordance with Section 402.4.3</ins>.	As proposed
	SHGC: as specified in Table C402.4<ins>(1) or C402.4(2), in accordance with Section 402.4.3</ins>, except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed

	External shading and PF: None	As proposed
Skylights	Area 1.The proposed skylight area; where the proposed skylight area is less than 3 percent of gross area of roof assembly. 2.3 percent of gross area of roof assembly; where the proposed skylight area is 3 percent or more of gross area of roof assembly	As proposed
	U-factor: as specified in Table C402.4(1) or C402.4(2), In accordance with Section 402.4.3.	As proposed
	SHGC: as specified in Table C402.4(1) or C402.4(2), in accordance with Section 402.4.3, 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 C405.4.2. 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 C405.5.2(2). Areas and dimensions of tradable and nontradable surfaces shall be the same as proposed.	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
		Receptacle, motor and process loads shall be modeled and estimated based on the space

Internal gains	Same as proposed	use classification. All 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	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 C403.2.6.
Heating systems	Fuel type: same as proposed design	As proposed
	Equipment typea : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.2.3(4) and C403.2.3(5)	As proposed
	Capacityb : 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	As proposed

	factors are provided than in the proposed design.	
Cooling systems	Fuel type: same as proposed design	As proposed
	Equipment typec : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.2.3(1), C403.2.3(2) and C403.2.3(3)	As proposed
	Capacityb : 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
	Economizerd : same as proposed, in accordance with Section C403.3.	As proposed
Service water heatinge	Fuel type: same as proposed	As proposed
	Efficiency: as specified in Table C404.2	For Group R, as proposed multiplied by SWHF. For other than Group R, 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 C403.3 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 C403.3.

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 unit efficiency · 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 unit efficiency · 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 unit efficiency · 0.26)].

4. Where Items 1 through 3 are not met, SWHF = 1.0.

Reason: The purpose of this code proposal is to establish prescriptive requirements for more efficient vertical fenestration in buildings three stories and less. This proposal first separates fenestration requirements for buildings above 3 stories in height from smaller buildings similar to the division for multifamily residential (R-2) where buildings are separated for purposes of efficiency requirements. This proposal then uses the more stringent residential requirements for U-factor for vertical fenestration in the smaller buildings, just as is done for smaller R-2 buildings. U-factor requirements for curtainwall, storefront, entrance doors and skylights are unchanged from the current commercial building requirements. A simplified version of the commercial SHGC requirements is also included. Given that these buildings can have up to 30% glazing area, these improvements in fenestration performance will bring substantial savings for smaller commercial buildings.

To determine the energy savings impact of these improvements, energy simulations were performed across all climate zones using the U.S. DOE's Commercial Prototype Building Models for small commercial office buildings. These prototype models designate characteristics of a typical small commercial office building including, but not limited to, building size, window area, HVAC system type, lighting type, and occupancy. The models were modified to create a baseline building that aligned with the 2015 IECC and an upgrade that met the proposed fenestration U-factors for each climate zone. These energy simulations yielded savings from 0.5% to 1.6% and a positive life-cycle cost reduction in all climate zones.

Climate Zone	% Savings	Life Cycle Cost
CZ 1	0.5%	-$749
CZ 2	0.9%	-$1,263
CZ 3	0.8%	-$823
CZ 4	0.5%	-$407
CZ 5	1.1%	-$925
CZ 6	1.2%	-$943
CZ 7	0.8%	-$627
CZ 8	1.6%	-$1,200

Cost Impact: Will increase the cost of construction
For a small commercial office building, we estimate that the construction cost will increase by approximately $57 to $288 across all climate zones per the NREL Residential Energy Efficiency Measure Database (http://www.nrel.gov/ap/retrofits/group_listing.cfm). This data source is relevant as the window types explicitly called out in this proposal are typical of residential construction. Although construction costs are increased in this proposal, improvements to the window U-factor requirements yield a positive life cycle cost when analyzed over a 30 year period. The analysis used to assess this efficiency improvement is based on the U.S. DOE's residential code change methodology.

Climate Zone	Incremental Cost
CZ 1-2	$172.99
CZ 3	$288.32
CZ 4	$115.33
CZ 5	$149.93
CZ 6	$126.86
CZ 7-8	$57.66

CE91-16 : C402.4-FAY12594

CE92-16

IECC: C402.4.

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, ICF International, representing Energy Efficient Codes Coalition

2015 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**	**SEW**	**N**	**SEW**	**N**	**SEW**	**N**	**SEW**	**N**
PF	0.25	0.33	0.25	0.33	0.25	0.33	0.25~~0.40~~	0.33~~0.53~~	0.25~~0.40~~	0.33~~0.53~~	0.25~~0.40~~	0.33~~0.53~~	0.45	NR	0.45	NR
0.2 ≤ PF	0.30	0.37	0.30	0.37	0.30	0.37	0.30~~0.48~~	0.37~~0.58~~	0.30~~0.48~~	0.37~~0.58~~	0.30~~0.48~~	0.37~~0.58~~	NR	NR	NR	NR
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.40~~0.64~~	0.40~~0.64~~	0.40~~0.64~~	0.40~~0.64~~	0.40~~0.64~~	0.40~~0.64~~	NR	NR	NR	NR
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 proposed code change is to strengthen the SHGC requirement for vertical fenestration in climate zones 4 - 6 from 0.40 to 0.25, thereby increasing the energy efficiency of vertical fenestration in these climate zones.

Low solar heat gain fenestration is even more critical for commercial buildings than residential buildings in virtually all climate zones because commercial buildings tend to be internal heat load dominated, and require cooling during far more hours. Recognizing this fact, the IECC (and ASHRAE 90.1) currently require some degree of solar control in commercial buildings in all climate zones, by requiring an SHGC of 0.45 or less even in climate zones 7 - 8, 0.40 or less in climate zones 4 – 6; and 0.25 or less in climate zones 1 - 3.

When the 0.40 maximum was established for climate zones 4 - 6, a consideration that may have justified the higher SHGC was the reduction in visible light that came with lower SHGC glazing at that time. However, this issue has since been addressed with the introduction of low SHGC glass with much higher visible light transmission resulting from optimizing control of solar gain outside of the visible light spectrum. As a result, lower SHGCs have already been established for residential buildings in climate zones 1 -3 (dropping from 0.40 SHGC in the 2006 *IECC* to 0.25 in the 2012 *IECC*). A similar benefit can be captured for commercial buildings in climate zones 4 – 6 by setting the maximum SHGC at 0.25 for these climate zones. The level of solar heat gain, whether 0.40 or 0.25, is simply a choice of low-e coatings and does not involve significant increases in cost.

The Efficient Windows Collaborative ("EWC") shows how low solar gain, low U-factor and high visible light can now be achieved with improved glazing (see Image #1; note that these are glass-only values; since NFRC ratings also factor in frames, the reported SHGC and VT can be expected to be at least 10% lower).

It is well documented that buildings (which account for over 70% of the electricity used in the United States) have the greatest potential for reducing both energy use and particularly peak electricity use. Peak electricity use is driven by air conditioning load, which is, in large part, driven by summer solar gain. Lower SHGC windows will translate into substantial energy cost savings for building owners and a reduced need for utilities to build additional peak generating plants. For example, based on U.S. DOE's EnergyPlus office reference buildings and an assumption of 30% fenestration area, we estimate a net energy savings (heating, cooling and hot water) for this proposed reduction in maximum SHGC to 0.25 ranging between 2% and 5% depending on the climate zone.

Lower SHGCs also produce increased summer comfort, as also illustrated by the EWC on its website (see Image #2). According to EWC:

"In summer, strong direct sunlight strikes people and interior surfaces, creating overheating and discomfort. Windows with low solar heat gain coefficients will reduce the solar radiation coming through the glass and associated discomfort. Low solar heat gain low-E glass (spectrally selective) reduces heat gain while still providing sufficient light and view."

For all of these reasons, reducing the SHGC prescriptive requirement to 0.25 in climate zones 4 – 6 is justified in order to reduce energy use and electrical peak demand in commercial buildings.

Cost Impact: Will not increase the cost of construction
Lower SHGCs in climate zones 4-6 can be expected to result in smaller cooling equipment for such buildings, which is likely to easily offset any cost increase for a lower SHGC, which is generally only the difference in cost for a different SHGC coating, at most. Reducing SHGC will provide savings to all consumers, and not just the owners or operators of buildings.

CE92-16 : C402.4-FAY12755

CE93-16

IECC: C402.4, C402.4.3, C402.4.3 (New), C402.4.3.1 (New).

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition

2015 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~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~
<u>All Vertical Fenestration</u>~~PF~~	0.25	~~0.33~~	0.25	~~0.33~~	0.25	~~0.33~~	0.40	~~0.53~~	0.40	~~0.53~~	0.40	~~0.53~~	0.45	~~NR~~	0.45	~~NR~~
~~0.2 ≤ PF~~	~~0.30~~	~~0.37~~	~~0.30~~	~~0.37~~	~~0.30~~	~~0.37~~	~~0.48~~	~~0.58~~	~~0.48~~	~~0.58~~	~~0.48~~	~~0.58~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~
~~PF ≥ 0.5~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.64~~	~~0.64~~	~~0.64~~	~~0.64~~	~~0.64~~	~~0.64~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~
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.~~

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 furthest 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.~~

Add new text as follows:

TABLE C402.4.3
FENESTRATION SHGC MULTIPLIERS

PROJECTION FACTOR	ALL ORIENTATIONS
0.2 ≤ PF < 0.40	0.91
0.40 ≤ PF < 0.60	0.74
0.60 ≤ PF < 0.80	0.61
0.80 ≤ PF < 1.00	0.51

C402.4.3.1 SHGC adjustment for projection factor Where the fenestration projection factor for a specific vertical fenestration product is greater than or equal to 0.2, the SHGC of that fenestration product shall be reduced by multiplying the product SHGC by the multiplier specified in Table C402.4.3 that corresponds with the projection factor.
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 furthest 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.

Reason: The purpose of this proposed code change is to restore the simpler and more stringent SHGC values from the 2012 IECC and ASHRAE 90.1-2013 (see Tables 5.5-1 through 5.5-8) and to implement a simplified projection factor multiplier based on ASHRAE 90.1-2013 Table 5.5.4.4.1.
It should be noted that proposed Table C402.4.3 reflects ASHRAE projection factor values, but has been condensed from 9 projection factor ranges to 4 ranges and from two different orientations to a single orientation (the value for "All Other Orientations") in order to simplify the application of the table. The proposed Table uses the most conservative values for each of the four ranges. This proposal will improve efficiency under the code, simplify the

application of these requirements, and reduce the potential for confusion in the application of this trade-off.

See R. Hart, et. al., *National Cost-Effectiveness of ANSI/ASHRAE/IES Standard 90.1-2013* (Jan. 2015), https://www.energycodes.gov/sites/default/files/documents/Cost-effectiveness_of_ASHRAE_Standard_90-1-2013-Report.pdf.

Bibliography: *National Cost-Effectiveness of ANSI/ASHRAE/IES Standard 90.1-2013, R. Hart, et. al.,* January 2015,
https://www.energycodes.gov/sites/default/files/documents/Cost-effectiveness_of_ASHRAE_Standard_90-1-2013-Report.pdf.

Cost Impact: Will not increase the cost of construction
In most cases, there is little or no additional cost to meet the SHGC requirement since the U-factor requirements for the windows are likely to already require low-e, making SHGC only a function of which low-e coating is selected. In addition, lower SHGC would result in lower cooling loads and likely smaller-sized equipment at a lower cost. Finally, it is unlikely this exception is used very much given the cost of overhangs and the nature of the exception.
This proposal also aligns with ASHRAE 90.1-2013, which has been determined by the U.S. DOE to be cost-effective.

CE93-16 : C402.4-FAY12759

CE94-16

IECC: C402.4.

Proponent : Thomas Culp, Birch Point Consulting LLC, representing the Glazing Industry Code Committee (culp@birchpointconsulting.com)

2015 International Energy Conservation Code

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	SEW	N	SEW	N	SEW	N	SEW	N
PF	0.25	0.33	0.25	0.33	0.25	0.33	~~0.40~~ 0.36	~~0.53~~ 0.48	~~0.40~~ 0.38	~~0.53~~ 0.51	0.40	0.53	0.45	NR	0.45	NR
0.2 ≤ PF	0.30	0.37	0.30	0.37	0.30	0.37	~~0.48~~ 0.43	~~0.58~~ 0.53	~~0.48~~ 0.46	~~0.58~~ 0.56	0.48	0.58	NR	NR	NR	NR
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	~~0.64~~ 0.58	~~0.64~~ 0.58	~~0.64~~ 0.61	~~0.64~~ 0.61	0.64	0.64	NR	NR	NR	NR
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: This proposal decreases the maximum SHGC requirement in climate zones 4 and 5. This represents a reasonable increase in stringency for these zones with mixed heating and cooling, and is consistent with the SHGC values in addendum "ai" for ASHRAE 90.1-2016. As a basis for these values, the ASHRAE 90.1 committee reviewed energy modeling results for the prototype medium office building used by PNNL for DOE determinations, and also considered the range of other types of buildings covered by the standard, balance between heating and cooling, and product availability. The 10% and 5% reductions in SHGC will result in energy cost savings and tighten the energy budget for the performance path in these zones, and also smooth the progression in SHGC from southern to northern zones. While this reduction will restrict certain higher SHGC products, this level of reduction is practical and is supported by the glazing industry.

Both IECC and ASHRAE 90.1 include the combined effect of fenestration SHGC and shading by permanent projections for compliance, but in different formats. The 2015 IECC uses a simpler look-up table based on projection factor and orientation (and compliance can always be satisfied by simply using the most stringent value within each zone if the user doesn't want to consider shading and orientation), whereas ASHRAE 90.1 uses more complicated equations. For this table, the corresponding SHGC values with projection factors between 0.2 – 0.5 and greater than 0.5 were determined using the same shading multipliers from the 2012 IECC (which were based on ASHRAE 90.1 although slightly more conservative), and can also be derived by simple interpolation between the values for zones 3 and 6.

Cost Impact: Will not increase the cost of construction
This proposal will not increase the cost of construction. The ASHRAE 90.1 analysis considered the incremental costs of 305 different fenestration assemblies including 42 double and triple glazing combinations covering different low-e glass technologies. While this proposal does restrict certain glazing products, the lowest cost low-e glazing products will comply, and therefore not significantly impact construction cost.

CE94-16 : TABLE C402.4-CULP12407

CE95-16

IECC: C402.4.

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

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**	**SEW**	**N**	**SEW**	**N**	**SEW**	**N**	**SEW**	**N**
PF	~~0.25~~0.22	0.33	~~0.25~~0.22	0.33	0.25	0.33	0.40	0.53	0.40	0.53	0.40	0.53	0.45	NR	0.45	NR
0.2 ≤ PF	~~0.30~~0.26	0.37	~~0.30~~0.26	0.37	0.30	0.37	0.48	0.58	0.48	0.58	0.48	0.58	NR	NR	NR	NR
PF ≥ 0.5	~~0.40~~0.35	0.40	~~0.40~~0.35	0.40	0.40	0.40	0.64	0.64	0.64	0.64	0.64	0.64	NR	NR	NR	NR
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: This proposed change modifies the Solar Heat Gain Coefficient (SHGC) requirements for fenestration in Climate Zones 1 and 2 to increase stringency. The SHGC indicates how much solar heating is absorbed through fenestration. The lower the SHGC, the less heat gain there is into a building through the windows. Requiring windows with a lower SHGC reduces the heat gain in a building space and reduces the need for cooling, saving energy. There are also likely to be comfort improvements as a result of less solar gain inside the space.

Energy Savings: DOE conducted an energy analysis using the established methodology: https://www.energycodes.gov/development/commercial/methodology.[1] An analysis of energy impact shows that savings from the improved SHGC in the proposal ranges from $0.087 to $0.141 per square foot of glazing area in medium-sized offices and mid-rise apartment buildings in Climate Zones 1 and 2. More details are found in the cost-effectiveness analysis referenced in the cost impact section.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

Bibliography:

1. Hart, R., and Liu, B. (2015). *Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes.* Pacific Northwest National Laboratories for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-23923 Rev1. https://www.energycodes.gov/development/commercial/methodology.
2. Athalye, R. and R. Hart. August 2015. "Cost-effectiveness Analysis Summary for SHGC Upgrade." https://www.energycodes.gov/development/2018IECC.

Cost Impact: Will increase the cost of construction

Lower SHGC adds a moderate cost to the building, ranging from $1.40 to $1.50 per square foot of glass area for the changes indicated in the proposal. In addition, there can be a reduction in peak cooling loads that may result in smaller cooling equipment, reducing costs—such HVAC cost reductions were not included in the cost-effectiveness analysis.

Cost-effectiveness: DOE conducted a cost-effectiveness analysis using the established DOE methodology: https://www.energycodes.gov/development/commercial/methodology.[1] Results of the cost-effectiveness analysis showed that in Climate Zones 1 and 2 the average savings-to-investment ratio (SIR) was 2.5 in medium-sized offices and 1.7 in mid-rise apartment buildings. A proposal 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 complete cost-effectiveness analysis is available at: https://www.energycodes.gov/development/2018IECC.[2] The cost effectiveness analysis evaluates savings for the base case in the table where projection factor (PF) is less than 0.2. The remaining projection factor cases are adjusted proportionally to existing requirements.

CE95-16 : TABLE C402.4-WILLIAMS12168

CE96-16

IECC: C402.4.1, C402.4.1.2, C402.4.2.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C402.4.1 Maximum area. The vertical fenestration area (not including opaque doors and opaque spandrel panels) shall not be greater than 30 percent of the gross above-grade wall area. The skylight area shall not be greater than 3 percent of the gross roof area.

<u>**Exception:** The skylight area shall not be limited to 3 percent of the gross roof area where required for compliance with Section C402.4.2.</u>

C402.4.1.2 Increased skylight area with daylight responsive controls. ~~The skylight area shall be permitted to be not more than 5 percent of the roof area provided *daylight responsive controls*~~
<u>Where daylight responsive controls</u> complying with Section C405.2.3.1 are ~~installed~~ <u>provided</u> in ~~*daylight zones*~~<u>daylight zones</u> under skylights<u>, the allowed skylight area shall be increased to not greater than 5 percent of the gross roof area</u>.

<u>**Exception:** The skylight area shall not be limited to 5 percent of the gross roof area where required for compliance with Section C402.4.2.</u>

C402.4.2 Minimum skylight fenestration area. ~~In an~~
<u>Skylights shall be provided in</u> enclosed ~~space~~ <u>spaces</u> greater than 2,500 square feet (232 m^2) 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~~ <u>. The</u> total *daylight zone* under skylights shall be not less than half the floor area and shall ~~provide~~ <u>comply with</u> one of the following:

1. A minimum skylight area to *daylight zone* under skylights of not less than 3 percent where all skylights have a VT of at least 0.40 as determined in accordance with Section C303.1.3.
2. A minimum skylight effective aperture of at least 1 percent, determined in accordance with Equation 4-4.

$$\text{Skylight Effective Aperture} = \frac{0.85 \cdot \text{Skylight Area} \cdot \text{Skylight VT} \cdot \text{WF}}{\text{Daylight zone under skylight}}$$

(Equation 4-4)

(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/ft^2 (5.4 W/m^2).
3. Areas where it is documented that existing structures or natural objects block direct beam sunlight on at least 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 daylight zones adjacent to vertical fenestration is less than 2,500 square feet (232 m^2), and where the lighting is controlled according to Section ~~C405.2.3~~ C405.2.5.

Reason: Establishing a maximum skylight area of 3% or 5% of the roof area in Sections C402.4.1 and C402.4.1.2 conflicts with the requirements and intent of Section C402.4.2. Section C402.4.2 requires that minimum toplighting be provided in certain, specific large open commercial spaces to the extent that at least half of the floor area is toplit (in a daylight zone under skylights). It also requires a minimum ratio of skylight area to toplight area of 3%. Restricting the skylight area to either 3% or 5% of the roof area increases the difficulty, and in some cases the cost, of complying with this provision particularly in buildings that consist primarily of such large, open commercial spaces.

Consider, for example, a 10,000 sq. ft. retail store. In this case, a fairly high percentage of the building (perhaps as high as 90%) might be required to have toplighting (i.e. the space has a ceiling height greater than 15 feet, and is used as storage or retail space). So in this case, the toplighting requirements apply to 9000 sq. ft. of the building, and at least 4500 sq. ft must be toplight, with a minimum skylight area of 4500 x 0.03 = 135 sq. ft. At the same time, 4500 sq. ft. of the space must be toplighted with no more than 10,000 x 0.05 = 500 sq. ft of skylight (assuming 5% since the space to be toplighted must be equipped with automatic lighting controls).

Toplighting 4500 sq. ft. with 500 sq. ft of skylights in a space with a 15 foot ceiling can be accomplished, but it requires multiple skylights distributed over the entire area to be toplighted. If a single 5 ft by 10 ft skylight were used, for example, it would only toplight (5 + 2(0.7)15)(10 + 2(0.7)15) = 806 sq. ft. In this case 6 such skylights would need to be used, which of course would exceed the 500 sq. ft. of skylight area permitted for the entire building. If there are vertical obstructions in the storage area, such as floor to ceiling storage racks, the problem is compounded even more. The problem can be solved by providing multiple skylights distributed over the roof of the building, but the cost goes up with each roof opening provided.

Another example is a gymnasium/exercise center. Although the primary space is likely to be large and open, and the requirements of Section C402.4.2 would not apply to certain other spaces such as locker rooms and office, there may very well be a third type of space to which they do apply, but which are separated from the primary space by floor to ceiling walls. These spaces include racquetball courts, dance studios and fitness rooms (rooms with exercise equipment).

In this case the percentage of the total building to which the toplighting requirements apply may be less than that of the previous example. But the area provided with toplighting by some of the skylights may be severely reduced due to the presence of vertical obstructions which prevent the distribution of toplighting from one space to another.

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The intent of the proposal is to coordinate the provisions for maximum skylights and minimum skylights. The clarity may result in more or fewer skylights in certain designs, but should not affect the cost of construction.

CE96-16 : C402.4.1-COLLINS11554

CE97-16

IECC: C402.4.1.2.

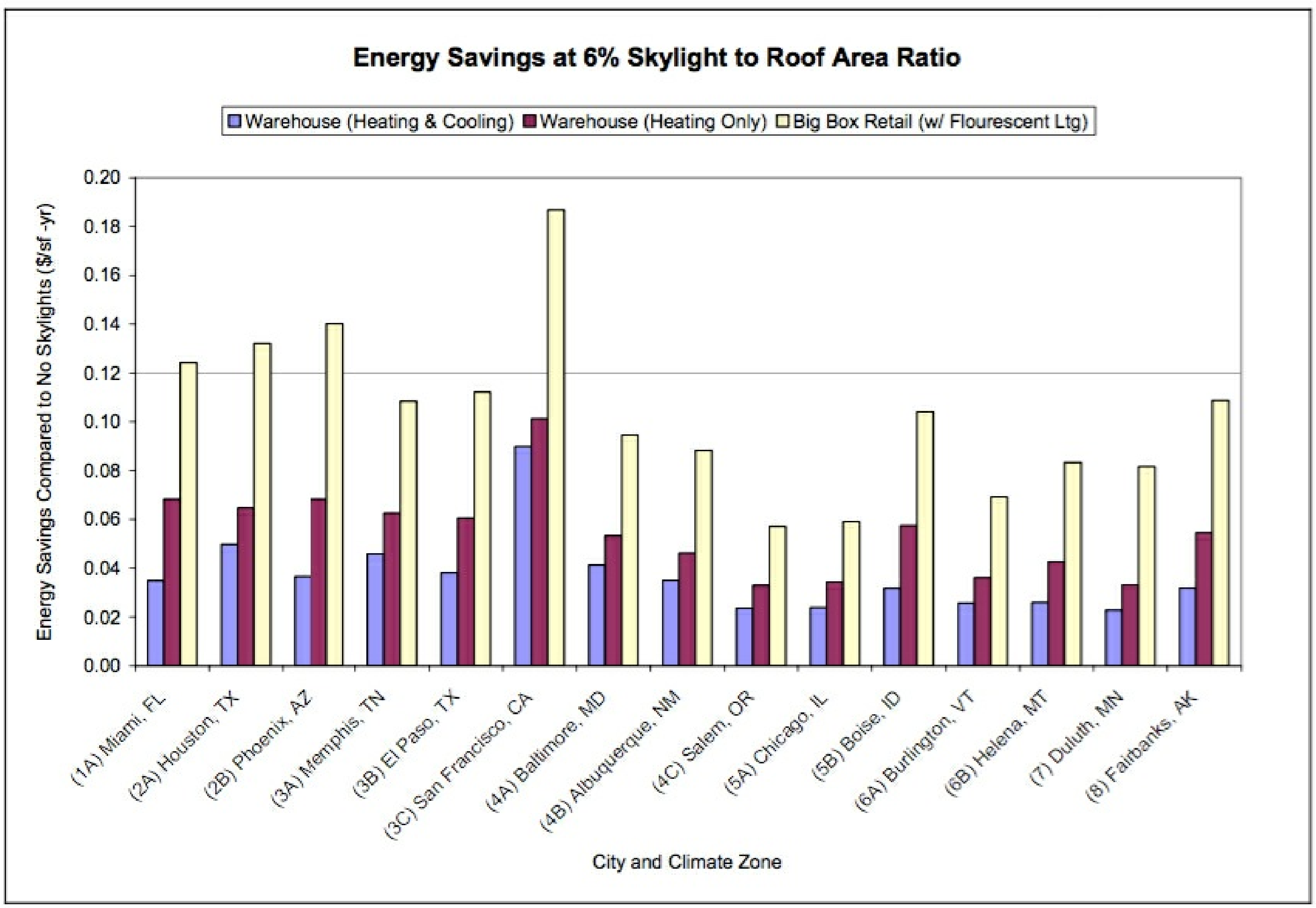
Proponent : Thomas Culp, Birch Point Consulting LLC, representing the Glazing Industry Code Committee and Aluminum Extruders Council (culp@birchpointconsulting.com)

2015 International Energy Conservation Code

Revise as follows:

C402.4.1.2 Increased skylight area with daylight responsive controls. The skylight area shall be permitted to be not more than ~~5~~ 6 percent of the roof area provided that *daylight responsive controls* complying with Section C405.2.3.1 are installed in *daylight zones* under skylights.

Reason: This proposal changes the maximum skylight area when daylighting controls are used from 5% to 6% of the roof area. When the toplighting requirements were first added to ASHRAE 90.1-2010 and the 2012 IECC, the research studies they were based on showed positive energy savings for skylight areas > 6% in all climate zones (for example, see figure below). ASHRAE 90.1 has the same cap on skylight area as the IECC of 3% when no daylight controls are provided, but allows 6% with proper toplighting instead of 5%. This proposal updates the percentage allowed with daylight controls to the same 6%. This will also help reduce potential conflicts where the minimum toplighting requirement of C402.3.2 would require more skylight area than allowed by this section.



Heschong Mahone Group / AAMA, page 20.

Bibliography: "90.1 Skylighting Requirements Code Change Proposal" Heschong Mahone Group, Pacific Northwest National Laboratory, Project No: 0726 PNNL ASHRAE 90.1, 2008.

"Updates to Treatment of Skylighting in the IECC", Heschong Mahone Group for AAMA Skylight Council, 2005.

"Energy Study in Support of the Proposed Revision of the International Energy Conservation Code (IECC), Skylight Portion of Table 502.3", Carli Inc. for AAMA Skylight Council, 2006.

Cost Impact: Will not increase the cost of construction
This proposal will not increase the cost of construction, as it simply changes the amount of skylight area allowed, but does not require skylights.

CE97-16 : C402.4.1.2-CULP12417

CE98-16

IECC: C402.4.1.2, C402.4.2, C402.4.2.1.

Proponent : Hope Medina, representing Colorado Chapter of ICC (hmedina@coloradocode.net)

2015 International Energy Conservation Code

Revise as follows:

C402.4.1.2 Increased skylight area with daylight responsive controls. The skylight area shall be permitted to be not more than 5 percent of the roof area provided *daylight responsive controls* complying with Section C405.2.3.1 are installed in *Toplight daylight zones*. ~~under skylights.~~

C402.4.2 Minimum skylight fenestration area. In an enclosed space greater than 2,500 square feet (232 m^2) 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 *toplight daylight zone* ~~under skylights~~ shall be not less than half the floor area and shall provide one of the following:

1. A minimum skylight area to *toplight daylight zone* ~~under skylights~~ of not less than 3 percent where all skylights have a VT of at least 0.40 as determined in accordance with Section C303.1.3.
2. A minimum skylight effective aperture of at least 1 percent, determined in accordance with Equation 4-4.

$$\text{Skylight Effective Aperture} = \frac{0.85 \cdot \text{Skylight Area} \cdot \text{Skylight VT} \cdot \text{WF}}{\text{Daylight zone under skylight}} \quad \text{(Equation 4-4)}$$

(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/ft^2 (5.4 W/m^2).
3. Areas where it is documented that existing structures or natural objects block direct beam sunlight on at least 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 ~~adjacent to vertical fenestration~~ is less than 2,500 square feet (232 m^2), and where the lighting is controlled according to Section C405.2.3.

C402.4.2.1 Lighting controls in toplight daylight zones ~~under skylights.~~ *Daylight responsive controls* complying with Section C405.2.3.1 shall be provided to control all electric lights within ~~*daylight zones* under skylights~~ toplight daylight zones.

Reason: The section and figure titles need to the reflect the same names as the requirements within them do. That way people can find what they are looking for. The definition and the verbiage in the sections got changed in the last code cycle, but for some reason the section titles and figures still use the old names as found in the 2012 IECC code.
Our Theme: A Code for the End User

Is the code section completely understandable to the end user?

Is the code section or requirement easy to find?

Is the code requirement even doable in the real world?

Will the code requirement really save energy or only on paper?

Cost Impact: Will not increase the cost of construction
This change is to correct the titles, so will not impact cost.

CE98-16 : C402.4.1.2-MEDINA12924

CE99-16

IECC: C402.4.2.

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 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 m^2) 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 *daylight zone* under~~ skylights ~~shall be~~ are required to provide toplight *daylight zone area* not less than half the floor area and shall provide one of the following:

1. A minimum skylight area to toplight *daylight zone* ~~under skylights~~ area of not less than 3 percent where all skylights have a VT of at least 0.40 as determined in accordance with Section C303.1.3.
2. A minimum skylight effective aperture of at least 1 percent, determined in accordance with Equation 4-4.

$$\cancel{\text{Skylight Effective Aperture} = \frac{0.85 \cdot \text{Skylight Area} \cdot \text{Skylight VT} \cdot \text{WF}}{\text{Daylight zone under skylight}} \quad \text{(Equation 4-4)}}$$

(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~~ combined total *general lighting* and specific application power ~~densities are~~ density is less than 0.5 W/ft^2 (5.4 W/m^2).
3. Areas where it is documented that existing structures or natural objects block direct beam sunlight on at least 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 floor area minus the ~~area of~~ sidelight daylight ~~zones~~

~~adjacent to vertical fenestration~~ zone area is less than 2,500 square feet (232 m^2), and where the lighting in the daylight zone is controlled ~~according to~~ in accordance with Section C405.2.3.

Reason: The goal of the code change proposals to Section C402.4.2 is to improve clarity regarding how the skylight daylight zone requirement in this provision is defined. Currently the IECC uses the term "toplighting" and not "daylighting under skylights." This proposal modifies the terminology for consistency. The proposal also limits projects that are eligible for Exception 2 by including both general area and specific application lighting power for the 0.5 watts per sf exception. This would increase the energy savings an additional $384 to $408 per year over the current estimated energy savings.

Bibliography: Energy Center of Wisconsin

Cost Impact: Will increase the cost of construction
The additional energy cost for this proposal will be $2.00—$2.50 per square foot of floor area for buildings that were exempt under the 2015 IECC under the lighting power density exemption (see Exemption 2).
Skylight's average installed cost is $25—$45 per sf of skylight assembly area. At 5% roof area, the overall cost is $1.25—$2.25 per sf of floor area. Daylighting controls cost is $0.50—$1.00 per sf of floor area. Total installed cost of skylights and daylighting controls $2.00—$2.50 per square foot of floor area.

CE99-16 : C402.4.2-MAKELA12461

CE100-16

IECC: C402.4, C402.4.3.

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, ICF International, representing Energy Efficient Codes Coalition

2015 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~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~
All Vertical Fenestration~~PF~~	0.25	~~0.33~~	0.25	~~0.33~~	0.25	~~0.33~~	0.40	~~0.53~~	0.40	~~0.53~~	0.40	~~0.53~~	0.45	~~NR~~	0.45	~~NR~~
~~0.2 ≤ PF~~	~~0.30~~	~~0.37~~	~~0.30~~	~~0.37~~	~~0.30~~	~~0.37~~	~~0.48~~	~~0.58~~	~~0.48~~	~~0.58~~	~~0.48~~	~~0.58~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~
~~PF ≥ 0.5~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.64~~	~~0.64~~	~~0.64~~	~~0.64~~	~~0.64~~	~~0.64~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~
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.~~

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 furthest 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.~~

Reason: The purpose of this proposed code change is to accomplish two improvements: Restore the simpler and more stringent SHGC values from the 2012 IECC (and the 2013 ASHRAE 90.1 Standard – see Tables 5.5-1 through 5.5-8) and eliminate projection factor trade-offs in the prescriptive path.
In the 2015 IECC, the SHGC for the north orientation was increased from 0.25 to 0.33. This proposal would return this SHGC to the more stringent level required by the 2012 IECC and ASHRAE Standard 90.1-2013.

Projection factor trade-offs overly complicate the code and provide no energy efficiency benefit (by definition, the trade-off is, at best, energy neutral). In fact, given the much higher cost to build permanent projections/overhangs versus reducing the SHGC for fenestration and the benefits of both, we think that the current trade-off unnecessarily confuses the code and promotes free ridership and weaker fenestration for those buildings that would already have overhangs. In order to use this trade-off, it would be necessary to calculate the projection factor for each window, determine the orientation and then specify and install the correct window in that orientation on the job site. There are too many opportunities to fail in this process and no real opportunity for any efficiency gain – this is particularly problematic for buildings using the simple prescriptive path. In short, this prescriptive projection factor trade-off should be eliminated. If the builder wants to design the building and use overhangs as an energy feature, they can do so in the performance path, where at least the benefits are more precisely determined.

Cost Impact: Will not increase the cost of construction
In most cases, there is little or no additional cost to meet the SHGC requirement since the U-factor requirements for the windows are likely to already require low-e coatings, making SHGC only a function of which low-e coating is selected. In addition, lower SHGC would result in lower cooling loads and likely smaller-sized equipment at a lower cost. Finally, it is unlikely this exception will be used very much given the cost of overhangs and the nature of the exception.

CE100-16 : C402.4.3-FAY12763

CE101-16

IECC: C402.4.3.4 (New).

Proponent : Michael Jouaneh, Lutron Electronics Co., Inc., representing Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

2015 International Energy Conservation Code

Add new text as follows:

C402.4.3.4 Dynamic shades. Where interior or exterior window shades, blinds, louvers or drapes are used to improve the overall SHGC of the fenestration system, the combined performance satisfies the SHGC of Table C402.4, where the shading device is permanent and capable of automatically modulating in multiple steps the amount of solar gain and light transmitted into the space in response to daylight levels or solar intensity, and the shading devices comply with all of the following:

1. They are capable of providing not less than 90 percent coverage of the fenestration in the closed position.
2. Manual override controls located in the same space as the as dynamic shading shall not override operation of automatic controls for periods longer than 4 hours.

Reason: Window shading systems can provide significant improvement in SHGC of fenestration systems. The only way to guarantee that these system blocks 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 hardwired into the building and are as permanent as any luminaire.

The combined SHGC is readily available from the shading manufacturers or computed in free software such as WINDOW from LBNL.

There are industry standards that are used to measure the combined SHGC performance of windows with the shading devices such as "performance tests were conducted in accordance with EN 14501:2005, ASTM E891, ASTM E903-96: Solar Heat Gain Coefficient SHGC (G-Value), Solar Transmittance (Ts), Solar Reflectance (Rs), Solar Absorptance (As), Visible Light Transmission VLT (Tv), Double Glazing 6 mm / ½" air / 6 mm with low E on surface #2. Glass performance tests were conducted using the Lawrence Berkeley National Laboratory Window 6.3 NFRC certified software." See example from Mermet : http://www.mermetusa.com/transparent/t-screen-with-koolblack-3-5.html.

An automated shading system allows building to effectively reject solar heat gain when undesirable (while cooling the space) while allowing solar heat gain when desired (while heating the space).

An example study showing how automated shading systems with high solar reflectance fabrics save significant cooling energy can be found at: http://performanceshadingadvisor.com/#thermalmanagement

Cost Impact: Will not increase the cost of construction
No impact to cost of construction. This proposal does not require use of dynamic shading, just allow combined SHGC to be used if project is already using dynamic shades.

CE101-16 : C402.4.3.4 (NEW)-JOUANEH12722

CE102-16

IECC: C402.4.4 (New), C405.2.3, C405.2.3.1, C405.2.3.2, C405.2.3.3.

Proponent : Shaunna Mozingo, representing Colorado Chapter of ICC Energy Code Development Committee (smozingo@coloradocode.net)

2015 International Energy Conservation Code

Add new text as follows:

C402.4.4 Daylight Zones Daylight zones referenced in Sections C402.4.1.1 through C402.4.3.2 or Section C405.2.3 shall comply with Section C402.4.4.1 and C402.4.4.2, as applicable.

Revise as follows:

~~**C405.2.3.2**~~ **C402.4.4.1** **Sidelight daylight zone.** The sidelight *daylight zone* is the floor area adjacent to vertical *fenestration* which complies with all of the following:

1. Where the fenestration is located in a wall, the 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(1~~ C402.4.4.1(1).
2. Where the *fenestration* is located in a rooftop monitor, the *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(2~~ C402.4.4.1(2) and ~~C405.2.3.2(3~~ C402.4.4.1(3).
3. The area of the *fenestration* is not less than 24 square feet (2.23 m^2).
4. The distance from the *fenestration* to any building or geological formation which 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. Where located in existing buildings, the *visible transmittance* of the *fenestration* is not less than 0.20.

~~**C405.2.3.3**~~ **C402.4.4.2** **Toplight daylight zone.** The toplight daylight zone is the floor area underneath a roof fenestration assembly which complies with all of the following:

1. The 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~~ C402.4.4.2.
2. No building or geological formation blocks direct sunlight from hitting the roof *fenestration* assembly at the peak solar angle on the summer solstice.
3. Where located in existing buildings, 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 *daylight zone* is not less than 0.008.

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 sidelight *daylight zones* complying with Section ~~C405.2.3.2~~ C402.4.4.1. *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 toplight *daylight zones* complying with Section ~~C405.2.3.3~~ C402.4.4.2.

   Exceptions: Daylight responsive controls are not required for the following:
   1. Spaces in health care facilities where patient care is directly provided.
   2. Dwelling units and sleeping units.
   3. Lighting that is required to have specific application control in accordance with Section C405.2.4.
   4. Sidelight daylight zones on the first floor above grade in Group A-2 and Group M occupancies.

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 toplight *daylight zones* in accordance with Section ~~C405.2.3.3~~ C402.4.4.2 shall be controlled independently of lights in sidelight *daylight zones* in accordance with Section ~~C405.2.3.2~~ C402.4.4.1.
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 r*eadily accessible*.
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 capable of a complete shutoff of all controlled lights.
6. Lights in sidelight *daylight zones* in accordance with Section ~~C405.2.3.2~~ C402.4.4.1 facing different cardinal orientations [i.e., 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: When going through the code to do plan review and w e get to Section C402.4.1.1 because they are trying to increase the allow ed glazing area, w e see this requirement for 50% of the net floor area to be w ithin a *daylight zone*.
What does that mean? Well, daylight zone is italicized so that means there is a definition for it, let's go there.

The definition says that it is the portion of a building's interior floor area that is illuminated by natural light. Ok, that's helpful. So if half of my floor area is illuminated by natural light I'm good? Seems like it but how do I measure that at plan review ? I look around the rest of this section and there is no w here that it tells me w hat to do so I just forget about it for now .

It isn't until I'm nearing the end of my energy code plan review and get to the lighting controls section and all of the sudden there are these pictures and definitions of toplight daylight zone and sidelight daylight zone. Wait! Are these w hat they w ere talking about back in the envelope section in C402? Now I have to go back and re-evaluate my envelope compliance, now that I know w hat they w ere talking about.

That can't be the w ay it's done. So w hat are our options?

Option 1: go through all of C402.4 and every w here it mentions *daylight zone,* add a reference to Sections C405.2.3.2 and C405.2.3.3. You w ould need to do that in 11 places.

Option 2: Bring the definitions and pictures from C405.2.3.2 and C405.2.3.3 over into C402.4 and then renumber everything after it.

Option 3: Bring the definitions and pictures from C405.2.3.2 and C405.2.3.3 over into the definitions chapter in its entirety, but some of that is not just definition, it's requirements that don't belong in a definition.

So what did we do?

Our first attempt was to redefine the terms without bringing all of the requirements into the definition and then putting a pointer to the place where the requirements were. We even had precedence where in the IBC a definition references a code section when talking about Wind Borne Debris. But after trying and trying to use the code for plan review it was determined that we needed to just go with option 2 and bring everything that dealt with what a daylight zone is and how to measure it over into the section of the code where it is needed. It was the harder option but the right one. Daylight Zones are a function of the thermal envelope and need to be in the envelope section. Daylight Responsive Controls are a lighting control function and should remain in the lighting controls section. We changed the references in the lighting control section to point back to the new sections in the envelope.

We created a new Section C402.4.4, moving the existing one down and renumbering everything after that. The placement into C402.4.4 was made because these daylight zones are mentioned in Sections C402.4.2 and C402.4.3 and we couldn't determine which of those sections should actually receive the moved information so we put it after all of it and made cross references to the new section. It does seem complicated but once you actually see it and try to use it, we believe it will all make sense and be much easier.

NOTE: Our proposal moves the Figures too but I couldn't make it happen in CDP access.

Figure C405.2.3.2 (1) is now Figure C402.4.4.1(1)

Figure C405.2.3.2 (2) is now Figure C402.4.4.1(2)

Figure C405.2.3.2 (3) is now Figure C402.4.4.1(3)

Figure C405.2.3.3 is now Figure C402.4.4.2

Our Theme: A Code for the End User

Is the code section completely understandable to the end user?

Is the code section or requirement easy to find?

Is the code requirement even doable in the real world?

Will the code requirement really save energy or only on paper?

Cost Impact: Will not increase the cost of construction
There are no new requirements in this proposal, simply moved text from one section to another for ease of use.

CE102-16 : C402.4.4 (NEW)-MOZINGO12927

CE103-16

IECC: C402.5, C402.5.1, C402.5.1.1, C402.5.1.1 (New), C402.5.1.2, C402.5.1.2.1, C402.5.1.2.2, C402.5.1.3 (New), C402.5.9 (New).

Proponent : Shaunna Mozingo, Colorado Code Consulting - City of Cherry Hills Village, representing Colorado Chapter of ICC Energy Code Development Committee (smozingo@coloradocode.net)

2015 International Energy Conservation Code

Delete and substitute 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 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/ft^2 (0.2 L/s • m^2). Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.~~
The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections C402.5.1 through C402.5.9.

Revise as follows:

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~~ Section C402.5.1.1, and Section C402.5.1.2 or C402.5.1.3.

> **Exception:** Air barriers are not required in buildings located in *Climate Zone* 2B.

Delete and substitute as follows:

C402.5.1.1 Air barrier ~~construction~~ installation. ~~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. Joints and seals associated with penetrations shall be sealed in the same manner or taped or covered with moisture vapor-permeable wrapping material. Sealing materials shall be appropriate to the construction materials being sealed and 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.~~

The components of the building thermal envelope specified in Table C402.5.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria specified within Table C405.5.1.1, as applicable to the method of construction.

TABLE C402.5.1.1
Air Barrier Installation

Component	**Air Barrier Criteria**
General requirements	A continuous air barrier shall be installed in the building thermal envelope. Breaks or joints in the air barrier shall be sealed
Ceiling/attic	The air barrier in dropped ceilings and soffits shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs and knee- wall doors to unconditioned attic spaces shall be sealed.
Walls	The junction of the foundation and the sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee- walls shall be sealed.
Windows, skylights and doors	The space between window and door jambs and framing, and skylights and framing shall be sealed.
Rim joists	Rim joists shall include the air barrier.
Floors	The air barrier shall be installed at any exposed edge of insulation.
Crawl space walls	Exposed earth in unventlated crawl spaces shall be covered with a Class I vapor retarder and overlapping joints shall be taped.
Shafts, penetrations	Duct shafts, utility penetrations, and chimney shafts opening to exterior or unconditioned space shall be sealed.

Garage separation	Air sealing shall be provided between the garage and conditioned spaces.
Recessed Lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the ceiling membrane.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate such walls from the showers and tubs.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communications boxes or air-sealed boxes shall be installed.
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or wall membrane
Concealed Sprinklers	Where required to be sealed, concealed fire sprinklers shall be sealed in a manner that is recommended by the sprinkler manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

Revise as follows:

C402.5.1.2 ~~Air barrier compliance~~ Testing options. ~~A continuous air barrier for the opaque~~ 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 shall be deemed to comply with ~~Section C402.5.1.2.1 or C402.5.1.2.2~~ the provisions of this section where the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft2 (0.2 L/s • m2). Where compliance is based on such testing, the building shall comply with Sections C402.5.4, C402.5.5, C402.5.6 and C402.5.7.

Add new text as follows:

C402.5.1.3 Air barrier compliance options As an alternative to testing, air barriers in the thermal envelope shall comply with Section C402.5.1.3.1 or C402.5.1.3.2.

Revise as follows:

~~C402.5.1.2.1~~ C402.5.1.3.1 Materials. Materials with an air permeability not greater than 0.004 cfm/ft^2 (0.02 L/s • m^2) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E 2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided 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 $^3/_8$ inch (10 mm).
2. Oriented strand board having a thickness of not less than $^3/_8$ inch (10 mm).

3. Extruded polystyrene insulation board having a thickness of not less than $^1/_2$ inch (12.7 mm).
4. Foil-back polyisocyanurate insulation board having a thickness of not less than $^1/_2$ inch (12.7 mm).
5. Closed-cell spray foam a minimum density of 1.5 pcf (2.4 kg/m^3) having a thickness of not less than $1^1/_2$ inches (38 mm).
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m^3) 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 $^1/_2$ inch (12.7 mm).
8. Cement board having a thickness of not less than $^1/_2$ 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 $^5/_8$ 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~~ C402.5.1.3.2 Assemblies. Assemblies of materials and components with an average air leakage not greater than 0.04 cfm/ft^2 (0.2 L/s • m^2) under a pressure differential of 0.3 inch of water gauge (w.g.)(75 Pa) when tested in accordance with ASTM E 2357, ASTM E 1677 or ASTM E 283 shall comply with this section. Assemblies listed in Items 1 through 3 shall be deemed to comply, provided 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 $^1/_2$ inch (12.7 mm) in thickness.

Add new text as follows:

C402.5.9 Fireplaces New wood-burning fireplaces shall have tight-fitting flue dampers or doors, and shall be provided with outdoor combustion air. Where using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace. where using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907.

Reason: The residential chapter has an easy to follow path for air barriers, including a table that serves as a great checklist to designer, contractor and code official. The commercial air barrier section was written with many laundry lists did not serve the end user well. In an attempt to make the code easier for the end user to read, understand, comply with and enforce, we have reorganized the commercial air leakage/air barrier section to more closely resemble that of the residential chapter.

The options for testing vs materials vs assemblies is still there. In fact, most of the wording is still in tact, just reorganized.

C402.5.2 through C402.5.8 remains unchanged with this proposal.

It will be argued that bringing the air sealing requirements over from the residential chapter is making the commercial chapter more stringent but in reality this proposal only replaced the existing Section C402.5.1.1 Air barrier Construction, which stated that everything had to be sealed, calulked gasketed, etc, with the easy to read table so not much has changed. The existing section addressed things like concealed fire sprinklers, rescess lighting fixures and continuity just as the new table does. The table just breaks it out by component and creates that checklist that can be used at design, construction, plan review and inspection.

Cost Impact: Will not increase the cost of construction
There aren't new requirements with this proposal, just reworded.

CE103-16 : C402.5-MOZINGO12896

CE104-16

IECC: C402.5, C402.5.1.

Proponent : Ellen Thorp, Meridian Consulting for EPDM Roofing Association, representing EPDM Roofing Association (ellen.thorp@epdmroofs.org)

2015 International Energy Conservation Code

CHAPTER 4 [CE] COMMERCIAL ENERGY EFFICIENCY
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/ft^2 (0.2 L/s • m^2). 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~~ barrier shall be permitted to be located on the inside or outside of the building thermal envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall be designed to mitigate air movement through building thermal envelope assemblies. 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.

Reason: Clarification of the design intent of an air barrier. This proposal also includes editorial changes to identify the IECC-defined terms "building thermal envelope" and "air barrier" where appropriate.

Cost Impact: Will not increase the cost of construction
None. This proposal clarifies the section without changing any code requirements.

CE104-16 : C402.5-THORP13338

CE105-16

IECC: C402.5, C402.5.1, C402.5.1.2, C402.5.1.2 (New), C402.5.1.2.1, C402.5.1.2.1 (New), C402.5.1.2.2.

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

C402.5 Air leakage—thermal envelope (Mandatory). The ~~thermal envelope of buildings~~ *building thermal envelope* 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/ft~~$\sout{^2}$ ~~(0.2 L/s • m~~$\sout{^2}$~~). 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~~*continuous air barrier* shall be provided throughout the ~~building thermal envelope~~*building thermal envelope*. The ~~air barriers~~ *continuous air barrier* shall be permitted to be located on the inside or outside of the ~~building envelope~~*building thermal envelope*, located within the assemblies composing the ~~envelope~~*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~~. A ~~continuous air barrier~~*continuous air barrier* in buildings having a gross conditioned floor area equal to or greater than the value specified in Table C402.5.1.2, shall comply with the provisions of Section C402.5.1.2.1. A *continuous air barrier* for the opaque building envelope in buildings having a gross conditioned floor area less than the value specified in Table C402.5.1.2, shall comply with the provisions of Section C402.5.1.2.1 , C402.5.1.2.2 or ~~C402.5.1.2.2~~ C402.5.1.2.3.

Add new text as follows:

TABLE C402.5.1.2
MINIMUM BUILDING SIZE REQUIRING AIR LEAKAGE TESTING

Occupancy Groups R & I		All Other Occupancy and Use Groups	
Climate Zone	Building Floor Area, ft^2 (m^2)	Climate Zone	Building Floor Area, ft^2 (m^2)
5A, 6A, 7	6000 (600)	5A, 6A, 7	40,000 (3,700)
4A, 6B	9,000 (800)	0A, 1A, 4A, 6B	75,000 (7,000)
0A, 1A, 8	17,500 (1,600)	5B, 8	200,000 (18,600)

Occupancy Groups R & I		All Other Occupancy and Use Groups	
0B, 1B, 3A, 5B	25,000 (2,300)	0B, 1B, 2A, 3A	350,000 (32,500)
2A, 3B, 4C	50,000 (4,600)	2B, 3B, 3C, 4B, 4C, 5C	NR
4B	60,000 (5,600)		
2B, 3C, 5C	NR		

NR = Not Required

[Note (not proposed code language): Climate Zones 0A and 0B to be included in table above only if another proposal introducing these new very hot climate zones is approved.]

C402.5.1.2.1 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/ft^2 (0.2 L/s · m^2) of the *building thermal envelope* area at a pressure differential of 0.3 inch water gauge (75 Pa).

Exceptions:

1. For buildings having greater than 50,000 square feet (5,000 m^2) of gross conditioned floor area, air leakage testing need not be conducted on the whole building provided that the following portions of the building are tested:
   1.1. The entire floor area of all stories that have any spaces directly under a roof.
   1.2. The entire floor area of all stories that have a building entrance or loading dock.
   1.3. Representative above-grade sections of the building totaling not less than 25 percent of the wall area enclosing the remaining conditioned space.

   The measured air leakages shall be area-weighted by the surface areas of the building envelope addressed in items 1.1 through 1.3, to determine a whole building value. The test of the areas in item 1.3 shall be applied to the remainder of the building envelope surface area not included in items 1.1 through 1.3.

1. Where the measured air leakage rate exceeds 0.40 cfm/ft^2 (2.0 L/s•m^2) but does not exceed 0.60 cfm/ft^2 (3.0 L/s•m^2), a diagnostic evaluation using smoke tracer or infra-red imaging shall be conducted while the building is pressurized and any leaks noted shall be sealed where such sealing can be performed without destruction of existing building components. In addition, a visual inspection of the air barrier shall be conducted and any leaks noted shall be sealed where such sealing can be performed 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 satisfy the requirements of this section.

Revise as follows:

~~C402.5.1.2.1~~ <u>C402.5.1.2.2</u> **Materials.** Materials with an air permeability not greater than 0.004 cfm/ft^2 (0.02 L/s • m^2) <u>of tested material area</u> under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E 2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided 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 $^3/_8$ inch (10 mm).
2. Oriented strand board having a thickness of not less than $^3/_8$ inch (10 mm).
3. Extruded polystyrene insulation board having a thickness of not less than $^1/_2$ inch (12.7 mm).
4. Foil-back polyisocyanurate insulation board having a thickness of not less than $^1/_2$ inch (12.7 mm).
5. Closed-cell spray foam a minimum density of 1.5 pcf (2.4 kg/m^3) having a thickness of not less than $1^1/_2$ inches (38 mm).
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m^3) 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 $^1/_2$ inch (12.7 mm).
8. Cement board having a thickness of not less than $^1/_2$ 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 $^5/_8$ 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~~ <u>C402.5.1.2.3</u> **Assemblies.** Assemblies of materials and components with an average air leakage not greater than 0.04 cfm/ft^2 (0.2 L/s • m^2) <u>of tested assembly area</u> under a pressure differential of 0.3 inch of water gauge (w.g.)(75 Pa) when tested in accordance with ASTM E 2357, ASTM E 1677 or ASTM E 283 shall comply with this section. Assemblies listed in Items 1 through 3 shall be deemed to comply, provided 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 $^1/_2$ inch (12.7 mm) in thickness.

Reason: This proposal modifies the building thermal envelope section to require air leakage testing of certain buildings based on climate zone, building use and the floor area of the conditioned space. The minimum floor area of buildings w here air leakage testing is required is based on cost-effectiveness analysis. Based on that analysis, separate thresholds are provided for residential[1] (Group R) and institutional[2] (Group I) building occupancies; with a separate threshold for all other building occupancies. The testing requirement is currently an optional path in the IECC where whole building air leakage testing is allowed as a means of meeting air leakage requirements. This change does not modify the maximum leakage rate or method of test, it simply requires testing for certain buildings and for other buildings testing is retained as an option. The current options for compliance associated with the materials or assemblies used in construction of an air barrier are retained and would continue to be compliance options for buildings that would not have testing required by this proposal.

In addition to the testing compliance changes, some clarifications are made as follows:

- Clarity is added to the referred areas tested in each of the paths.
- Defined terms are inserted where appropriate, and italics are added for defined terms.
- The phrase "and the requirements of Section C402.5.1.1 are met" is struck from the *Assemblies* compliance section (renumbered to C402.5.1.2.3), as it is redundant with the same requirement called out in the charging paragraph, C402.5.1.

Note that in the prior optional path when testing was used for compliance, sections C402.5.1.1, C405.5.2, C405.5.3, C405.5.4, and C405.5.8 were not required. Requirement for these sections has been retained with testing, as meeting the requirements of these sections is important in creation of a good air barrier and testing is really just a compliance verification path like the Materials and Assemblies paths. Further, the proposed testing limit of 0.40 cfm/ft^2 with a fallback to 0.60 cfm/ft^2 could result in increased leakage without the actual requirements for a *continuous air barrier* in these sections.

While it is important that the materials and assemblies have limited leakage, that alone does not guarantee a low leakage building. Recent research[3] shows that 40% of buildings constructed **without** an envelope consultant have air leakage exceeding the currently optional test standard, while buildings with envelope consultants had leakage below 0.25 cfm/ft^2. Requiring testing will ensure that the goal of this section of the code—limiting unintended air infiltration in buildings—will be achieved.

The proposal retains a test limit of 0.40 cfm/ft^2 as is currently required for optional testing. This is less stringent than the current Department of Defense requirements (0.25 cfm/ft^2) and case studies[4] have shown that much lower leakage levels–in the range of 0.15 cfm/ft^2–can be achieved. Since mandatory—rather than optional— testing would be a new requirement, it was felt appropriate to retain the current and higher limit of 0.4 cfm/ft^2 for improved building industry acceptance. The review of more stringent requirements by the Department of Defense[4] shows that while the range of building leakage can exceed the requirement by more than double (0.9 cfm/ft^2) the average leakage of buildings tested is well below the 0.4 limit when leak testing is part of the construction process. Therefore, a test limit of 0.40 cfm/ft^2 is a realistic and achievable goal. It was also prudent to provide some flexibility on the test standard to allow for building industry acceptance and a transition to a fixed requirement, because when the building envelope is complete and testing occurs, access to the air barrier for repairs is difficult. So an exception is included that allows the tested leakage rate to be below 0.6 cfm/ft^2 as long as specific remediation to be undertaken. This exception is meant to provide a modest relaxation of the requirement, but only if significant corrective actions are taken that may result in improving the air leakage. Another exception for large buildings (over 50,000 ft^2) allows representative portions of the building to be tested. This exception will make compliance more economical for large buildings.

This proposal is similar to the residential air leakage provisions in the 2015 IECC in that it also requires the use of ASTM E 779, but differs from those provisions in that the air leakage metric is calculated in the manner that is the industry standard for non-residential buildings. The proposal requires the same level of air leakage testing that is required by the State of Washington and City of Seattle commercial building energy codes[5] as well as procedures followed by the US Department of Defense 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.

Energy Savings: An analysis of energy impact in all climate zones shows that savings from air barrier testing ranges from $1.79 to $13.28 per thousand square feet of floor area in large offices and from $7.07 to $47.32 per thousand square feet of floor area in mid-rise apartment buildings in climate zones where testing is required in the proposal. More details are found in the cost-effectiveness analysis referenced in the cost impact section.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

Bibliography:

1. **Residential Group R**: uses intended for sleeping purposes. Group R is divided into four sub groups: **R-1** occupants are transient in nature; **R-2** occupancies containing sleeping units or more than two dwelling units where the occupants are more permanent in nature; **R-3** one and two family dwelling, or adult and child care facilities that provide accommodation for five or fewer persons of any age for less than 24 hours; **R-4** are intended for occupancy as residential care/assisted living facilities including more than five but not more than sixteen occupants, excluding staff.
2. **Institutional Group I**: uses intended in which people are cared for or live in a supervised environment, having physical limitations because of health or age are harbored for medical treatment or other care or treatment or in which the liberty of the occupants is restricted. Group I is divided into four sub groups: **I-1** houses more than 16 persons, on a 24 hour basis, who because of age, mental disability or other reasons, live in a supervised residential environment that provides personal care services. The occupants are capable of responding to an emergency situation without physical assistance from staff; **I-2** buildings are used for medical, surgical, psychiatric, nursing or custodial care on a 24 hr basis of more than five persons who are not capable of self-preservation (Less than five people shall be considered an R-3); **I-3** is inhabited by more than five persons who are under restraint or security and is occupied by persons who are generally incapable of self-preservation due to security measures not under the occupant's control.
3. 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.
4. Durston, J. L., and Heron, M. (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.
5. http://buildingconnections.seattle.gov/2012/03/01/air-barriers-and-pressure-testing/
6. Hart, R., and Liu, B. (2015). Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes. Pacific Northwest National Laboratories for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-23923 Rev1. https://www.energycodes.gov/development/commercial/methodology.
7. Hart, R., J Zhang, M. Halverson, M. Rosenberg & R. Athalye. September 2015. "Cost-effectiveness Analysis of Building Air Leakage Testing." https://www.energycodes.gov/development/2018IECC.

Cost Impact: Will increase the cost of construction

This proposal will increase the cost of construction of new commercial and mid- to high-rise multi-family residential buildings as whole building air leakage testing will be required. Based on a survey of professional commercial building air barrier testing companies, it was determined that the cost of air leakage testing for buildings could range from a minimum of about $4,000 to $7,000 for the small and relatively simple buildings to about twice that ($8,000 to $14,000) for larger and more complex buildings. As demand for air leakage testing in commercial buildings increases, more companies will enter the market to provide these services. This will lead to a gradual decrease in cost as more companies are available to do the testing. It is possible that small buildings (up to about 5,000 ft^2) could likely use residential air leakage testing firms such as those associated with HERS ratings; however, the current proposal does not require small building testing, except as an optional path. An examination of prices for residential air leakage testing indicated costs can be less than $350 per home. Given that both the residential and commercial air leakage testing protocols are based on the same ASTM E 779 standard, there is not likely to be much difference in the equipment and training needed for a company to perform small building commercial air leakage testing as well as residential air leakage testing.

Cost-effectiveness: PNNL performed a cost-effectiveness analysis using the established DOE methodology.[6] Results of the cost-effectiveness analysis showed that the average savings-to-investment ratio (SIR) was 1.8 in large offices and 1.6 in mid-rise apartment buildings. A proposal 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-effectiveness results were reviewed and air barrier testing was required by climate zone for buildings that have present value savings exceeding the testing cost based on building size. Note that while air barrier testing was found cost effective for residential and institutional buildings in Climate Zone 2B, it was not required there, because that climate zone has an exception not requiring an air barrier. The complete cost-effectiveness analysis is available at: https://www.energycodes.gov/development/2018IECC.[7]

CE105-16 : C402.5-WILLIAMS12334

CE106-16

Part I:

IECC: C402.5.

Part II:

IECC: R402.4.1.2, R405.5.2.

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

Proponent : Joseph Zimmer, Self, representing Joseph Zimmer, Architect (joe@studiojosephzimmer.com)

Part I

2015 International Energy Conservation Code

C402.5 Air leakage—thermal envelope (Mandatory). The ~~thermal envelope of buildings~~ *building thermal envelope* shall comply with Sections C402.5.1 through C402.5.8, or the ~~building~~ *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~~ *code official* and deemed to comply with the provisions of this section when the tested air leakage rate of the ~~building thermal envelope~~ exterior surface area of the *building thermal envelope* is not greater than 0.40 cfm/ft^2 (~~0.2~~ 2.0 L/s • m^2).

Exception: Enclosed gross building volumes not larger than 100,000 ft^3 (2831.68 m^3) tested in accordance with ASTM E779 or E1827 at a pressure differential of 0.2 inch water gauge (50 Pa) where test results indicate a leakage rate does not exceed five air changes per hour (0.08333 per minute).

Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

Part II

2015 International Energy Conservation Code

R402.4.1.2 (N1102.4.1.2) Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour (0.08333 per minute) in Climate Zones 1 and 2, and three air changes per hour (0.05 per minute) in Climate Zones 3 through 8. Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch ~~w.g.~~ water gauge (50 Pascals).

Exception: Testing in accordance with ASTM E779 at a pressure differential of 0.3 inch water gauge (75 Pascals) where the tested air leakage rate of the exterior surface area of the *building thermal envelope* or dwelling unit floor, wall and ceiling enclosure is not greater than 0.40 cfm/ft^2 (2.0 L/s * m^2).

Where required by the ~~*code official*~~ *code official*, testing shall be conducted by an ~~*approved*~~ *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the ~~*code official*~~*code official*. Testing shall be performed at any time after creation of all penetrations of the ~~*building thermal envelope*~~*building thermal envelope*.

During testing:

~~1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.~~
~~2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.~~
~~3. Interior doors, if installed at the time of the test, shall be open.~~
~~4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.~~
~~5. Heating and cooling systems, if installed at the time of the test, shall be turned off.~~
~~6. Supply and return registers, if installed at the time of the test, shall be fully open.~~

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, if installed at the time of the test, shall be open.
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
5. Heating and cooling systems, if installed at the time of the test, shall be turned off.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

TABLE R405.5.2(1) [N1105.5.2(1)]
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	Air leakage rate of 5 air changes per hour (0.08333 per minute) in climate zones 1 and 2, 3 air changes per hour (0.05 per minute) in climate zones 3 through 8 at pressure differential or 0.2 inch water gauge (50 Pa), or a rate of 0.40 cfm/ft^2 (2.0 L/s * m^2) over the exterior surface area of the *building thermal envelope* or dwelling unit floor, wall and ceiling enclosure at a pressure differential of 0.3 inch water gauge (75 Pa) in all climate zones. The mechanical ventilation rate shall be in addition to the air leakage rate at the same as in the proposed design, but no greater than ~~0.01~~0.03 x ~~CFA~~Area$_{floor}$ + 7.5 x (N_{br} + 1) where: ~~CFA = conditioned floor area~~ Area$_{floor}$ = floor area of building/unit (ft^2) N_{br} = number of bedrooms or 0.15 x Area$_{floor}$ + 3.5 (N_{br} + 1) where: Area$_{floor}$ = floor area of building/unit (m^2) N_{br} = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences or dwelling units that are not tested, the same air leakage rate as the standard reference design. For tested residences or dwelling units, the measured air exchange rate[a]. The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case:Annual vent fan energy use:kWh/yr = 0.03942 × *CFA* + 29.565 × (N_{br} +1)where:*CFA* = conditioned floor areaN_{br} = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 × *CFA* + 4104 × N_{br} (Btu/day	Same as standard reference design.

	per dwelling unit)	
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.4 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed
Heating systems[d, e]	As proposed for other than electric heating without a heat pump, where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC-Commercial Provisions.Capacity: sized in accordance with Section R403.7	As proposed
Cooling systems[d, f]	As proposed Capacity: sized in accordance with Section R403.7.	As proposed
Service water heatingd, e, f, g	As proposed Use: same as proposed design	As proposed gal/day = 30 + (10 × N_{br})
Thermal distribution systems	Duct insulation: From Section R403.2.1A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditionedfloor* area at a pressure of differential of 0.1 inches w.g. (25 Pa).	As tested or as specified in Table R405.5.2(2) if not tested. Duct insulation shall be as proposed.
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case:Annual vent fan energy use:kWh/yr = 0.03942 × *CFA* + 29.565 × (N_{br} +1)where:*CFA* = conditioned floor areaN_{br} = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 × *CFA* + 4104 × N_{br} (Btu/day per dwelling unit)	Same as standard reference design.
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.4 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed
Heating systems[d, e]	As proposed for other than electric heating without a heat pump, where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC-Commercial Provisions.Capacity: sized in accordance with Section R403.7	As proposed
Cooling systems[d, f]	As proposed Capacity: sized in accordance with Section R403.7.	As proposed

Service water heatingd, e, f, g	As proposed Use: same as proposed design	As proposed gal/day = 30 + (10 × N_{br})
Thermal distribution systems	Duct insulation: From Section R403.2.1A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditionedfloor* area at a pressure of differential of 0.1 inches w.g. (25 Pa).	As tested or as specified in Table R405.5.2(2) if not tested. Duct insulation shall be as proposed.
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

For SI: 1 square foot = 0.93 m^2 , 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2 , 1 gallon (US) = 3.785 L, Â°C = (Â°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 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 must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must 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 with 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 with 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 with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with 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 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 x 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.
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 gross enclosed volume air exchange rate test at 0.2 inch water gauge (50 Pascals) is widely recognized for testing of *residential buildings* and *dwelling units* and there are many qualified individuals/agencies performing air leakage testing using this method.
If this method is permitted for smaller volume non residential buildings, these already qualified individuals/agencies could perform air leakage tests without requiring additional training or knowledge.

Because the test method based upon the exterior surface area of the building or dwelling unit enclosure is a more directly applicable measure for builing or dwelling unit enclosure leakage rates, it should become the norm for all buildings in the future. measuring at the 0.3 water gauge (75 pascals) presuure differential is also the same pressure materials are tested at to determine if they are defined as 'air impermeable'. This, too, makes the measure more directly related to the purpose of the test.

The most important aspect of testing building thermal envelope leakage rates is to help mitigate air/humidty movement through insulated assemblies where condensation within the assembly may cause damage. This is another reason why testing on the basis of enclosure surface area, rather than enclosed volume, should eventually become the single method of measure.

The changes in Table R405.5.2(1) are made to make the table consistent with option for envelope surface area (rather than enclosed volume) testing and to make mechanical ventilation rate calculation consistent with most recent edition of ASHRAE 62.2 and include the SI unit version of calculation.

Cost Impact: Will not increase the cost of construction
No effect on construction cost, perhaps in early years of requiring leakage testing in other than residential buildings (in lieu of the material or assembly test and inspection options), providing the option for the established enclosed volume air exchange rate at 0.2 inch water gauge (50 Pascals) will contain the costs of air leakage tests by using a well known method by already trained individuals/agencies.

CE106-16 : C402.5-ZIMMER11988

CE107-16

IECC: C402.5.1, C408.4 (New), C408.4.1 (New), C408.4.2 (New), C408.4.3 (New).

Proponent : Sean Denniston, New Buildings Institute, representing New Buildings Institute (sean@newbuildings.org)

2015 International Energy Conservation Code

Revise as follows:

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 and C402.5.1.2. Commissioning of the air barrier shall be provided in accordance with Section C408.4.

Exception: Air barriers are not required in buildings located in *Climate Zone* 2B.

Add new text as follows:

C408.4 Air barrier commissioning. Where an air barrier is required in accordance with Section C402.5.1, prior to passing final inspection, the *registered design professional* shall provide evidence of air barrier commissioning and completion in accordance with the provisions of this section.

Exception: Buildings that have met the air leakage testing requirement of Section C402.5.

C408.4.1 Documentation. Documentation of the continuous air barrier components included in the design and a field inspection checklist clearly indicating all requirements necessary for maintaining air barrier continuity and durability in accordance with Section C402.5.1, shall be included in the *construction documents*. Documentation shall include a field inspection checklist indicating the requirements necessary for proper installation of the *continuous air barrier*.

C408.4.2 Field inspections. Reports from field inspections during project construction showing compliance with *continuous air barrier* requirements including proper material handling and storage, use of approved materials and approved substitutes, proper material and surface preparation, and air barrier continuity at *building thermal envelope* penetrations shall be provided to the owner and, upon request, to the *code official*..

C408.4.3 Report. A final commissioning report indicating compliance with the continuous air barrier requirements shall be provided to the building owner and, upon request, to the *code official.*

Reason: According to a study by the Pacific Northw est National Lab ("Achieving the 30% Goal: Energy and Cost Savings Analysis of ASHRAE Standard 90.1-2010"), in common practice the prescriptive air barrier requirements found in the IECC and Standard 90.1 w ill not achieve the 0.40 CFM/sf leakage rate required by the testing alternative. Instead, they w ould only achieve, on average, a leakage rate of 1.0 CFM/sf. The same report also estimates that the average leakage rate for commercial construction before the new air barrier requirements w ent into effect w as 1.8 CFM/sf. The result is that the prescriptive air barrier requirements only achieve about half of the savings anticipated by the infiltration rate required by the testing alternative.

The air barrier commissioning requirements w ould use a commissioning protocol to improve the effectiveness of installed air barriers. Through change in practice, the performance of air barriers built to the prescriptive requirements can be improved and brought more in line w ith w hat is required by testing w ithout actually making testing mandatory. The requirements as w ritten are not achieving the energy savings intent of the code, and are therefore introducing complexity w ithout the full corresponding energy benefit.

Cost Impact: Will increase the cost of construction
New Buildings Institute's *Advanced Buildings New Construction Guide* contains a similar requirement for air barrier commissioning. An incremental cost study w as conducted by Skanska and found that the air barrier commissioning requirement w ould have an incremental cost of $0.08-0.13/sf depending on building type and regional market.

CE107-16 : C402.5.1-DENNISTON13109

CE108-16

IECC: C402.5.1.1.

Proponent : Howard Ahern, representing Airex Mfg. (howard.ahern@airexmfg.com)

2015 International Energy Conservation Code

Revise as follows:

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. Joints and seals associated with penetrations shall be sealed in the same manner or taped or covered with moisture vapor-permeable wrapping material. Sealing materials shall be appropriate to the construction materials being sealed and 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.<u> Refrigerent piping penetrations shall be sealed by gasketing and mechanically secured.</u>
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.

Reason: This change simply allow s for a mechanical sealing system for penetrations. Mechanical sealing system are used for some types of penetrations such as refrigerant piping w hich needs to specifically address vibration problems associated w ith sustainable sealing of the penetration and transfer of vibration energy.

Cost Impact: Will not increase the cost of construction
Will not increase cost of construction as this change simply allow s an option for a mechanically sealed systems w hich are already being used in construction

CE108-16 : C402.5.1.1-AHERN10909

CE109-16

IECC: C402.5.1.1.

Proponent : Hope Medina, representing Colorado Chapter of ICC (hmedina@coloradocode.net)

2015 International Energy Conservation Code

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. Joints and ~~seals~~ <u>seams</u> associated with penetrations shall be sealed in the same manner or taped or covered with ~~moisture vapor-permeable~~ <u>moisture-vapor permeable</u> wrapping material. Sealing materials ~~shall be appropriate to the construction materials being sealed and~~ 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.

Reason: Delete hyphen betw een vapor and permeable, move it betw een moisture and vapor. Already says in the first sentence that the sealing material has to be compatible w ith the construction material and location. Why say it again?

Cost Impact: Will not increase the cost of construction
rew ording existing text

CE109-16 : C402.5.1.1-MEDINA13006

CE110-16

IECC: C402.5.1.2.1.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

C402.5.1.2.1 Materials. Materials with an air permeability not greater than 0.004 cfm/ft^2 (0.02 L/s • m^2) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E 2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided 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 $^3/_8$ inch (10 mm).
2. Oriented strand board having a thickness of not less than $^3/_8$ inch (10 mm).
3. Extruded polystyrene insulation board having a thickness of not less than $^1/_2$ inch (12.7 mm).
4. Foil-back polyisocyanurate insulation board having a thickness of not less than $^1/_2$ inch (12.7 mm).
5. Closed-cell spray foam a minimum density of 1.5 pcf (2.4 kg/m^3) having a thickness of not less than 1$^1/_2$ inches (38 mm).
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m^3) 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 $^1/_2$ inch (12.7 mm).
8. Cement board having a thickness of not less than $^1/_2$ inch (12.7 mm).
9. Built-up roofing membrane.
10. Modified bituminous roof membrane.
11. ~~Fully adhered single-ply~~ Single-ply roof membrane.
12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than $^5/_8$ 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: This change clarifies the intent of the code that the method of attachment for deemed-to-comply materials pertains to materials and not installation methods or assemblies. The material is a single ply roof membrane. "Fully adhered" is related to how the material is installed and belongs in code sections dealing with roof installation. The change will align IECC with ASHRAE 90.1-2013 where a similar change has been approved per Addendum AY

Cost Impact: Will not increase the cost of construction
This change is a clarification of existing code requirements and thus will not increase the cost of construction

CE110-16 : C402.5.1.2.1-FERGUSON12490

CE111-16

IECC: C402.5.1.2.1.

Proponent : Mike Fischer, Kellen Company, representing Polyisocyanurate Insulation Manufacturers Association (mfischer@kellencompany.com)

2015 International Energy Conservation Code

Revise as follows:

C402.5.1.2.1 Materials. Materials with an air permeability not greater than 0.004 cfm/ft^2 (0.02 L/s • m^2) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E 2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided 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 $^3/_8$ inch (10 mm).
2. Oriented strand board having a thickness of not less than $^3/_8$ inch (10 mm).
3. Extruded polystyrene insulation board having a thickness of not less than $^1/_2$ inch (12.7 mm).
4. ~~Foil-back polyisocyanurate~~ <u>Polyisocyanurate</u> insulation board having a thickness of not less than $^1/_2$ inch (12.7 mm).
5. Closed-cell spray foam a minimum density of 1.5 pcf (2.4 kg/m^3) having a thickness of not less than 1$^1/_2$ inches (38 mm).
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m^3) 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 $^1/_2$ inch (12.7 mm).
8. Cement board having a thickness of not less than $^1/_2$ 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 $^5/_8$ 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 IECC includes includes foil-faced polyisocyanurate insulation board on a list of materials that have been "deemed to comply" with air barrier requirements, as an alternate to testing to ASTM E 2178. A review of polyiso insulation manufacturers' test data shows that the foil-facing is not necessary for the product to exceed the test requirement. Foil facers are not always a preferred product solution for roof and wall applications, depending upon the assembly; this proposal more appropriately captures the material's performance and removes a bias in the code that permits other unfaced insulation products in the code to qualify without requiring either a foil-face or testing. The code does require that the insulation material have a minimum thickness and that it be installed as an air barrier, with sealed joints.

Cost Impact: Will not increase the cost of construction

The proposal provides greater flexibility in material selection.

CE111-16 : C402.5.1.2.1-FISCHER13337

CE112-16

IECC: C402.5.1.2.1.

Proponent : Jason Wilen AIA CDT RRO, National Roofing Contractors Association (NRCA), representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net)

2015 International Energy Conservation Code

Revise as follows:

C402.5.1.2.1 Materials. Materials with an air permeability not greater than 0.004 cfm/ft^2 (0.02 L/s • m^2) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E 2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided 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 $^3/_8$ inch (10 mm).
2. Oriented strand board having a thickness of not less than $^3/_8$ inch (10 mm).
3. Extruded polystyrene insulation board having a thickness of not less than $^1/_2$ inch (12.7 mm).
4. Foil-back polyisocyanurate insulation board having a thickness of not less than $^1/_2$ inch (12.7 mm).
5. Closed-cell spray foam a minimum density of 1.5 pcf (2.4 kg/m^3) having a thickness of not less than $1^1/_2$ inches (38 mm).
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m^3) 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 $^1/_2$ inch (12.7 mm).
8. Cement board having a thickness of not less than $^1/_2$ 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 $^5/_8$ 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: Section C402.5.1.2.1-Materials indicates materials tested in accordance with ASTM E 2178 and meeting the stated air permeability are considered in compliance with the code section. E 2178 is a test method to measure the air permeance of flexible sheet or rigid panel-type materials; the method of attachment is not part of the E 2178 test method so it makes sense to remove attachment components from the deemed-to-comply list in section C402.5.1.2.1. Also, the Significant and Use statement of ASTM E 2178 states "This method does not address the installed air leakage performance of building materials." Installation and attachment issues related to air barriers are already regulated in IECC Section C402.5.1.1-Air Barrier Construction.

Cost Impact: Will not increase the cost of construction
The proposed change is a clarification and does not change the stringency of existing code requirements so the

cost of construction w ill be unchanged.

CE112-16 : C402.5.1.2.1-WILEN AIA CDT RRO9964

CE113-16

IECC: C402.5.2.

Proponent : Joseph Hetzel, representing American Association of Automatic Door Manufacturers (Jhetzel@thomasamc.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE C402.5.2
MAXIMUM AIR LEAKAGE RATE FOR FENESTRATION ASSEMBLIES

FENESTRATION ASSEMBLY	MAXIMUM RATE(CFM/FT^2)	TEST PROCEDURE
Windows	0.20 [a]	AAMA/WDMA/ CSA101/I.S.2/A440 or NFRC 400
Sliding doors	0.20 [a]	
Swinging doors	0.20 [a]	
Skylights – with condensation weepage openings	0.30	
Skylights – all other	0.20 [a]	
Curtain walls	0.06	NFRC 400 or ASTM E 283 at 1.57 psf (75 Pa)
Storefront glazing	0.06	
Commercial glazed swinging entrance doors	1.00	
Power-operated sliding doors and power-operated folding doors	1.00	
Revolving doors	1.00	
Garage doors	0.40	ANSI/DASMA 105, NFRC 400, or ASTM E 283 at 1.57 psf (75 Pa)
Rolling doors	1.00	
High-speed doors	1.30	

For SI: 1 cubic foot per minute = 0.47L/s, 1 square foot = 0.093 m^2.

a. The maximum rate for windows, sliding and swinging doors, and skylights is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with AAMA/WDMA/CSA101/I.S.2/A440 at 6.24 psf (300 Pa).

Reason: Per the current Table, it can be interpreted that the value for "sliding doors" encompasses both manual sliding doors, used primarily in residential dwelling applications, and power-operated sliding doors, used primarily in non-residential applications. The maximum air leakage rate for power-operated sliding doors, and for power-operated folding doors, should be differentiated from "sliding doors" similar to how commercial glazed swinging entrance doors are differentiated from "swinging doors" for the following reasons:

-
    - Power-operated sliding and power-operated folding door designs must accommodate a high number of repeated openings and closings similar to such accommodation for commercial glazed swinging entrance doors.
    - For emergency egress situations, power-operated sliding and power-operated folding doors must be capable of "breakout" to allow emergency egress when the power is out. Breakout almost always entails designing the door panels of these doors to hinge similar to a swinging door (i.e. breakout) when adequate force is applied to the door panel. Thus, the perimeter air leakage sealing principles for commercial swinging entrance doors are similar to those for power-operated sliding and power-operated folding doors.
    - Sealing any power-operated door at the floor is very difficult to achieve for commercial service durability because such doors must meet ADA / accessibility requirements. These requirements involve a low / flat threshold, and the requirement to allow for door breakout as required for egress.

Additionally, the IBC currently requires power-operated sliding doors and power-operated folding doors to comply with BHMA A156.10. Approved revisions to the 2018 IBC will require low-energy power-operated doors of these configurations to comply with BHMA A156.38. Extensive technical requirements for breakout and other safety-related requirements are included in both of these standards.

Cost Impact: Will not increase the cost of construction
The cost could theoretically decrease since a reduction in materials could occur, yet the building industry would be provided with an acceptable level of air leakage resistance.

CE113-16 : TABLE C402.5.2-HETZEL11624

CE114-16

Part I:
IECC: C402.5.3.
Part II:
R402.4.4 (IRC N1102.4.4)

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

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

Part I

2015 International Energy Conservation Code

Revise as follows:

C402.5.3 Rooms containing fuel-burning appliances. In *Climate Zones* 3 through 8, where ~~open~~ combustion air ~~ducts provide combustion air~~ is supplied through openings in an exterior wall to ~~open combustion~~ a room or space ~~conditioning~~ containing a space-conditioning fuel-burning ~~appliances~~ appliance, one of the ~~appliances and combustion air openings~~ 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 ~~in a room~~ and isolated from conditioned spaces inside the building thermal envelope. Such rooms shall ~~be sealed and insulated in accordance~~ comply with ~~the envelope requirements~~ all of ~~Table C402.1.3 or C402.1.4, where the~~ the following.

2.1. The walls, floors and ceilings ~~shall meet~~ that separate the ~~minimum~~ enclosed room or space from conditioned spaces shall be insulated to be at least 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 ~~below-grade wall *R*-value requirement~~ enclosed room or space from conditioned spaces shall be sealed in accordance with Section C402.5.1.1.

2.3. The ~~door~~ doors into the enclosed room or space shall be fully gasketed~~, and any water~~ .

2.4. Water lines and ducts in the enclosed room or space shall be insulated in accordance with Section C403.~~ The~~

2.5. Where the air duct supplying combustion air ~~duct shall be insulated, where it~~ to the enclosed room or space passes through conditioned space, the duct shall be insulated to~~ a minimum~~ an R-value of not less than R-8.

~~**Exceptions:**~~

~~1. Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.~~

~~2.~~ **Exception** Fireplaces and stoves complying with Sections 901 through 905 of the International Mechanical Code, and Section 2111.13 of the International Building Code.

Part II

2015 International Energy Conservation Code

Revise as follows:

R402.4.4 (IRC N1102.4.4) Rooms containing fuel-burning appliances. ~~In~~ Where in *Climate* ~~*Zones*~~ *Zone* 3 through 8, where ~~open~~ combustion air ~~ducts provide combustion air~~ is supplied to ~~open combustion fuel burning appliances,~~ a room or space containing a space-conditioning fuel-burning appliance through transfer openings, grilles or ducts through an exterior wall, one of the ~~appliances and combustion air opening~~ following shall be met:

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 ~~in a room,~~ and isolated from conditioned spaces inside the building thermal envelope. Such rooms shall ~~be sealed and insulated in accordance~~ comply with the ~~envelope requirements of Table R402.1.2, where the walls~~ following.

2.1. Walls, floors and ceilings ~~shall meet not less than~~ which separate the ~~basement wall *R*-value~~ enclosed room or space from conditioned spaces shall be insulated to be at least equivalent to the insulation requirement of below grade walls as specified in Table R402.1.2 (IRC Table N1102.1.2.)

2.2. ~~The door~~ Walls, floors and ceilings which separate the enclosed room or space from conditioned spaces shall be sealed in accordance with Section R402.4.1.1 (IRC N1102,4,1,1).

2.3. Doors into the enclosed room or space shall be fully gasketed ~~and any water~~ .

2.4. Water lines and ducts in the enclosed room or space shall be insulated in accordance with Section R403 (IRC N1103). ~~The~~

2.5. Where the air duct supplying combustion air to the enclosed room or space passes through conditioned space, the duct shall be insulated ~~where it passes through conditioned space~~ to a minimum of R-8.

~~Exceptions~~ Exception:

~~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*.

Reason: The intent of this section as it was proposed for the 2015 edition of the code was to deal with spaces where air comes in unrestricted to a place where the fuel burning appliance is located. The section then outlines 2 ways you can deal with it - 1 - keep it outside the thermal envelope, or 2 - if you want it located in a space that is

within the thermal envelope, you need to build an 'isolation' chamber - what the section calls an enclosed room or space. The intent of SEHPCAC was to revise this section so that these 2 options are clear. We don't find them clear in the single paragraph format currently found in the 2015 code. The revised wording changes the focus from the appliance to the fact that air is penetrating the building envelope.
There is one apparent substantive change which is removing of the exception for direct vent appliances. With the rewording of the section to focus on air coming through the walls unrestricted, the exception is not needed as a direct vent appliance has vents to the outdoors connected to the appliance.

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The proposal is an editorial repackaging of the requirement. There is no change to the technical requirements of the code.

CE114-16 : C402.5.3-COLLINS11480

CE115-16

Part I:
IECC: C402.5.3.
Part II:
R402.4.4 [IRC N1102.4.4]

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 ORDERS FOR THESE COMMITTEES.

Proponent : Ted Williams, representing American Gas Association

Part I

2015 International Energy Conservation Code

Delete without substitution:

~~**C402.5.3 Rooms containing fuel-burning appliances.** In *Climate Zones* 3 through 8, where open combustion air ducts provide combustion air to open combustion space conditioning fuel-burning appliances, the appliances and combustion air openings shall be located outside of the *building thermal envelope* or enclosed in a room isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table C402.1.3 or C402.1.4, where the walls, floors and ceilings shall meet the minimum of the below-grade 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 C403. The combustion air duct shall be insulated, where it passes through conditioned space, to a minimum of R-8.~~

~~**Exceptions:**~~

1. ~~Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.~~
2. ~~Fireplaces and stoves complying with Sections 901 through 905 of the *International Mechanical Code*, and Section 2111.13 of the *International Building Code*.~~

Part II

2015 International Energy Conservation Code

Delete without substitution:

~~**R402.4.4 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, 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 a minimum of 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*.~~

Reason: These requirements, appearing for the first time in the 2015 edition of the IECC, do not save energy and do not belong in the IECC. The U. S. Department of Energy "determinations" report covering changes implemented by the 2015 edition, performed by Pacific Northwest National Laboratory (PNNL), classified the proposal leading to this change as "Not Applicable to Residential Energy Efficiency" and is one of five such proposals so classified that were promulgated as new requirements in the 2015 edition. Of the four states adopting the 2015 edition of the IECC, one state (Illinios) has removed this coverage by amendment for residential occupancies. A full account for adopting states will be presented at the April hearing. In any case, adoption experience to date has shown that local jurisdictions have not seen this provision as reasonable or justified for an energy code, The IECC would be well advised to elimnate this provision. .Also, the "Cost Impact" cited in the IECC monograph states that, "The code change proposal will increase the cost of construction, while it will reduce the energy consumption and cost throughout the life of the home." This finding is contradicted by the PNNL analysis on the basis of energy savings not realized and by independent analysis by Home Innovations Labs in its evaluation of 2015 IECC Code changes on the basis of cost effectiveness. Finally, the original proposal for the code change cited professed combustion appliance safety concerns. Such concerns should be addressed to the International Fuel Gas Code and National Fuel Gas Code processes where combustion safety is addressed, not within the IECC.

Cost Impact: Will not increase the cost of construction
The elimination of this requirement would reduce construction costs for thermally isolating rooms with combustion appliances. Since PNNL and others do not cite energy savings from the provision, no payback on these costs would be realized.

CE115-16 : C402.5.3-WILLIAMS12507

CE116-16

IECC: C402.5.6.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C402.5.6 Loading dock weatherseals. Cargo doors and loading dock ~~doors~~ door openings shall be equipped with weatherseals ~~to~~ that restrict infiltration ~~when~~ and provide direct contact along the top and sides of vehicles ~~are~~ parked in the doorway.

Reason: This provision has been in the IECC for over 10 years and has posed challenges to enforcement because the term 'restrict infiltration' is somew hat subjective in that any w eatherseal no matter how good or bad w ill restrict infiltration. Ideally there w ould be a test standard upon w hich to measure and express the air leakage of these products and then an acceptable/unacceptable limit as a function of door area, door perimeter, etc. could be established. In the absence of such a method of test and the ability to effectively study costs of such products as a function of some standardized method of test/leakage results the proposed change provides a more meaningful criterion to address the issue of air leakage at these doors. Specifically, w e believe a criterion that the w eatherseal provide continuous contact w ith the top and sides of the vehicle being serviced (along the bottom is not feasible for obvious reasons) supports the intent of reducing air leakage into or out of the space served than does a criterion to 'restrict infiltration'. Technically, compared to not installing a w eatherseal at all one could be installed that had marginal contact across the top of the vehicle but now here else and considered as restricting infiltration (because it is better than nothing). The proposed change provides those w ho must document or verify compliance w ith the code w ith more specific and enforceable provisions.
This proposal w as submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC w as established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes w ith 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 2015, the SEHPCAC has held three tw o- or three-day open meetings and 25 w orkgroup calls, w hich included members of the SEHPCAC as w ell as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC w ebsite at: http://w w w .iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will increase the cost of construction
It is assumed that the loading dock seals needed to comply w ith this revised criteria w ill likely be more costly equipment than is often used today. This w ould be a first cost. Any increase in first cost of construction (or overall operating cost reductions due to the change over the life of the building or product) cannot be determined because the current criterion is subjective in nature so a baseline for establishing an air leakage rate under the current code and comparing it to w hat results w hen the w eather seal is in contact w ith the vehicle as proposed is not possible.

CE116-16 : C402.5.6-COLLINS11625

CE117-16

IECC: C402.5.7.

Proponent : Ellen Eggerton, representing self (ellen.eggerton@fairfaxcounty.gov)

2015 International Energy Conservation Code

Revise as follows:

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 m^2) 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.~~

Reason: Delete C402.5.7 exception 7, air curtain option, for vestibules because the use of an air curtain in place of a vestibule does not meet the spirit and functional intent of the vestibule requirements. Air curtains per the standard ANSI/AMCA 220 allow s continuous air leakage of conditioned air.

Cost Impact: Will not increase the cost of construction
Not having an air curtain w ill not increase the cost of construction. THe air curtain standards illustrates a significant leakage of conditioned air. THis vestibule option does not appear to meet the air leakage requirements of the existing code. So it should not increase the cost of construction to meet the exiting air leakage requirements.

CE117-16 : C402.5.7-EGGERTON13274

CE118-16

IECC: C402.5.7.1 (New).

Proponent : Ellen Eggerton (ellen.eggerton@fairfaxcounty.gov)

2015 International Energy Conservation Code

Add new text as follows:

C402.5.7.1 Unconditioned vestibules Vestibules spaces shall not be heated or cooled other than for necessary freeze protection located at operational door equipment and sprinkler heads. Freeze protection methods shall not direct heat to the outdoors when doors are open.

Reason: Vestibules are the separation betw een conditioned and unconditioned spaces. Vestibule spaces shall not be made conditioned spaces by adding heating or cooling. Localized freeze protection is permitted but limited to the equipment or pipes needing protection.
Heating and cooling vestibules just dumps conditioned air outside each time the door is opened.

Cost Impact: Will not increase the cost of construction
This w ill decrease both the cost of construction and the cost of operating the building. Heating or cooling w ill not be added and the cost of the ducts and/or heating elements w ill be eliminated. As needed, freeze protection w ill be provided for localized equipment or piping that w ill be much less than heating or cooling the vestibule space.

CE118-16 : C402.5.7.1 (NEW)-EGGERTON12499

CE119-16

IECC: C403, C403.1, C403.11 (New), C403.12 (New), C403.2, C403.2.1, C403.2.10, C403.2.10.1, C403.2.11, C403.2.12, C403.2.12.1, C403.2.12.2, C403.2.12.3, C403.2.13, C403.2.14, C403.2.15, C403.2.16, C403.2.17, C403.2.2, C403.2.3, C403.2.3.1, C403.2.3.2, C403.2.4, C403.2.4.1, C403.2.4.1.1, C403.2.4.1.2, C403.2.4.1.3, C403.2.4.2, C403.2.4.2.1, C403.2.4.2.2, C403.2.4.2.3, C403.2.4.3, C403.2.4.4, C403.2.4.5, C403.2.4.6, C403.2.4.7, C403.2.5, C403.2.6, C403.2.6.1, C403.2.6.2, C403.2.7, C403.2.8, C403.2.9, C403.2.9.1, C403.2.9.1.1, C403.2.9.1.2, C403.2.9.1.3, C403.3, C403.3 (New), C403.3.1, C403.3.2, C403.3.3, C403.3.3.1, C403.3.3.2, C403.3.3.3, C403.3.3.4, C403.3.3.5, C403.3.4, C403.3.4.1, C403.3.4.2, C403.4, C403.4 (New), C403.4.1, C403.4.1.1, C403.4.1.2, C403.4.1.3, C403.4.2, C403.4.2.1, C403.4.2.2, C403.4.2.3, C403.4.2.3.1, C403.4.2.3.2, C403.4.2.3.2.1, C403.4.2.3.2.2, C403.4.2.3.3, C403.4.2.4, C403.4.2.5, C403.4.2.6, C403.4.3, C403.4.3.1, C403.4.3.2, C403.4.3.2.1, C403.4.3.2.2, C403.4.3.3, C403.4.3.4, C403.4.4, C403.4.4.1, C403.4.4.2, C403.4.4.3, C403.4.4.4, C403.4.4.5, C403.4.4.6, C403.4.5, C403.4.6, C403.5, C403.5.1, C403.5.2, C403.7 (New), C403.8.1 (New).

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

SECTION C403 BUILDING MECHANICAL SYSTEMS

Revise as follows:

C403.1 General. Mechanical systems and equipment serving the building heating, cooling, ventilating or ~~ventilating~~ refrigeration needs shall comply with ~~Section C403.2 and shall comply with Sections C403.3 and C403.4 based on the equipment and systems provided.~~

~~Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with~~ this Section ~~C403.2.15 or 403.2.16~~.

~~**C403.2.11**~~ **C403.1.1 Mechanical systems commissioning and completion requirements.** *No change to text.*

~~**C403.2.1**~~ **C403.1.2 Calculation of heating and cooling loads.** *No change to text.*

C403.2 ~~**Provisions applicable to all mechanical systems (Mandatory).**~~ **System design** Mechanical systems ~~and equipment serving the building heating, cooling or ventilating needs~~ 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 ~~C403.2.16~~ C403.12, such elements shall comply with the applicable provisions of those sections.

~~**C403.2.4.4**~~ **C403.2.1 Zone isolation~~.~~ required.(Mandatory)** HVAC systems serving *zones* that are over 25,000 square feet (2323 m^2) 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 ~~C403.2.4.2.2~~ 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.

~~C403.2.6~~ C403.2.2 Ventilation~~.~~ .(Mandatory) *No change to text.*

Add new text as follows:

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.

Revise as follows:

~~C403.2.2~~ C403.3.1 Equipment sizing. The output capacity of heating and cooling equipment shall be not greater than the loads calculated in accordance with Section ~~C403.2.1~~ C403.1.2. 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 have the capability to sequence the operation of each unit based on load.

~~C403.2.3~~ C403.3.2 HVAC equipment performance requirements~~.~~ .(Mandatory) Equipment shall meet the minimum efficiency requirements of Tables ~~C403.2.3(1~~ C403.3,2(1), ~~C403.2.3(2~~ C403.3.2(2), ~~C403.2.3(3~~ C403.3.2(3), ~~C403.2.3(4~~ C403.3.2(4), ~~C403.2.3(5~~ C403.3.2(5), ~~C403.2.3(6~~ C403.3.2(6), ~~C403.2.3(7~~ C403.3.2(7), ~~C403.2.3(8~~ C403.3.2(8) ~~and C403.2.3(9~~ or 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 ~~C403.2.3(10~~ 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.

TABLE ~~C403.2.3~~ C403.3.2(1) (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 Before 1/1/2016	MINIMUM EFFICIENCY As of 1/1/2016	TEST PROCEDURE[a]
Air conditioners, air cooled	b	All	Split System	13.0 SEER	13.0 SEER	AHRI 210/240
			Single Package	13.0 SEER	14.0 SEER[c]	
Through-the-wall (air cooled)	≤ 30,000 Btu/h[b]	All	Split system	12.0 SEER	12.0 SEER	
			Single Package	12.0 SEER	12.0 SEER	
Small-duct high-velocity (air cooled)	b	All	Split System	11.0 SEER	11.0 SEER	
Air conditioners, air cooled	≥ 65,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	11.2 EER 11.4 IEER	11.2 EER 12.8 IEER	AHRI 340/360
		All other	Split System and Single Package	11.0 EER 11.2 IEER	11.0 EER 12.6 IEER	
	≥ 135,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	11.0 EER 11.2 IEER	11.0 EER 12.4 IEER	
		All other	Split System and Single Package	10.8 EER 11.0 IEER	10.8 EER 12.2 IEER	
	≥ 240,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	10.0 EER 10.1 IEER	10.0 EER 11.6 IEER	
		All other	Split System and Single Package	9.8 EER 9.9 IEER	9.8 EER 11.4 IEER	

	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.7 EER 9.8 IEER	9.7 EER 11.2 IEER	
		All other	Split System and Single Package	9.5 EER 9.6 IEER	9.5 EER 11.0 IEER	
Air conditioners, water cooled	b	All	Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 13.9 IEER	AHRI 340/360
		All other	Split System and Single Package	11.9 EER 12.1 IEER	11.9 EER 13.7 IEER	
	≥ 135,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	12.5 EER 12.5 IEER	12.5 EER 13.9 IEER	
		All other	Split System and Single Package	12.3 EER 12.5 IEER	12.3 EER 13.7 IEER	
	≥ 240,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	12.4 EER 12.6 IEER	12.4 EER 13.6 IEER	
		All other	Split System and Single Package	12.2 EER 12.4 IEER	12.2 EER 13.4 IEER	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.2 EER 12.4 IEER	12.2 EER 13.5 IEER	
		All other	Split System and Single Package	12.0 EER 12.2 IEER	12.0 EER 13.3 IEER	

			SUB-	**MINIMUM EFFICIENCY**	

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	CATEGORY OR RATING CONDITION	Before 1/1/2016	As of 1/1/2016	TEST PROCEDURE[a]
Air conditioners, evaporatively cooled	b	All	Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 12.3 IEER	AHRI 340/360
		All other	Split System and Single Package	11.9 EER 12.1 IEER	11.9 EER 12.1 IEER	
	≥ 135,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	12.0 EER 12.2 IEER	12.0 EER 2.2 IEER	
		All other	Split System and Single Package	11.8 EER 12.0 IEER	11.8 EER 12.0 IEER	
	≥ 240,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	11.9 EER 12.1 IEER	11.9 EER 2.1 IEER	
		All other	Split System and Single Package	11.7 EER 11.9 IEER	11.7 EER 11.9 IEER	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.7 EER 11.9 IEER	11.7 EER 11.9 IEER	
		All other	Split System and Single Package	11.5 EER 11.7 IEER	11.5 EER 11.7 IEER	

Condensing units air cooled	≥ 135,000 Btu/h			10.5 EER 11.8 IEER	10.5 EER 11.8 IEER	AHRI 365
Condensing units, water cooled	≥ 135,000 Btu/h			13.5 EER 14.0 IEER	13.5 EER 14.0 IEER	
Condensing units, evaporatively cooled	≥ 135,000 Btu/h			13.5 EER 14.0 IEER	13.5 EER 14.0 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.

c. Minimum efficiency as of January 1, 2015.

TABLE ~~C403.2.3~~ C403.3.2(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]
				Before 1/1/2016	As of 1/1/2016	
Air cooled (cooling mode)	b	All	Split System	13.0 SEER[c]	14.0 SEER[c]	AHRI 210/240
			Single Package	13.0 SEER[c]	14.0 SEER[c]	
Through-the-wall, air cooled	≤ 30,000 Btu/h[b]	All	Split System	12.0 SEER	12.0 SEER	
			Single Package	12.0 SEER	12.0 SEER	
Single-duct high-velocity air cooled	b	All	Split System	11.0 SEER	11.0 SEER	

Air cooled (cooling mode)	≥ 65,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	11.0 EER 11.2 IEER	11.0 EER 12.0 IEER	AHRI 340/360
		All other	Split System and Single Package	10.8 EER 11.0 IEER	10.8 EER 11.8 IEER	
	≥ 135,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	10.6 EER 10.7 IEER	10.6 EER 11.6 IEER	
		All other	Split System and Single Package	10.4 EER 10.5 IEER	10.4 EER 11.4 IEER	
	≥ 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.5 EER 9.6 IEER	9.5 EER 10.6 IEER	
		All other	Split System and Single Package	9.3 EER 9.4 IEER	9.3 EER 9.4 IEER	
Water to Air: Water Loop (cooling mode)		All	86°F entering water	12.2 EER	12.2 EER	ISO 13256-1
	≥ 17,000 Btu/h and	All	86°F entering water	13.0 EER	13.0 EER	
	≥ 65,000 Btu/h and	All	86°F entering water	13.0 EER	13.0 EER	
Water to Air: Ground Water (cooling mode)		All	59°F entering water	18.0 EER	18.0 EER	ISO 13256-1
Brine to Air: Ground Loop (cooling mode)		All	77°F entering water	14.1 EER	14.1 EER	ISO 13256-1
Water to						

Water: WaterLoop (cooling mode)		All	86°F entering water	10.6 EER	10.6 EER	ISO 13256-2
Water to Water: Ground Water (cooling mode)		All	59°F entering water	16.3 EER	16.3 EER	
Brine to Water: Ground Loop (cooling mode)		All	77°F entering fluid	12.1 EER	12.1 EER	

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE[a]
				Before 1/1/2016	As of 1/1/2016	
Air cooled (heating mode)	b	—	Split System	7.7 HSPF[c]	8.2 HSPF[c]	AHRI 210/240
		—	Single Package	7.7 HSPF[c]	8.0 HSPF[c]	
Through-the-wall, (air cooled, heating mode)	≤ 30,000 Btu/h[b] (cooling capacity)	—	Split System	7.4 HSPF	7.4 HSPF	
		—	Single Package	7.4 HSPF	7.4 HSPF	
Small-duct high velocity (air cooled, heating mode)	b	—	Split System	6.8 HSPF	6.8 HSPF	
Air cooled	≥ 65,000 Btu/h and (cooling capacity)	—	47ºF db/43ºF wb outdoor air	3.3 COP	3.3 COP	AHRI 340/360
			17ºF db/15ºF wb outdoor air	2.25 COP	2.25 COP	

(heating mode)	≥ 135,000 Btu/h (cooling capacity)	—	47ºF db/43ºF wb outdoor air	3.2 COP	3.2 COP	
			17ºF db/15ºF wb outdoor air	2.05 COP	2.05 COP	
Water to Air: Water Loop (heating mode)	(cooling capacity)	—	68°F entering water	4.3 COP	4.3 COP	ISO 13256-1
Water to Air: Ground Water (heating mode)	(cooling capacity)	—	50°F entering water	3.7 COP	3.7 COP	
Brine to Air: Ground Loop (heating mode)	(cooling capacity)	—	32°F entering fluid	3.2 COP	3.2 COP	
Water to Water: Water Loop (heating mode)	(cooling capacity)	—	68°F entering water	3.7 COP	3.7 COP	ISO 13256-2
Water to Water: Ground Water (heating mode)	(cooling capacity)	—	50°F entering water	3.1 COP	3.1 COP	
Brine to Water: Ground Loop (heating mode)	(cooling capacity)	—	32°F entering fluid	2.5 COP	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 air conditioners less than 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.

c. Minimum efficiency as of January 1, 2015.

TABLE ~~C403.2.3~~ C403.3.2(3) (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[c]	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)		95°F db/ 75°F wb outdoor air	9.0 EER	AHRI 390
	≥ 65,000 Btu/h and	95°F db/ 75°F wb outdoor air	8.9 EER	
	≥ 135,000 Btu/h and	95°F db/ 75°F wb outdoor air	8.6 EER	
SPVHP (cooling mode)		95°F db/ 75°F wb outdoor air	9.0 EER	
	≥ 65,000 Btu/h and	95°F db/ 75°F wb outdoor air	8.9 EER	
	≥ 135,000 Btu/h and	95°F db/ 75°F wb outdoor air	8.6 EER	

SPVHP (heating mode)		47°F db/ 43°F wb outdoor air	3.0 COP	AHRI 390
	≥ 65,000 Btu/h and	47°F db/ 43°F wb outdoor air	3.0 COP	
	≥ 135,000 Btu/h and	47°F db/ 75°F wb outdoor air	2.9 COP	
Room air conditioners, with louv ered sides		—	9.7 SEER	ANSI/ AHAM RAC-1
	≥ 6,000 Btu/h and	—	9.7 EER	
	≥ 8,000 Btu/h and	—	9.8 EER	
	≥ 14,000 Btu/h and	—	9.7 SEER	
	≥ 20,000 Btu/h	—	8.5 EER	
Room air conditioners, without louv ered sides		—	9.0 EER	
	≥ 8,000 Btu/h and	—	8.5 EER	
	≥ 20,000 Btu/h	—	8.5 EER	
Room air-conditioner heat pumps with louv ered sides		—	9.0 EER	
	≥ 20,000 Btu/h	—	8.5 EER	
Room air-conditioner heat pumps without louv ered sides		—	8.5 EER	
	≥ 14,000 Btu/h	—	8.0 EER	

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Room air conditioner casement only	All capacities	—	8.7 EER	ANSI/ AHAM RAC-1
Room air conditioner				

casement-slider	All capacities	—	9.5 EER	

For SI: 1 British thermal unit per hour = 0.2931 W, °C = [(°F) - 32]/1.8, wb = wet bulb, db = wet 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.

c. Before January 1, 2015 the minimum efficiency shall be 13.8 - (0.300 x Cap/1000) EER.

TABLE ~~C403.2.3~~ C403.3.2(4) (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		—	78% AFUE or 80%E_t[c]	DOE 10 CFR Part 430 or ANSI Z21.47
	≥ 225,000 Btu/h	Maximum capacity[c]	80%E_t[f]	ANSI Z21.47
Warm-air furnaces, oil fired		—	78% AFUE or 80%E_t[c]	DOE 10 CFR 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_c	ANSI Z83.8
Warm-air unit heaters, gas fired	All capacities	Maximum capacity[b]	80%E_c	ANSI Z83.8
Warm-air unit heaters, oil fired	All capacities	Maximum capacity[b]	80%E_c	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_c = 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 ~~C403.2.3~~ C403.3.2(5) (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		80% 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_c	
	Oil-fired[c]		80% 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_c	
Boilers, steam	Gas-fired		75% 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[c]		80% 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_c = Combustion efficiency (100 percent less flue losses).

e. E_t = Thermal efficiency. See referenced standard for detailed information.

TABLE ~~C403.2.3~~ C403.3.2(6) (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 ~~C403.2.3~~ C403.3.2(7) (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[c]
			Path A	Path B	Path A	Path B	
Air-cooled	< 150 Tons	EER	≥ 9.562 FL	NA[c]	≥ 10.100 FL	≥ 9.700 FL	
			≥ 12.500 IPLV		≥ 13.700 IPLV	≥ 15,800 IPLV	

chillers	≥ 150 Tons	(Btu/W)	≥ 9.562 FL	NA[c]	≥ 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		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		≤ 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		≤ 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		≤ 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	

			≤ 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		≤ 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		≤ 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		≤ 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	COP	≥ 0.600 FL	NA[c]	≥ 0.600 FL	NA[c]	
Water cooled absorption, single effect	All capacities	COP	≥ 0.700 FL	NA[c]	≥ 0.700 FL	NA[c]	

Absorption, double effect, indirect fired	All capacities	COP	≥ 1.000 FL ≥ 1.050 IPLV	NA[c]	≥ 1.000 FL ≥ 1.050 IPLV	NA[c]	AHRI 560
Absorption double effect direct fired	All capacities	COP	≥ 1.000 FL ≥ 1.000 IPLV	NA[c]	≥ 1.000 FL ≥ 1.050 IPLV	NA[c]	

a. The requirements for centrifugal chiller shall be adjusted for nonstandard rating conditions in accordance with Section ~~C403.2.3.1~~ C403.3.2.1 and are only applicable for the range of conditions listed in Section ~~C403.2.3.1~~ C403.3.2.1. 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 ~~C403.2.3~~ C403.3.2(8) (8)
MINIMUM EFFICIENCY REQUIREMENTS: HEAT REJECTION EQUIPMENT

EQUIPMENT TYPE[a]	TOTAL SYSTEM HEAT REJECTION CAPACITY AT RATED CONDITIONS	SUBCATEGORY OR RATING CONDITION[i]	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	CTI ATC-105 and CTI STD-201
Centrifugal fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥ 20.0 gpm/hp	CTI ATC-105 and CTI STD-201
Propeller or axial fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 14.0 gpm/hp	CTI ATC-105S and CTI STD-201
Centrifugal fan closed- circuit	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 7.0 gpm/hp	CTI ATC-105S and CTI STD-201

cooling towers				
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·hp	CTI ATC-106
Centrifugal 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·hp	CTI 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·hp	CTI ATC-106
Centrifugal 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·hp	CTI 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·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 listed in Table 403.2.3(8) divided by the fan nameplate-rated motor power.

c. 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 listed in Table 403.2.3(8) 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 and/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 ~~C403.2.3~~ C403.3.2(9) (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	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	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	2.45 / 2.34	ANSI/ASHRAE 127
	≥ 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	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	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.

TABLE ~~C403.2.3~~ C403.3.2(10) (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.

~~C403.2.3.1~~ 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 I/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)**

$PLV_{adj} = \mathrm{IPLV}/K_{adj}$ **(Equation 4-7)**

where:

K_{adj} = $A \times B$

FL = Full-load kW/ton value as specified in Table ~~C403.2.3(7~~ C403.3.2(7).

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

$IPLV$ = Value as specified in Table ~~C403.2.3(7~~ C403.3.2(7).

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

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

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

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

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

$L_{vg}E_{vap}$ = 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. Tweenty°F ≤ *LIFT*≤ 80°F.

~~C403.2.3.2~~ C403.3.2.2. Positive displacement (air- and water-cooled) chilling packages~~.~~ . (Mandatory Equipment with a leaving fluid temperature higher than 32°F (0°C) and water-cooled positive displacement chilling packages with a condenser leaving fluid temperature below 115°F

(46°C) shall meet the requirements of Table ~~C403.2.3(7~~ C403.3.2(7) when tested or certified with water at standard rating conditions, in accordance with the referenced test procedure.

~~C403.4.6~~ C403.3.3 Hot gas bypass limitation. 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 ~~C403.4.6~~ C403.3.3, as limited by Section ~~C403.3.1~~ C403.5.1..

TABLE ~~C403.4.6~~ C403.3.3
MAXIMUM HOT GAS BYPASS CAPACITY

RATED CAPACITY	MAXIMUM HOT GAS BYPASS CAPACITY (% of total capacity)
≤ 240,000 Btu/h	50
> 240,000 Btu/h	25

For SI: 1 British thermal unit per hour = 0.2931 W.

~~C403.4.2.5~~ C403.3.4 Boiler turndown. *Boiler systems* with design input of greater than 1,000,000 Btu/h (293 kW) shall comply with the turndown ratio specified in Table ~~C403.4.2.5~~ 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.

TABLE ~~C403.4.2.5~~ C403.3.4
BOILER TURNDOWN

BOILER SYSTEM DESIGN INPUT (Btu/h)	MINIMUM TURNDOWN RATIO
≥ 1,000,000 and less than or equal to 5,000,000	3 to 1
> 5,000,000 and less than or equal to 10,000,000	4 to 1
> 10,000,000	5 to 1

For SI: 1 British thermal unit per hour = 0.2931 W.

Delete without substitution:

~~**C403.2.4 HVAC system controls.** Each heating and cooling system shall be provided with thermostatic controls as specified in Section C403.2.4.1, C403.2.4.1.3, C403.2.4.2, C403.2.4.3, C403.3.1, C403.4, C403.4.1 or C403.4.4.~~

Add new text as follows:

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.

Revise as follows:

~~C403.2.4.1~~ 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, at least 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 *zone*s also served by an interior system provided:

1. The perimeter system includes at least 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); and
2. The perimeter system heating and cooling supply is controlled by thermostats located within the *zones*served by the system.

~~C403.2.4.1.1~~ C403.4.1.1 **Heat pump supplementary heat~~.~~ .(Mandatory)** *No change to text.*

~~C403.2.4.1.2~~ C403.4.1.2 **Deadband~~.~~ .(Mandatory)** Where used to control both heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or deadband of at least 5°F (2.8°C) within which the supply of heating and cooling energy to the zone is capable of being 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.

~~C403.2.4.1.3~~ C403.4.1.3 **Set point 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 provided with the capability to prevent the heating set point from exceeding the cooling set point and to maintain a deadband in accordance with Section ~~C403.2.4.1.2~~ C403.4.1.2.

~~C403.2.5~~ C403.4.1.4 **Hot water boiler outdoor temperature setback control~~.~~ .(Mandatory)** *No change to text.*

~~C403.2.4.2~~ 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 readily accessible manual shutoff switch.

~~C403.2.4.2.1~~ C403.4.2.1 **Thermostatic setback capabilities~~.~~ .(Mandatory)** *No change to text.*

~~C403.2.4.2.2~~ C403.4.2.2 **Automatic setback and shutdown capabilities~~.~~ .(Mandatory)** *No change to text.*

~~C403.2.4.2.3~~ C403.4.2.3 **Automatic start capabilities~~.~~ .(Mandatory)** *No change to text.*

~~C403.4.2~~ 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 ~~C403.4.2.1~~ C403.4.3.1 through ~~C403.4.2.3~~ 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 capable of sequencing operation of the boilers. Hydronic heating systems comprised 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.

~~C403.4.2.1~~ C403.4.3.1 Three-pipe system. *No change to text.*

~~C403.4.2.2~~ C403.4.3.2 Two-pipe changeover system. *No change to text.*

~~C403.4.2.3~~ C403.4.3.3 Hydronic (water loop) heat pump systems. Hydronic heat pump systems shall comply with Sections ~~C403.4.2.3.1 through C403.4.2.3.2~~ C403.4.3.3.1 and C403.4.3.3.2..

~~C403.4.2.3.1~~ C403.4.3.3.1 Temperature dead band. Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are capable of providing a heat pump water supply temperature dead band of not less than 20°F (11°C) between initiation of heat rejection and heat addition by the central devices.

> **Exception:** Where a system loop temperature optimization controller is installed and can determine the most efficient operating temperature based on realtime conditions of demand and capacity, dead bands of less than 20°F (11°C) shall be permitted.

~~C403.4.2.3.2~~ C403.4.3.3.2 Heat rejection. Heat rejection equipment shall comply with Sections ~~C403.4.2.3.2.1~~ C403.4.3.3.2.1 and ~~C403.4.2.3.2.2~~ C403.4.3.3.2.2.

> **Exception:** Where it can be demonstrated that a heat pump system will be required to reject heat throughout the year.

~~C403.4.2.3.2.1~~ C403.4.3.3.2.1 Climate zones 3 and 4. For *Climate Zones* 3 and 4:

1. Where a closed-circuit cooling tower is used directly in the heat pump loop, either an automatic valve shall be installed to bypass all but a minimal flow of water around the tower, or lower leakage positive closure dampers shall be provided.
2. Where an open-circuit tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the tower.
3. Where an open- or closed-circuit cooling tower is used in conjunction with a separate heat exchanger to isolate the cooling tower from the heat pump loop, then heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop.

~~C403.4.2.3.2.2~~ C403.4.3.3.2.2 Climate zones 5 through 8. *No change to text.*

~~C403.4.2.3.3~~ C403.4.3.3.3 Two-position valve. *No change to text.*

~~C403.4.2.4~~ C403.4.4 Part-load controls. Hydronic systems greater than or equal to 500,000 Btu/h (146.5 kW) in design output capacity supplying heated or chilled water to comfort conditioning systems shall include controls that have the capability to do all of the following:

1. Automatically reset the supply-water temperatures in response to varying building heating and cooling demand using coil valve position, zone-return water temperature, building-return water temperature or outside air temperature. The temperature shall be

capable of being reset by not less than 25 percent of the design supply-to-return water temperature difference.

2. Automatically vary fluid flow for hydronic systems with a combined motor capacity of 10 hp (7.5 kW) or larger with three or more control valves or other devices by reducing the system design flow rate by not less than 50 percent by designed valves that modulate or step open and close, or pumps that modulate or turn on and off as a function of load.
3. Automatically vary pump flow on chilled-water systems and heat rejection loops serving water-cooled unitary air conditioners with a combined motor capacity of 10 hp (7.5 kW) or larger by reducing pump design flow by not less than 50 percent, utilizing adjustable speed drives on pumps, or multiple-staged pumps where not less than one-half of the total pump horsepower is capable of being automatically turned off. Pump flow shall be controlled to maintain one control valve nearly wide open or to satisfy the minimum differential pressure.

Exceptions:

1. Supply-water temperature reset for chilled-water systems supplied by off-site district chilled water or chilled water from ice storage systems.
2. Minimum flow rates other than 50 percent as required by the equipment manufacturer for proper operation of equipment where using flow bypass or end-of-line 3-way valves.
3. Variable pump flow on dedicated equipment circulation pumps where configured in primary/secondary design to provide the minimum flow requirements of the equipment manufacturer for proper operation of equipment.

~~C403.4.2.6~~ C403.4.5 **Pump isolation.** Chilled water plants including more than one chiller shall have the capability to reduce flow automatically through the chiller plant when a chiller is shut down. Chillers piped in series for the purpose of increased temperature differential shall be considered as one chiller.

Boiler plants including more than one boiler shall have the capability to reduce flow automatically through the boiler plant when a boiler is shut down.

~~C403.3~~ C403.5 **Economizers (Prescriptive).** Each cooling system shall include either an air or water economizer complying with Sections ~~C403.3.1~~ C403.5.1 through ~~C403.3.4~~ C403.5.5.

Exceptions: Economizers are not required for the systems listed below.

1. In cooling systems for buildings located in Climate Zones 1A and 1B.
2. In climate zones other than 1A and 1B, where individual fan cooling units have a capacity of less than 54,000 Btu/h (15.8 kW) and meet one of the following:
    1. Have direct expansion cooling coils.
    2. The total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).

       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. 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.
4. Systems that serve residential spaces where the system capacity is less than five times

the requirement listed in Table C403.3(1).
5. Systems expected to operate less than 20 hours per week.
6. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.
7. Where the cooling efficiency meets or exceeds the efficiency requirements in Table C403.3(2).
8. Chilled-water cooling systems that are passive (without a fan) or use induction where the total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).
9. Systems that include a heat recovery system in accordance with Section C403.4.5.

TABLE ~~C403.3~~ C403.5(1) (1)
MINIMUM CHILLED-WATER SYSTEM COOLING CAPACITY FOR DETERMINING ECONOMIZER COOLING REQUIREMENTS

CLIMATE ZONES (COOLING)	TOTAL CHILLED-WATER SYSTEM CAPACITY LESS CAPACITY OF COOLING UNITS WITH AIR ECONOMIZERS	
	Local Water-cooled Chilled-water Systems	Air-cooled Chilled-water Systems or District Chilled-Water Systems
1a	No economizer requirement	No economizer requirement
1b, 2a, 2b	960,000 Btu/h	1,250,000 Btu/h
3a, 3b, 3c, 4a, 4b, 4c	720,000 Btu/h	940,000 Btu/h
5a, 5b, 5c, 6a, 6b, 7, 8	1,320,000 Btu/h	1,720,000 Btu/h

For SI:1 British thermal unit per hour = 0.2931 W.

TABLE ~~C403.3~~ C403.5(2) (2)
EQUIPMENT EFFICIENCY PERFORMANCE EXCEPTION FOR ECONOMIZERS

CLIMATE ZONES	COOLING EQUIPMENT PERFORMANCE IMPROVEMENT (EER OR IPLV)
2B	10% efficiency improvement
3B	15% efficiency improvement
4B	20% efficiency improvement

~~C403.3.1~~ C403.5.1 **Integrated economizer control.** Economizer systems shall be integrated with the mechanical cooling system and be capable of providing partial cooling even where additional mechanical cooling is required to provide the remainder of the cooling load. Controls shall not be capable of creating a false load in the mechanical cooling systems by limiting or disabling the economizer or any other means, such as hot gas bypass, except at the lowest stage of mechanical cooling.

Units that include an air economizer shall comply with the following:

1. Unit controls shall have the mechanical cooling capacity control interlocked with the air economizer controls such that the outdoor air damper is at the 100-percent open position when mechanical cooling is on and the outdoor air damper does not begin to close to prevent coil freezing due to minimum compressor run time until the leaving air temperature is less than 45°F (7°C).
2. Direct expansion (DX) units that control 75,000 Btu/h (22 kW) or greater of rated capacity of the capacity of the mechanical cooling directly based on occupied space temperature shall have not fewer than two stages of mechanical cooling capacity
3. Other DX units, including those that control space temperature by modulating the airflow to the space, shall be in accordance with Table ~~C403.3.1~~ C403.5.1.

TABLE ~~C403.3.1~~ C403.5.1
DX COOLING STAGE REQUIREMENTS FOR MODULATING AIRFLOW UNITS

RATING CAPACITY	MINIMUM NUMBER OF MECHANICAL COOLING STAGES	MINIMUM COMPRESSOR DISPLACEMENT[a]
≥ 65,000 Btu/h and < 240,000 Btu/h	3 stages	≤ 35% of full load
≥ 240,000 Btu/h	4 stages	≤ 25% full load

For SI: 1 British thermal unit per hour = 0.2931 W.

a. For *mechanicalcooling stage* control that does not use variable compressor displacement, the percent displacement shall be equivalent to the mechanical cooling capacity reduction evaluated at the full load rating conditions for the compressor.

~~C403.3.2~~ C403.5.2 **Economizer heating system impact.** HVAC system design and economizer controls shall be such that economizer operation does not increase building heating energy use during normal operation.

Exception: Economizers on variable air volume (VAV) systems that cause *zone* level heating to increase due to a reduction in supply air temperature.

~~C403.3.3~~ C403.5.3 Air economizers. Air economizers shall comply with Sections ~~C403.3.3.1~~ C403.5.3.1 through ~~C403.3.3.5~~ C403.5.3.5.

~~C403.3.3.1~~ C403.5.3.1 Design capacity. *No change to text.*

~~C403.3.3.2~~ C403.5.3.2 Control signal. Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment and shall not be controlled by only mixed-air temperature.

Exception: The use of mixed-air temperature limit control shall be permitted for systems controlled from space temperature (such as single-*zone* systems).

~~C403.3.3.3~~ C403.5.3.3 High-limit shutoff. Air economizers shall be capable of automatically reducing *outdoor air* intake to the design minimum *outdoor air* quantity when *outdoor air* intake will no longer reduce cooling energy usage. High-limit shutoff control types for specific climates shall be chosen from Table ~~C403.3.3.3~~ C403.5.3.3.. High-limit shutoff control settings for these control types shall be those specified in Table ~~C403.3.3.3~~ C403.5.3.3.

TABLE ~~C403.3.3.3~~ C403.5.3.3
HIGH-LIMIT SHUTOFF CONTROL SETTING FOR AIR ECONOMIZERS[b]

DEVICE TYPE	CLIMATE ZONE	REQUIRED HIGH LIMIT (ECONOMIZER OFF WHEN):	
		Equation	Description
Fixed dry bulb	1B, 2B, 3B, 3C, 4B, 4C, 5B, 5C, 6B, 7, 8	$T_{OA} > 75°F$	Outdoor air temperature exceeds 75°F
	5A, 6A	$T_{OA} > 70°F$	Outdoor air temperature exceeds 70°F
	1A, 2A, 3A, 4A	$T_{OA} > 65°F$	Outdoor air temperature exceeds 65°F
Differential dry bulb	1B, 2B, 3B, 3C, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8	$T_{OA} > T_{RA}$	Outdoor air temperature exceeds return air temperature
Fixed enthalpy with fixed dry-bulb temperatures	All	$h_{OA} > 28$ Btu/lb[a] or $T_{OA} > 75°F$	Outdoor air enthalpy exceeds 28 Btu/lb of dry air[a] or Outdoor air temperature exceeds 75°F
			Outdoor air enthalpy exceeds

Differential enthalpy with fixed dry-bulb temperature	All	$h_{OA} > h_{RA}$ or $T_{OA} > 75°F$	return air enthalpy or Outdoor air temperature exceeds 75°F

For SI: 1 foot = 305 mm, °C = (°F - 32)/1.8, 1 Btu/lb = 2.33 kJ/kg.

a. At altitudes substantially different than sea level, the fixed enthalpy limit shall be set to the enthalpy value at 75°F and 50-percent relative humidity. As an example, at approximately 6,000 feet elevation, the fixed enthalpy limit is approximately 30.7 Btu/lb.

b. Devices with selectable setpoints shall be capable of being set to within 2°F and 2 Btu/lb of the setpoint listed.

~~C403.3.3.4~~ C403.5.3.4 Relief of excess outdoor air. *No change to text.*

~~C403.3.3.5~~ C403.5.3.5 Economizer dampers. Return, exhaust/relief and outdoor air dampers used in economizers shall comply with Section ~~C403.2.4.3~~ C403.7.5.

~~C403.3.4~~ C403.5.4 Water-side economizers. Water-side economizers shall comply with Sections ~~C403.3.4.1~~ C403.5.4.1 and ~~C403.3.4.2~~ C403.5.4.2.

~~C403.3.4.1~~ C403.5.4.1 Design capacity. Water economizer systems shall be capable of cooling supply air by indirect evaporation and providing up to 100 percent of the expected system cooling load at *outdoor air* temperatures of not greater than 50°F (10°C) dry bulb/45°F (7°C) wet bulb.

Exceptions:

1. Systems primarily serving computer rooms in which 100 percent of the expected system cooling load at 40°F (4°C) dry bulb/35°F (1.7°C) wet bulb is met with evaporative water economizers.
2. Systems primarily serving computer rooms with dry cooler water economizers which satisfy 100 percent of the expected system cooling load at 35°F (1.7°C) dry bulb.
3. 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.

~~C403.3.4.2~~ C403.5.4.2 Maximum pressure drop. *No change to text.*

~~C403.2.4.7~~ C403.5.5 Economizer fault detection and diagnostics (FDD)~~.~~ .(Mandatory) Air-cooled unitary direct-expansion units listed in Tables ~~C403.2.3(1~~ C403.3.2(1) through ~~C403.2.3(3~~ C403.3.2(3) and variable refrigerant flow (VRF) units that are equipped with an economizer in accordance with Section ~~C403.3~~ C403.5 through C403.5.4 shall include a fault detection and diagnostics (FDD) 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 ±2°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 capable of providing 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 capable of reporting faults to a fault management application accessible by day-to-day operating or service personnel, or annunciated locally on zone thermostats.
7. The FDD system shall be capable of detecting 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.

Delete without substitution:

~~**C403.4 Hydronic and multiple-zone HVAC systems controls and equipment. (Prescriptive).**~~ ~~Hydronic and multiple- zone HVAC system controls and equipment shall comply with this section~~
.

Revise as follows:

~~**C403.4.4**~~ **C403.6** ~~**Requirements for complex mechanical systems serving**~~ **Variable air volume (VA) and** **multiple** ~~**zones.**~~ **zone systems** ~~Sections C403.4.4.1 through C403.4.6.4 shall apply to complex mechanical systems serving multiple zones.~~
Supply air systems serving multiple zones shall be variable air volume (VAV) systems that, during periods of occupancy, are designed and capable of being controlled to reduce primary air supply to each *zone* to one of the following before reheating, recooling or mixing takes place:

1. Thirty percent of the maximum supply air to each *zone*.
2. Three hundred cfm (142 L/s) or less where the maximum flow rate is less than 10 percent of the total fan system supply airflow rate.
3. 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 reheat/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 or site-solar energy source.

2. *Zones* where special humidity levels are required to satisfy process needs.
3. *Zones* with a peak supply air quantity of 300 cfm (142 L/s) or less and where the flow rate is less than 10 percent of the total fan system supply airflow rate.
4. *Zones* where the volume of air to be reheated, recooled or mixed is not greater than the volume of outside air required to provide the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*.
5. *Zones*or supply air systems with thermostatic and humidistatic controls capable of operating in sequence the supply of heating and cooling energy to the*zones* and which are capable of preventing 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.

~~C403.4.4.1~~ C403.6.1 **Single-duct VAV systems, terminal devices.** *No change to text.*

~~C403.4.4.2~~ C403.6.2 **Dual-duct and mixing VAV systems, terminal devices.** *No change to text.*

~~C403.4.4.3~~ C403.6.3 **Single-fan dual-duct and mixing VAV systems, economizers.** *No change to text.*

~~C403.4.4.5~~ C403.6.4 **Supply-air temperature reset controls.** Multiple-*zone*HVAC systems shall include controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperature. The controls shall be capable of resetting the supply air temperature not less than 25 percent of the difference between the design supply-air temperature and the design room 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. *Zones* with peak supply air quantities of 300 cfm (142 L/s) or less.

~~C403.4.4.6~~ C403.6.5 **Multiple-zone VAV system ventilation optimization control.** Multiple-zone VAV systems with direct digital control of individual zone boxes reporting to a central control panel shall have automatic controls configured to reduce outdoor air intake flow below design rates in response to changes in system*ventilation*efficiency (*Ev*) as defined by the International Mechanical Code.

Exceptions:
1. VAV systems with zonal transfer fans that recirculate air from other zones without directly mixing it with outdoor air, dual-duct dual-fan VAV systems, and VAV systems with fan-powered terminal units.
2. Systems having exhaust air energy recovery complying with Section ~~C403.2.7~~ C403.7.3..
3. Systems where total design exhaust airflow is more than 70 percent of total design outdoor air intake flow requirements.

~~C403.4.1.3~~ C403.6.6 **Set points for direct digital control.** For systems with direct digital control of individual zones reporting to the central control panel, the static pressure set point shall be reset based on the *zone* requiring the most pressure. In such case, the set point is reset lower until one zone damper is nearly wide open. The direct digital controls shall be capable of monitoring *zone* damper positions or shall have an alternative method of indicating the need for static pressure that is capable of all of the following:

1. Automatically detecting any *zone* that excessively drives the reset logic.
2. Generating an alarm to the system operational location.
3. Allowing an operator to readily remove one or more zones from the reset algorithm.

~~C403.4.1.2~~ C403.6.7 **Static pressure sensor location.** *No change to text.*

Add new text as follows:

C403.7 Ventilation and exhaust systems In addition to other requirements of Section C403 applicable to the provision of ventilation air or the exhaust of air, ventilation and exhaust systsm shall be in accordance with Section C403.7.1 through C403.7.5.

Revise as follows:

~~C403.2.6.1~~ C403.7.1 **Demand controlled ventilation~~.~~ .(Mandatory)** Demand control ventilation (DCV) shall be provided for spaces larger than 500 square feet (46.5 m^2) and with an average occupant load of 25 people per 1,000 square feet (93 m^2) 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).

Exception: Demand control ventilation is not required for systems and spaces as follows:

1. Systems with energy recovery complying with Section ~~C403.2.7~~ C403.7.3.
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 for process loads only.

~~C403.2.6.2~~ 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 *InternationalMechanical 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.

~~C403.2.7~~ C403.7.3 Energy recovery ventilation systems~~.~~ .(Mandatory) Where the supply airflow rate of a fan system exceeds the values specified in Tables ~~C403.2.7(1~~ C403.7.3(1) and ~~C403.2.7(2~~ C403.7.3(2), the system shall include an energy recovery system. The energy recovery system shall have the capability 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 which permit operation of the economizer as required by Section ~~C403.3~~ 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 at least one of the following features:
   - 2.1. Variable-air-volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values.
   - 2.2. Direct makeup (auxiliary) air supply equal to at least 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, 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 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 ~~C403.2.7(1~~ C403.7.3(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.

TABLE ~~C403.2.7~~ C403.7.3(1) (1)
ENERGY RECOVERY REQUIREMENT (Ventilation systems operating less than 8,000 hours per year)

CLIMATE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
			≥ 30%	≥ 40%	≥ 50%	≥ 60%	≥ 70%	

ZONE	≥10% and	≥ 20% and	and	and 50%	and 60%	and 70%	and 80%	≥ 80%
	DESIGN SUPPLY FAN AIRFLOW RATE (cfm)							
3B, 3C, 4B, 4C, 5B	NR	NR	NR	NR	NR	NR	NR	NR
1B, 2B, 5C	NR	NR	NR	NR	≥ 26,000	≥ 12,000	≥ 5,000	≥ 4,000
6B	≥ 28,000	≥ 26,5000	≥ 11,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,500	≥ 1,500
1A, 2A, 3A, 4A, 5A, 6A	≥ 26,000	≥ 16,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,000	≥ 1,000	> 0
7, 8	≥ 4,500	≥ 4,000	≥ 2,500	≥ 1,000	> 0	> 0	> 0	> 0

For SI: 1 cfm = 0.4719 L/s.

NR = Not Required.

TABLE ~~C403.2.7~~ C403.7.3(2) (2)
ENERGY RECOVERY REQUIREMENT (Ventilation systems operating not less than 8,000 hours per year)

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	≥ 10% and	**≥ 20% and**	**≥ 30% and**	**≥ 40% and**	**≥ 50% and**	**≥ 60% and**	**≥ 70% and**	**≥ 80%**
	Design Supply Fan Airflow Rate (cfm)							
3C	NR	NR	NR	NR	NR	NR	NR	NR
1B, 2B, 3B, 4C, 5C	NR	≥ 19,500	≥ 9,000	≥ 5,000	≥ 4,000	≥ 3,000	≥ 1,500	> 0
1A, 2A, 3A, 4B, 5B	≥ 2,500	≥ 2,000	≥ 1,000	≥ 500	> 0	> 0	> 0	> 0
4A, 5A, 6A, 6B, 7, 8	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0

For SI: 1 cfm = 0.4719 L/s.

NR = Not required

~~C403.2.8~~ C403.7.4 **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 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 ~~C403.2.8~~ C403.7.4 and shall comply with one of the following:

2.1. Not less than 50 percent of all replacement air shall be transfer air that would otherwise be exhausted.
2.2. Demand ventilation systems on not less than 75 percent of the exhaust air that are capable of 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.
2.3. 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 ~~C403.2.8~~ C403.7.4
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.

~~C403.2.4.3~~ C403.7.5 **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/ft^2 (20.3 L/s • m^2) 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: Gravity (nonmotorized) dampers shall be permitted to be used 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).

Gravity (nonmotorized) dampers shall have an air leakage rate not greater than 20 cfm/ft^2 (101.6 L/s • m^2) where not less than 24 inches (610 mm) in either dimension and 40 cfm/ft^2 (203.2 L/s • m^2) 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.

~~C403.2.12~~ C403.8 ~~Air system design~~ Fans and ~~control.~~ fan controls.(Mandatory) ~~Each~~ Fans in HVAC ~~system having a total fan system motor nameplate horsepower (hp) exceeding 5 hp (3.7 kW)~~ systems shall comply with ~~the provisions of Sections C403.2.12.1 through C403.2.12.3~~ this section.

Add new text as follows:

C403.8.1 Fans exceeding 5 hp. Each HVAC system having a total fan system motor nameplate horsepower (hp) exceeding 5 hp (3.7 kW) shall comply with the provisions of Sections C403.8.1.1 through C403.8.1.3.

Revise as follows:

~~C403.2.12.1~~ C403.8.1.1 Allowable fan motor horsepower~~.~~ .(Mandatory) Each HVAC system at fan system design conditions shall not exceed the allowable *fan system motor nameplate hp* (Option 1) or *fan system bhp* (Option 2) as shown in Table ~~C403.2.12.1(1~~ C403.8.1.1(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.

TABLE ~~C403.2.12.1~~ C403.8.1.1(1) (1)
FAN POWER LIMITATION

	LIMIT	CONSTANT VOLUME	VARIABLE VOLUME
Option 1: Fan system motor nameplate hp	Allowable nameplate motor hp	hp ≤ CFM_S • 0.0011	hp ≤ CFM_S • 0.0015
Option 2: Fan system bhp	Allowable fan system bhp	bhp ≤ CFM_S · 0.00094 + *A*	bhp ≤ CFM_S • 0.0013 + *A*

For SI: 1 bhp = 735.5 W, 1 hp = 745.5 W, 1 cfm = 0.4719 L/s.

where:

CFM_S

CFM_S

CFM_S

=

=

The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.

The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.

hp

hp

=

=

The maximum combined motor nameplate horsepower.

The maximum combined motor nameplate horsepower.

Bhp

Bhp

=

=

The maximum combined fan brake horsepower.

The maximum combined fan brake horsepower.

A

A

=

=

Sum of [$PD \times CFM_D / 4131$]

Sum of [$PD \times CFM_D$ / 4131]

where:

PD

PD

PD

=

=

Each applicable pressure drop adjustment from Table C403.2.12.1(2) in. w.c.

Each applicable pressure drop adjustment from Table C403.2.12.1(2) in. w.c.

CFM_D

CFM_D

=

=

The design airflow through each applicable device from Table C403.2.12.1(2) in cubic feet per minute.

The design airflow through each applicable device from Table C403.2.12.1(2) in cubic feet per minute.

TABLE ~~C403.2.12.1~~ C403.8.1.1(2) (2)
FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT

DEVICE	ADJUSTMENT
Credits	
Fully ducted return and/or exhaust air systems	0.5 inch w.c. (2.15 in w.c. for laboratory and vivarium systems)
Return and/or exhaust airflow control devices	0.5 inch w.c.
Exhaust filters, scrubbers or other exhaust treatment	The pressure drop of device calculated at fan system design condition
Particulate filtration credit: MERV 9 thru 12	0.5 inch w.c.
Particulate filtration credit: MERV 13 thru 15	0.9 inch. w.c.
Particulate filtration credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2x clean filter pressure drop at fan system design condition.
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition.
Biosafety cabinet	Pressure drop of device at fan system design condition.

Energy recovery device, other than coil runaround loop	(2.2 × energy recovery effectiveness) – 0.5 inch w.c. for each airstream.
Coil runaround loop	0.6 inch w.c. for each airstream.
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design conditions.
Sound attenuation section (fans serving spaces with design background noise goals below NC35)	0.15 inch w.c.
Exhaust system serving fume hoods	0.35 inch w.c.
Laboratory and vivarium exhaust systems in high-rise buildings	0.25 inch w.c./100 feet of vertical duct exceeding 75 feet.
Deductions	
Systems without central cooling device	- 0.6 in. w.c.
Systems without central heating device	- 0.3 in. w.c.
Systems with central electric resistance heat	- 0.2 in. w.c.

For SI: 1 inch w.c. = 249 Pa, 1 inch = 25.4 mm.

w.c. = water column, NC = Noise criterion.

~~C403.2.12.2~~ C403.8.1.2 **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 ~~C403.2.12.1~~ C403.8.1.1 *fan system motor nameplate hp* (Option 1).

~~C403.2.12.3~~ C403.8.1.3 **Fan efficiency~~.~~ .(Mandatory)** Fans shall have a fan efficiency grade (FEG) of not less than 67 when 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. Single fan 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.
1.3. Fans that are part of equipment covered under Section ~~C403.2.3.~~ C403.3.2
1.4. Fans included in an equipment package certified by an *approved agency* for air or energy performance.
1.5. Powered wall/roof ventilators.
1.6. Fans outside the scope of AMCA 205.
1.7. Fans that are intended to operate only during emergency conditions.

~~**C403.4.4.4**~~ **C403.8.2 Fractional hp fan motors.** Motors for fans that are not less than $^{1}/_{12}$ 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 also 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 ~~403.2.3~~ C403.3.2 or ~~C403.2.12.~~ Sections C403.8.1.1 through C403.8.1.3
3. Motors that comply with Section C405.8.

~~**C403.4.1**~~ **C403.8.3 Fan control.** Controls shall be provided for fans in accordance with ~~Sections C403.4.1.1 through C403.4.1.3~~ Section C403.8.3.1 and as required for specific systems provided in Section C403..

~~**C403.4.1.1**~~ **C403.8.3.1 Fan airflow control.** Each cooling system listed in Table ~~C403.4.1.1~~ C403.8.3.1 shall be designed to vary the indoor fan airflow as a function of load and shall comply with the following requirements:

1. Direct expansion (DX) and chilled water cooling units that control the capacity of the mechanical cooling directly based on space temperature shall have not fewer than two stages of fan control. Low or minimum speed shall not be greater than 66 percent of full speed. At low or minimum speed, the fan system shall draw not more than 40 percent of the fan power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.
2. Other units including DX cooling units and chilled water units that control the space temperature by modulating the airflow to the space shall have modulating fan control. Minimum speed shall be not greater than 50 percent of full speed. At minimum speed the fan system shall draw not more than 30 percent of the power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.
3. Units that include an airside economizer in accordance with Section ~~C403.3~~ C403.5 shall have not fewer than two speeds of fan control during economizer operation

Exceptions:

1. Modulating fan control is not required for chilled water and

evaporative cooling units with fan motors of less than 1 hp (0.746 kW) where the units are not used to provide *ventilation* air and the indoor fan cycles with the load.

2. Where the volume of outdoor air required to comply with the *ventilation* requirements of the *International Mechanical Code* at low speed exceeds the air that would be delivered at the speed defined in Section ~~C403.4.1~~ C403.8.3, the minimum speed shall be selected to provide the required *ventilation air*.

TABLE ~~C403.4.1.1~~ C403.8.3.1
EFFECTIVE DATES FOR FAN CONTROL

COOLING SYSTEM TYPE	FAN MOTOR SIZE	MECHANICAL COOLING CAPACITY
DX cooling	Any	≥ 75,000 Btu/h (before 1/1/2016)
		≥ 65,000 Btu/h (after 1/1/2016
Chilled water and evaporative cooling	≥ 5 hp	Any
	≥ 1/4 hp	Any

For SI: 1 British thermal unit per hour = 0.2931 W; 1 hp = 0.746 kW.

~~C403.4.3~~ C403.9 **Heat rejection equipment.** Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

> **Exception:** Factory-installed heat rejection devices within HVAC equipment tested and rated in accordance with Tables ~~C403.2.3(6~~ C403.3.2(6) and ~~C403.2.3(7~~ C403.3.2(7).

~~C403.4.3.1~~ C403.9.1 **General.** Heat rejection equipment such as air-cooled condensers, dry coolers, open-circuit cooling towers, closed-circuit cooling towers and evaporative condensers used for comfort cooling applications shall comply with this section.

> **Exception:** Heat rejection devices where energy usage is included in the equipment efficiency ratings listed in Tables ~~C403.2.3(6~~ C403.3.2(6) and ~~C403.2.3(7~~ C403.3.2(7).

~~C403.4.3.2~~ C403.9.2 **Fan speed control.** The fan speed shall be controlled as provided in Sections ~~C403.4.3.2.1~~ C403.9.2.1 and ~~C403.4.3.2.2~~ C403.9.2.2..

~~C403.4.3.2.1~~ C403.9.2.1 **Fan motors not less than 7.5 hp.** Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

Exception: The following fan motors over 7.5 hp (5.6 kW) are exempt:

1. Condenser fans serving multiple refrigerant circuits.
2. Condenser fans serving flooded condensers.
3. Installations located in *Climate Zones* 1 and 2.

~~C403.4.3.2.2~~ C403.9.2.2 Multiple-cell heat rejection equipment. Multiple-cell heat rejection equipment with variable speed fan drives shall be controlled in both of the following manners:

1. To operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components.
2. So all fans can operate at the same fan speed required for the instantaneous cooling duty, as opposed to staged (on/off) operation.

Minimum fan speed shall be the minimum allowable speed of the fan drive system in accordance with the manufacturer's recommendations.

~~C403.4.3.3~~ C403.9.3 Limitation on centrifugal fan open-circuit cooling towers. Centrifugal fan open-circuit cooling towers with a combined rated capacity of 1,100 gpm (4164 L/m) or greater at 95°F (35°C) condenser water return, 85°F (29°C) condenser water supply, and 75°F (24°C) outdoor air wet-bulb temperature shall meet the energy efficiency requirement for axial fan open-circuit cooling towers listed in Table ~~C403.2.3(8~~ C403.3.2(8).

Exception: Centrifugal open-circuit cooling towers that are designed with inlet or discharge ducts or require external sound attenuation.

~~C403.4.3.4~~ C403.9.4 Tower flow turndown. *No change to text.*

~~C403.4.5~~ C403.9.5 Heat recovery for service water heating. Condenser heat recovery shall be installed for heating or reheating of service hot water provided that the facility operates 24 hours a day, the total installed heat capacity of water-cooled systems exceeds 6,000,000 Btu/hr (1 758 kW) of heat rejection, and the design service water heating load exceeds 1,000,000 Btu/h (293 kW).

The required heat recovery system shall have the capacity to provide the smaller of the following:

1. Sixty percent of the peak heat rejection load at design conditions.
2. The preheating required to raise the peak service hot water draw to 85°F (29°C).

Exceptions:

1. Facilities that employ condenser heat recovery for space heating or reheat purposes with a heat recovery design exceeding 30 percent of the peak water-cooled condenser load at design conditions.
2. Facilities that provide 60 percent of their service water heating from site solar or site recovered energy or from other sources.

~~C403.2.14~~ C403.10 Refrigeration equipment performance (Mandatory). Refrigeration equipment shall have an energy use in kWh/day not greater than the values of Tables ~~C403.2.14(1~~ C403.10.1(1) and ~~C403.2.14(2~~ 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.

~~C403.2.15~~ 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 not either site assembled or 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.
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-i 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* doors 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/ft^2 (76 W/m^2) 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.

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.

TABLE ~~C403.2.14~~ C403.10.1(1) (1)
MINIMUM EFFICIENCY REQUIREMENTS: COMMERCIAL REFRIGERATION

EQUIPMENT TYPE	APPLICATION	ENERGY USE LIMITS (kWh per day)[a]	TEST PROCEDURE
Refrigerator with solid doors		0.10 · V + 2.04	

Refrigerator with transparent doors	Holding Temperature	0.12 · V + 3.34	AHRI 1200
Freezers with solid doors		0.40 · V + 1.38	
Freezers with transparent doors		0.75 · V + 4.10	
Refrigerators/freezers with solid doors		the greater of 0.12 · V + 3.34 or 0.70	
Commercial refrigerators	Pulldown	0.126 · V + 3.51	

a. V = volume of the chiller or frozen compartment as defined in AHAM-HRF-1.

TABLE ~~C403.2.14~~ C403.10.1(2) (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 · TDA + 4.07	
SVO.RC.M	Semivertical open	Remote condensing	Medium	0.83 · TDA + 3.18	
HZO.RC.M	Horizontal open	Remote condensing	Medium	0.35 · TDA + 2.88	
VOP.RC.L	Vertical open	Remote condensing	Low	2.27 · TDA + 6.85	
HZO.RC.L	Horizontal open	Remote condensing	Low	0.57 · TDA + 6.88	
VCT.RC.M	Vertical transparent door	Remote condensing	Medium	0.22 TDA + 1.95	
VCT.RC.L	Vertical transparent door	Remote condensing	Low	0.56 · TDA + 2.61	

SOC.RC.M	Service over counter	Remote condensing	Medium	0.51 · TDA + 0.11	AHRI 1200
VOP.SC.M	Vertical open	Self-contained	Medium	1.74 · TDA + 4.71	
SVO.SC.M	Semivertical open	Self-contained	Medium	1.73 · TDA + 4.59	
HZO.SC.M	Horizontal open	Self-contained	Medium	0.77 · TDA + 5.55	
HZO.SC.L	Horizontal open	Self-contained	Low	1.92 · TDA + 7.08	
VCT.SC.I	Vertical transparent door	Self-contained	Ice cream	0.67 · TDA + 3.29	
VCS.SC.I	Vertical solid door	Self-contained	Ice cream	0.38 · V + 0.88	
HCT.SC.I	Horizontal transparent door	Self-contained	Ice cream	0.56 · TDA + 0.43	
SVO.RC.L	Semivertical open	Remote condensing	Low	2.27 · TDA + 6.85	
VOP.RC.I	Vertical open	Remote condensing	Ice cream	2.89 · TDA + 8.7	
SVO.RC.I	Semivertical open	Remote condensing	Ice cream	2.89 · TDA + 8.7	
HZO.RC.I	Horizontal open	Remote condensing	Ice cream	0.72 · TDA + 8.74	
VCT.RC.I	Vertical transparent door	Remote condensing	Ice cream	0.66 · TDA + 3.05	
HCT.RC.M	Horizontal transparent door	Remote condensing	Medium	0.16 · TDA + 0.13	

EQUIPMENT TYPE				ENERGY USE LIMITS	TEST
Equipment					

Class[c]	Family Code	Operating Mode	Rating Temperature	(kWh/day)[a,b]	PROCEDURE
HCT.RC.L	Horizontal transparent door	Remote condensing	Low	0.34 · TDA + 0.26	
HCT.RC.I	Horizontal transparent door	Remote condensing	Ice cream	0.4 · TDA + 0.31	
VCS.RC.M	Vertical solid door	Remote condensing	Medium	0.11 · V + 0.26	
VCS.RC.L	Vertical solid door	Remote condensing	Low	0.23 · V + 0.54	
VCS.RC.I	Vertical solid door	Remote condensing	Ice cream	0.27 · V + 0.63	
HCS.RC.M	Horizontal solid door	Remote condensing	Medium	0.11 · V + 0.26	
HCS.RC.L	Horizontal solid door	Remote condensing	Low	0.23 · V + 0.54	
HCS.RC.I	Horizontal solid door	Remote condensing	Ice cream	0.27 · V + 0.63	
HCS.RC.I	Horizontal solid door	Remote condensing	Ice cream	0.27 · V + 0.63	AHRI 1200
SOC.RC.L	Service over counter	Remote condensing	Low	1.08 · TDA + 0.22	
SOC.RC.I	Service over counter	Remote condensing	Ice cream	1.26 · TDA + 0.26	
VOP.SC.L	Vertical open	Self-contained	Low	4.37 · TDA + 11.82	
VOP.SC.I	Vertical open	Self-contained	Ice cream	5.55 · TDA + 15.02	
	Semivertical				

SVO.SC.L	open	Self-contained	Low	$4.34 \cdot TDA + 11.51$	
SVO.SC.I	Semivertical open	Self-contained	Ice cream	$5.52 \cdot TDA + 14.63$	
HZO.SC.I	Horizontal open	Self-contained	Ice cream	$2.44 \cdot TDA + 9.0$	
SOC.SC.I	Service over counter	Self-contained	Ice cream	$1.76 \cdot TDA + 0.36$	
HCS.SC.I	Horizontal solid door	Self-contained	Ice cream	$0.38 \cdot V + 0.88$	

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.

c. Equipment class designations consist of a combination [(in sequential order separated by periods (AAA).(BB).(C))] of:

(AAA) (AAA)

(AAA)

An equipment family code where:

An equipment family code where:

VOP = vertical open

VOP = vertical open

SVO = semivertical open

SVO = semivertical open

HZO = horizontal open

HZO = horizontal open

VCT = vertical transparent doors

VCT = vertical transparent doors

VCS = vertical solid doors

VCS = vertical solid doors

HCT = horizontal transparent doors

HCT = horizontal transparent doors

HCS = horizontal solid doors

HCS = horizontal solid doors

SOC = service over counter

SOC = service over counter

(BB)

(BB)

An operating mode code:

An operating mode code:

RC = remote condensing

RC = remote condensing

SC = self-contained

SC = self-contained

(C)

(C)

A rating temperature code:

A rating temperature code:

M = medium temperature (38°F)

M = medium temperature (38°F)

L = low temperature (0°F)

L = low temperature (0°F)

I = ice-cream temperature (15°F)

I = ice-cream temperature (15°F)

For example, "VOP.RC.M" refers to the "vertical-open, remote-condensing, medium-temperature" equipment class.

~~C403.2.16~~ 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 m^2) 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/ft^2 (76 W/m^2) of door opening for *walk-in freezers*, and not greater than 3.0 W/ft^2 (32 W/m^2) of door opening for *walk-in coolers*.
10. Antisweat heater controls shall be capable of reducing 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.

~~C403.2.17~~ <u>C403.10.3</u> Refrigerated display cases~~.~~ <u>.(Mandatory)</u> 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 at least 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.

~~C403.5~~ <u>C403.10.4</u> Refrigeration systems. Refrigerated display cases, *walk-in coolers* or *walk-in freezers* that are served by remote compressors and remote condensers not located in a *condensing unit*, shall comply with Sections ~~C403.5.1~~ <u>C403.10.4.1</u> and ~~C403.5.2~~ <u>C403.10.4.2</u>.

> **Exception:** Systems where the working fluid in the refrigeration cycle goes through both subcritical and supercritical states (transcritical) or that use ammonia refrigerant are exempt.

~~C403.5.1~~ <u>C403.10.4.1</u> Condensers serving refrigeration systems. Fan-powered condensers shall comply with the following:

1. The design *saturated condensing temperatures* for air-cooled condensers shall not exceed the design dry-bulb temperature plus 10°F (5.6°C) for low-*temperature refrigeration systems*, and the design dry- bulb temperature plus 15°F (8°C) for *medium temperature refrigeration systems* where the *saturated condensing temperature* for blend refrigerants shall be determined using the average of liquid and vapor temperatures as converted from the condenser drain pressure.
2. Condenser fan motors that are less than 1 hp (0.75 kW) shall use electronically commutated motors, permanent split-capacitor-type motors or 3-phase motors.

3. Condenser fans for air-cooled condensers, evaporatively cooled condensers, air- or water-cooled fluid coolers or cooling towers shall reduce fan motor demand to not more than 30 percent of design wattage at 50 percent of design air volume, and incorporate one of the following continuous variable speed fan control approaches:
    3.1. Refrigeration system condenser control for air-cooled condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient dry-bulb temperature.
    3.2. Refrigeration system condenser control for evaporatively cooled condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient wet-bulb temperature.
4. Multiple fan condensers shall be controlled in unison.
5. The minimum condensing temperature setpoint shall be not greater than 70°F (21°C).

~~C403.5.2~~ <u>C403.10.4.2</u> **Compressor systems.** Refrigeration compressor systems shall comply with the following:

1. Compressors and multiple-compressor system suction groups shall include control systems that use floating suction pressure control logic to reset the target suction pressure temperature based on the temperature requirements of the attached refrigeration display cases or walk-ins.

    Exception: Controls are not required for the following:

    1. Single-compressor systems that do not have variable capacity capability.
    2. Suction groups that have a design saturated suction temperature of 30°F (-1.1°C) or higher, suction groups that comprise the high stage of a two-stage or cascade system, or suction groups that primarily serve chillers for secondary cooling fluids.
4. Liquid subcooling shall be provided for all low-temperature compressor systems with a design cooling capacity equal to or greater than 100,000 Btu/hr (29.3 kW) with a design-saturated suction temperature of -10°F (-23°C) or lower. The sub-cooled liquid temperature shall be controlled at a maximum temperature setpoint of 50°F (10°C) at the exit of the subcooler using either compressor economizer (interstage) ports or a separate compressor suction group operating at a saturated suction temperature of 18°F (-7.8°C) or higher.
    4.1. Insulation for liquid lines with a fluid operating temperature less than 60°F (15.6°C) shall comply with Table C403.2.10.
5. Compressors that incorporate internal or external crankcase heaters shall provide a means to cycle the heaters off during compressor operation.

Add new text as follows:

<u>**C403.11 Construction of HVAC system elements** Ducts, plenums, piping and other elements that are part of an HVAC system shall be constructed and insulated in accordance with Sections C403.11.1 through C403.11.3.1.</u>

Revise as follows:

~~C403.2.9~~ <u>C403.11.1</u> **Duct and plenum insulation and sealing~~.~~ <u>.(Mandatory)</u>** Supply and return air ducts and plenums shall be insulated with a minimum of R-6 insulation where located in unconditioned spaces and where located outside the building with a minimum of R-8 insulation in *Climate Zones* 1 through 4 and a minimum of 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 a minimum of R-8 insulation in *Climate Zones* 1 through 4 and a minimum of 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*.

~~C403.2.9.1~~ C403.11.2 **Duct construction~~.~~ .(Mandatory)** *No change to text.*

~~C403.2.9.1.1~~ 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), mastic-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.

~~C403.2.9.1.2~~ C403.11.2.2 **Medium-pressure duct systems~~.~~ .(Mandatory)** *No change to text.*

~~C403.2.9.1.3~~ C403.11.2.3 **High-pressure duct systems~~.~~ .(Mandatory)** Ducts and plenums designed to operate at static pressures greater than 3 inches water gauge (747 Pa) shall be insulated and sealed in accordance with Section ~~C403.2.9~~ C403.11.2. 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 at least 25 percent of the duct area have been tested and that all tested sections comply with the requirements of this section.

~~C403.2.10~~ C403.11.3 **Piping insulation~~.~~ .(Mandatory)** Piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table ~~C403.2.10~~ 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).

TABLE ~~C403.2.10~~ C403.11.3

[c] MINIMUM PIPE INSULATION THICKNESS (in inches)[a], [c]

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu · in./(h · ft^2· °F)[b]	Mean Rating Temperature, °F	< 1	1 to < $1^1/_2$	$1^1/_2$ to < 4	4 to < 8	≥ 8
> 350	0.32 – 0.34	250	4.5	5.0	5.0	5.0	5.0
251 – 350	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
201 – 250	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0
141 – 200	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
105 – 140	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5
40 – 60	0.21 – 0.27	75	0.5	0.5	1.0	1.0	1.0
	0.20 – 0.26	50	0.5	1.0	1.0	1.0	1.5

For SI: 1 inch = 25.4 mm, °C = [(°F) - 32]/1.8.

a. For piping smaller than $1\ ^1/_2$ inches and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch.

b For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

$T = r\{(1 + t/r)\ K/k - 1\}$

$T = r\{(1 + t/r)\ K/k - 1\}$

$T = r\{(1 + t/r)\ K/k - 1\}$

where:

T

T

T

=

=

minimum insulation thickness,

minimum insulation thickness,

r

r

=

=

actual outside radius of pipe,

actual outside radius of pipe,

t

t

=

=

insulation thickness listed in the table for applicable fluid temperature and pipe size,

insulation thickness listed in the table for applicable fluid temperature and pipe size,

K

K

=

=

conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu · in/h · ft ^{2} · °F) and

conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu · in/h · ft ^{2} · °F) and

k

k

=

=

the upper value of the conductivity range listed in the table for the applicable fluid temperature.

the upper value of the conductivity range listed in the table for the applicable fluid temperature.

c. For direct-buried heating and hot water system piping, reduction of these thicknesses by $1^1/_2$ inches (38 mm) shall be permitted (before thickness adjustment required in footnote b but not to thicknesses less than 1 inch (25 mm).

~~C403.2.10.1~~ C403.11.3.1 Protection of piping insulation~~.~~ .(Mandatory) *No change to text.*

Add new text as follows:

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

Revise as follows:

~~C403.2.13~~ C403.12.1 Heating outside a building~~.~~ .(Mandatory) Systems installed to provide heat outside a building shall be radiant systems.

Such heating systems shall be controlled by an occupancy sensing device or a timer switch, so that the system is automatically deenergized when no occupants are present.

~~C403.2.4.5~~ C403.12.2 Snow- and ice-melt system controls~~.~~ .(Mandatory) *No change to text.*

~~C403.2.4.6~~ C403.12.3 Freeze protection system controls~~.~~ .(Mandatory) *No change to text.*

Reason: This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx
Currently C403 has 5 subsections

C403.1 General

C403.2 Provisions applicable to all systems (Mandatory)

C403.3 Economizers (Prescriptive)

C403.4 Hydronic and multi-zone controls/equipment (Prescriptive)

C403.5 Refrigeration systems

The attached proposal has 12 sections as follows:

C403.1 General

C403.2 System Design

C403.3 Heating and Cooling Equipment Efficiencies

C403.4 Heating and cooling system controls

C403.5 Economizers

C403.6 VAV and multi-zone systems

C403.7 Ventilation and exhaust systems

C403.8 Fans and fan controls

C403.9 Heat rejection equipment

C403.10 Refrigeration systems

C403.11 Construction of HVAC system elements

C403.12 "Outdoor' HVAC systems

The existing Section C403 organization was based on a historic split between mandatory versus prescriptive provisions. The mandatory versus prescriptive is only needed as a distinction when C407 is used to for compliance. In previous editions Sections C403.3 and C403.4 were a single section which was split into simple versus complex systems. In the 2015 edition, Economizer regulations were split out, and the importance of simple/complex distinction was reduced. In addition, there were many new provisions added to the section C403 in 2015 which resulted in less cohesion of the requirements. In general there are very few 'requirements' for the HVAC systems under Section C403. However, where an HVAC systems includes equipment, then requirements for efficiency and provision of controls comes into play. The intent of the proposal is to provide an organization that is more specific to equipment type. The intent of the reorganization is to provide a chapter that is easier to use. It allows placement of new requirements with like provisions rather than among a long list of requirements based on whether the proponent considered them mandatory or prescriptive.

In a few places the code requires specific elements – for example Section C403.5 requires your HVAC system to have an economizer...unless you meet one of umpteen exceptions. In Section C403.2 – System Design – the code says you have zones (unless you meet the exception).

Overall the intent of the proposal is editorial. Text shown for deletion is existing routing text that is no longer needed in the new organization. New text, the same, routing text for the new organization.

Some detailed explanations:

C403.1 – General. Two provisions are moved here: the requirement for commissioning and the reference to ASHRAE 183 for calculating design loads. The latter seemed more of a basis for design and not a system requirement as found in other sections.

C403.2 – System Design: This includes two key 'requirements': Former Section C403.2.4.4 Zone isolation. Reading this section it appears to be a base requirement for all buildings – you create zones. The controls sections frequently refer to zones – it seemed appropriate to put the requirement for the zones at the beginning of the Section. The other requirement is to comply with ventilation requirements of the IMC. Again it seems like a thing to put first in the design of the system

C403.3 – Efficiencies. The home for equipment sizing and the efficiency tables.

C403.4 – System controls. The placement of control requirements which are more full system in nature versus those for specific equipment such as fans or kitchen ventilation. There are 3 key provisions: Thermostatic controls, Off-hour controls, and Hydronic system controls. Specific controls are found with the specific equipment/elements in Sections C403.5 through C403.12.

C403.4.1 – Thermostatic Controls – (includes boiler setback based on outdoor temp)

C403.4.2 – Off Hour controls

C403.4.3 – Hydronic system controls

C403.4.4 – Part load controls –

C403.4.5 – Pump isolation -

Boiler turndown and the last 3 all seemed fairly unique – they didn't seem to fit in as part of the 3 key provisions – Thermostat, Off-hour or Hydronic system

C403.5 – Economizers – existing economizer sections plus Fault Detection requirement

C403.6 - VAV and multiple zone systems – This is the home of existing C403.4.4. C403.4.4 is currently labeled 'requirements for complex system'....But when you read it, it appears to only be addressing VAV systems. Some of the requirements are specific to multizone designs.

C403.7 – Ventilation and Exhaust – this is a collection of unique related to ventilation and exhaust requirements. These are distinct from the requirement to comply with ventilation of the IMC.

C403.8 – Fans and fan controls. There is fan requirements scattered throughout the chapter. The provisions placed here seem to be specific about fans (efficiencies and controls).

C403.9 – Heat rejection equipment. Heat rejection equipment is a special type of fan system which could be combined with C403.8 – but is better to stand by itself.

C403.10 – Refrigeration everything

C403.11 – Construction: Insulation of ducts, piping, construction of ducts

C403.12- weird stuff that is really outside the envelope

Table below provides the section numbers and titles of the existing chapter with the new location in the second column

EXISTING C403	**PROPOSED C403**
C403 Building Mechanical Systems	**C403 Building Mechanical Systems**
C403.1 General	**C403.1 General**
C403.2 Provisions applicable to all mechanical systems (Mandatory)	Deleted – only a routing provision
C403.2.1 Calculation of heating and cooling loads	**C403.1.2**
	C403.2 – System design – new routing
C403.2.2 Equipment Sizing	**C403.3.1**
C403.2.3 HVAC equipment performance requirements TABLES	**C403.3.2**
C403.2.3.1 Water-cooled centrifugal chilling packages	**C403.3.2.1**
C403.2.3.2 Positive displacement (air and water-cooled) chilling packages	**C403.3.2.2**
C403.2.4 HVAC system controls	C403.4

C403.2.4.1 Thermostatic controls	**C403.4.1**
C403.2.4.1.1 Heat pump supplemental heat	**C403.4.1.1**
C403.2.4.1.2 Deadband	**C403.4.1.2**
C403.2.4.1.3 Set point overlap restrictions	**C403.4.1.3**
C403.2.4.2 Off-hour controls	**C403.4.2**
C403.2.4.2.1 Thermostatic setback capabilities	**C403.4.2.1**
C403.2.4.2.2 Automatic setback and shutdown capabilities	**C403.4.2.2**
C403.2.4.2.3 Automatic start capabilities	**C403.4.2.3**
C403.2.4.3 Shutoff Dampers	**C403.7.5**
C403.2.4.4 Zone Isolation	**C403.2.1**
C403.2.4.5 Snow- and ice-melt system controls	**C403.12.2**
C403.2.4.6 Freeze protection system controls	**C403.12.3**
C403.2.4.7 Economizer fault detection and diagnostic (FDD)	**C403.5.5**
C403.2.5 Hot water boiler outdoor temperature setback control	**C403.4.1.4**
C403.2.6 – Ventilation	**C403.2.2**
	C403.7 New routing section
C403.2.6.1 Demand controlled ventilation	**C403.7.1**
C403.2.6.2 Enclosed parking garage ventilation controls	**C403.7.2**
C403.2.7 Energy recovery ventilation systems	**C403.7.3**
C403.2.8 Kitchen exhaust systems	**C403.7.4**
	C403.11 – new routing section
C403.2.9 Duct and plenum insulation and sealing	**C403.11.1**
C403.2.9.1 Duct construction	**C403.11.2**
C403.2.9.1.1 through C403.2.9.1.3	**C403.11.2.1 through C403.11.2.3**
C403.2.10 Piping insulation	**C403.11.3**
C403.2.10.1 Protection of piping insulation	**C403.11.3.1**
C403.2.11 Mechanical systems commissioning and completion requirements	**C403.2.11**
C403.2.12 Air system design and control	**C403.8**
	C403.8.1 – Fan – new routing section
C403.2.12.1 Allowable fan motor horsepower	**C403.8.1.1**
C403.2.12.2 Motor nameplate horsepower	**C403.8.1.2**
C403.2.12.3 Fan Efficiency	**C403.8.1.3**
	C403.12 – new routing section
C403.2.13 Heating outside a building	**C403.12.1**
C403.2.14 Refrigeration equipment performance	**C403.10**
C403.2.15 Walkin coolers, walkin freezers, refrigerated warehouse coolers and refrigerated	**C403.10.1**
C403.2.16 Walkin coolers and walkin freezers	**C403.10.2**
C403.2.17 Refrigerated display cases	**C403.10.3**
C403.3 Economizers (prescriptive)	**C403.5**
C403.3.1 Integrated economizer control	**C403.5.1**

C403.3.2 Economizer heating impact	**C403.5.2**
C403.3.3 Air Economizers	**C403.5.3**
C403.3.3.1 through C403.3.3.5	**C403.5.3.1 through C403.5.3.5**
C403.3.4 Water-side economizers	**C403.5.4**
C403.3.4.1 and C403.3.4.2	**C403.5.4.1 and C403.5.4.2**
C403.4 Hydronic and multi-zone HVAC systems controls and equipment (Prescriptive)	**Deleted – routing section**
C403.4.1 Fan control	**C403.8.3**
C403.4.1.1 Fan airflow control	**C403.8.3.1**
C403.4.1.2 Static pressure sensor location	**C403.6.7**
C403.4.1.3 Set points for direct digital control	**C403.6.6**
C403.4.2 Hydronic system controls	**C403.4.3**
C403.4.2.1 Three pipe system	**C403.4.3.1**
C403.4.2.2 Two-pipe changeover system	**C403.4.3.2**
C403.4.2.3 Hydronic (water loop) heat pump systems	**C403.4.3.3**
C403.4.2.3.1 Temperature dead band	**C403.4.3.3.1**
C403.4.2.3.2 Heat rejection	**C403.4.3.3.2**
C403.4.2.3.2.1 Climate zones 3 and 4	**C403.4.3.3.2.1**
C403.4.2.3.2.2 Climate zones 5 through 8	**C403.4.3.3.2.2**
C403.4.2.3.3 Two position valve	**C403.4.3.3.3**
C403.4.2.4 Part-load controls	**C403.4.4**
C403.4.2.5 Boiler turndown	**C403.3.4**
C403.4.2.6 Pump isolation	**C403.4.5**
C403.4.3 Heat rejection equipment	**C403.9**
C403.4.3.1 General	**C403.9.1**
C403.4.3.2 Fan speed control	**C403.9.2**
C403.4.3.2.1 Fan motors not less than 7.5 hp	**C403.9.2.1**
C403.4.3.2.2 Multiple cell heat rejection equipment	**C403.9.2.2**
C403.4.3.3 Limitation on centrifugal fan open-circuit cooling towers	**C403.9.3**
C403.4.3.4 tower flow turndown	**C403.9.4**
C403.4.4 Requirements for complex mechanical systems serving multiple zones	**C403.6**
C403.4.4.1 Single duct VAV systems	**C403.6.1**
C403.4.4.2 Dual duct and mixing VAV systems	**C403.6.2**
C403.4.4.3 Single fan dual duct and mixing VAV systems	**C403.6.3**
C403.4.4.4 Fractional hp fan motors	**C403.8.2**
C403.4.4.5 Supply air temperature reset controls	**C403.6.4**
C403.4.4.6 Multiple zone VAV system ventilation optimization control	**C403.6.5**
C403.4.5 Heat recovery for service water heating	**C404.9.5**
C403.4.6 Hot gas bypass limitation	**C403.3.3**
C403.5 Refrigeration systems	**C403.10.4**

C403.5.1 Condensers serving refrigeration systems	**C403.10.4.1**
C403.5.2 Compressor systems.	**C403.10.4.2**

Cost Impact: Will not increase the cost of construction
There is no intent to change any technical requirement but to reorganize Section C403 into a more user friendly format.

CE119-16 : C403-COLLINS11420

CE120-16

IECC: C403.2.1.

Proponent : Hope Medina, representing Colorado Chapter of ICC (hmedina@coloradocode.net)

2015 International Energy Conservation Code

C403.2.1 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. <u>The design loads shall account for the building envelope, lighting, ventilation, and occupancy loads based on the project design.</u> 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: We w ere bringing back in the w ording from the previous code cycles that clarified w hat is involved in providing the correct claculations required by plans examiners to verify the correct sized equipment w ill be installed. If all of the correct information is not used to determine the loads the numbers w ill not correct, and the incorrect sized equipment may be installed. This may cause for the incorrect sized equipment w hich may cause for more energy usage. A simple w ay to attempt to correct this is to ask for and to get all of the correct information upfront. This verbiage does help designers and engineers provide the correct information needed, and for code officials to ask for the correct information.
Our Theme: A Code for the End User

Is the code section completely understandable to the end user?

Is the code section or requirement easy to find?

Is the code requirement even doable in the real w orld?

Will the code requirement really save energy or only on paper?

Cost Impact: Will not increase the cost of construction
This is w ording to clear up w hat is involved w ith the calculations.

CE120-16 : C403.2.1-MEDINA12938

CE121-16

IECC: C403.2.10.1.

Proponent : Tim Ledden, Armacell, LLC, representing Armacell, LLC (tim.r.ledden@armacell.com)

2015 International Energy Conservation Code

Revise as follows:

C403.2.10.1 Protection of piping insulation. ~~Piping~~ A protective barrier shall be installed on all piping insulation exposed to the weather . The protective barrier shall ~~be protected~~ protect the insulation from damage~~,~~ including that ~~due to~~ caused by sunlight, moisture, equipment maintenance~~ and~~ , wind, and birds. The protective barrier shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted and protection inherent in the composition of the insulation is not acceptable.

Reason: The intent of section C403.2.10.1, Protection of piping insulation, is to provide a barrier to all exterior hazards so that insulation installed on exterior refrigerant piping is not damaged. This way, the insulation lasts for the life of the mechanical system. Without protection, insulation will be damaged and either replaced at a significant cost or not replaced and the energy savings that the insulation is design to provide will be diminished. In addition, damaged insulation provides the opportunity for moisture to accumulate between the insulation and pipe which can lead to corrosion of pipes. As a result, the piping system may fail resulting in an even higher cost of repair than replacing just the insulation.
The current wording in the code requires protection of the piping insulation when it is exposed to weather but it leaves room for broad interpretation of what is considered protection. Installers and inspectors often consider painting the insulation or UV and water resistance inherent in the composition of the insulation adequate protection for complying with section C403.2.10.1. In reality, the composition of the insulation or painting the insulation can provide some protection from certain exterior hazards but cannot protect the insulation from all hazards and do not protect from any hazards long enough for the insulation to last the life of the mechanical system. Therefore, exterior refrigerant piping is often not adequately protected and is damaged shortly after installation. In order to remove the opportunity for interpretation so that the code has its intended result, the wording in section C403.2.10.1 should be changed to specify that a barrier to exterior hazards be installed on exterior piping insulation. As a result, the insulation can last the life of the mechanical system while providing the intended energy savings.

Cost Impact: Will not increase the cost of construction
Providing adequate insulation protection is already a requirement in the code. This proposal simply strengthens the language to remove any opportunity to misinterpret the code.

CE121-16 : C403.2.10.1-LEDDEN10701

CE122-16

IECC: 0, C403.2.12, C403.2.12.1, C403.2.12.2, C403.2.12.3, C403.4.1, C403.4.1.1, C403.4.1.2, C403.4.1.3, C403.4.4.4.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

SECTION C202 DEFINITIONS

FAN SYSTEM DESIGN CONDITIONS. Operating conditions that can be expected to occur during normal system operation that result in the highest supply fan airflow rate to conditioned spaces served by the system, other than during air economizer operation.

C403.2.12 Air system design and control. Each HVAC system ~~having~~ with a ~~total fan system motor nameplate horsepower (hp) exceeding 5 hp (3.7 kW)~~ shall comply with the provisions of Sections C403.2.12.1 through ~~C403.2.12.3~~ C403.2.12.5.

C403.2.12.1 Allowable fan ~~motor~~ horsepower. 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) as shown in Table C403.2.12.1(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.

C403.2.12.2 Motor nameplate horsepower. 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 C403.2.12.1 *fan system motor nameplate hp* (Option 1).

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

C403.2.12.3 Fan efficiency. Fans shall have a fan efficiency grade (FEG) of not less than 67 when 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. ~~Single fan~~ 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.
   1.3. Fans that are part of equipment covered under Section C403.2.3.
   1.4. Fans included in an equipment package certified by an *approved agency* for air or energy performance.
   1.5. Powered wall/roof ventilators.
   1.6. Fans outside the scope of AMCA 205.
   1.7. Fans that are intended to operate only during emergency conditions.

~~C403.4.4.4~~ C403.2.12.4 Fractional hp fan motors. Motors for fans that are not less than $^1/_{12}$ 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 also 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 403.2.3 or C403.2.12.
3. Motors that comply with Section C405.8.

~~C403.4.1~~ C403.2.12.5 Fan control. *No change to text.*

TABLE ~~C403.4.1.1~~ C403.2.12.5
~~EFFECTIVE DATES~~ Requirements FOR FAN CONTROL

COOLING SYSTEM TYPE	FAN MOTOR SIZE	MECHANICAL COOLING CAPACITY
DX cooling	Any	~~³ 75,000 Btu/h (before 1/1/2016)~~
		≥ 65,000 Btu/h ~~(after 1/1/2016~~
Chilled water and evaporative cooling	~~³ 5 hp~~	~~Any~~

	≥ 1/4 hp	Any

For SI: 1 British thermal unit per hour = 0.2931 W; 1 hp = 0.746 kW.

C403.4.1.1 Fan airflow control. Each cooling system listed in Table C403.4.1.1 shall be designed to vary the indoor fan airflow as a function of load and shall comply with the following requirements:

1. Direct expansion (DX) and chilled water cooling units that control the capacity of the mechanical cooling directly based on space temperature shall have not fewer than two stages of fan control. Low or minimum speed shall not be greater than 66 percent of full speed. At low or minimum speed, the fan system shall draw not more than 40 percent of the fan power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.
2. Other units including DX cooling units and chilled water units that control the space temperature by modulating the airflow to the space shall have modulating fan control. Minimum speed shall be not greater than 50 percent of full speed. At minimum speed the fan system shall draw not more than 30 percent of the power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.
3. Units that include an airside economizer in accordance with Section C403.3 shall have not fewer than two speeds of fan control during economizer operation

    Exceptions:

    1. Modulating fan control is not required for chilled water and evaporative cooling units with fan motors of less than 1 hp (0.746 kW) where the units are not used to provide *ventilation* air and the indoor fan cycles with the load.
    2. Where the volume of outdoor air required to comply with the *ventilation* requirements of the *International Mechanical Code* at low speed exceeds the air that would be delivered at the speed defined in Section C403.4.1, the minimum speed shall be selected to provide the required *ventilation air*.

C403.4.1.2 Static pressure sensor location. Static pressure sensors used to control VAV fans shall be located such that the controller set point is not greater than 1.2 inches w.c. (299 Pa). 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.

C403.4.1.3 Set points for direct digital control. For systems with direct digital control of individual zones reporting to the central control panel, the static pressure set point shall be reset based on the *zone* requiring the most pressure. In such case, the set point is reset lower until one zone damper is nearly wide open. The direct digital controls shall be capable of monitoring *zone* damper positions or shall have an alternative method of indicating the need for static pressure that is capable of all of the following:

1. Automatically detecting any *zone* that excessively drives the reset logic.
2. Generating an alarm to the system operational location.
3. Allowing an operator to readily remove one or more zones from the reset algorithm.

Reason: *Section C403.2.12 was added to the IECC under proposal CE239 in the hearings for 2015 IECC.Current code language limits some fan requirements to fans with motors greater than 5 hp. This is the result of a section* *being relocated in 90.1-2013 where it was inappropriately subject to the limit. Addendum **ap** to ASHRAE Standard 90.1-2013 revised 90.1 so that requirements for smaller fans are as originally intended. This proposal mirrors that revision. In addition fan requirements are moved to Section C403.2.12 so all fan requirements are in one location. Table C403.4.1.1 is relocated and revised to match the original intention and to reflect the publication date of IECC 2018.*

*Approval of this code change proposal will ensure consistency with ASHRAE Standard 90.1-16, which will be adopted by reference as an alternative path to the 2018 IECC Commercial Provisions. This change was made via addendum **ap** to ASHRAE Standard 90.1-2013*

Cost Impact: Will not increase the cost of construction

The proposal primarily deals with clarification and reorganization of the code to improve understanding and compliance. The proposal does clarify that improved fan efficiencies are required on smaller motors; however, that was the original intention of a past proposal to 90.1 that was included in prior proposal CE239. In addition, the ECM motors called for are standard construction practice where they would be applied. There is not expected to be an increase in construction cost over normal construction practice.

CE122-16 : C403.2.12-FERGUSON11741

CE123-16

IECC: C403.2.12.3.

Proponent : Amanda Hickman, InterCode Incorporated, representing Air Movement Control Association International (amanda@intercodeinc.com)

2015 International Energy Conservation Code

Revise as follows:

C403.2.12.3 Fan efficiency. Fans shall have a fan efficiency grade (FEG) of not less than 67 when 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. Single fan 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 under Section C403.2.3.
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: This proposal deletes the labeling clause for FEG. The Fan Efficiency Grade metric is defined in AMCA Standard 205 and ISO Standard 12759. The first U.S. model energy code/standard to adopt it was the 2012 International Green Construction Code. ASHRAE 90.1 adopted it for the 2013 edition, ASHRAE189.1-2013, and the 2015 IECC.

Despite its rapid penetration into model U.S. codes and standards, the U.S. Department of Energy decided to take a path leading to the need for a different metric when initiating a rulemaking on commercial and industrial fans and blowers. The rulemaking initiative started in June 2011. In the publication of the first regulatory milestone in January 2013, i.e., the *Framework Document,* DOE stated that they intended to regulate fans alone and in fan/motor and fan/motor/drive combinations. In subsequent meetings and public negotiations that have taken place in the interim, AMCA, DOE and other stakeholders, decided that an altogether different metric for fan efficiency was needed. This new metric, is called Fan Efficiency Index (FEI), and has no connection to the Fan Efficiency Grade metric.

The first complete draft of the regulation is expected late 2015; it would be released as a Notice of Public Rulemaking (NOPR), subject to review by the public. The final regulation is expected sometime in 2016 or 2017; and effectiveness is expected in year 2021 or after. Between now and then, the FEG will be a legacy metric; it will necessarily be replaced by the FEI metric over time.

During this interim period, AMCA is advising codes/standards communities to minimize dependence on the FEG metric. One way to do so is to eliminate the labeling requirement because:

- As written, the FEG requirement has four compliance checks in the charging statement:

1. FEG 67 or higher.
2. FEG rating is certified by an independent testing lab.
3. FEG labeled by the manufacturer.
4. Peak total efficiency requirement.

Labeling is inconsistent with 90.1, which does not require certification nor labeling. AMCA advises retaining the certification requirement because it aides with compliance assurance and checking. AMCA has been certifying fans for FEG ratings since 2010.

- There is no label that shows the FEG rating (FEG-67, for example), and having industry create one would be onerous given that the metric is on the way out and new labeling will have to be designed for DOE requirements and to support incentive programs for fans. Having multiple metrics and labels in the market over a period of years will be confusing to the industry and prolong the legacy of FEG.

- An AMCA label signifying certification exists; however, compliance checkers would have to perform research to determine what the actual FEG rating is (Figure 1). It may or may not be on the nameplate. The label is NOT required to be placed on certified fans. The label would, however, to comply with the AMCA Certified Ratings Program, at the very least have to be included in the manufacturers' literature and the literature would have to be present on the AMCA Website (www.amca.org).

Figure 1: AMCA Certified Ratings Seal for FEG

- The peak total efficiency requirement is not required to be on the label. Therefore, some research is needed to check this parameter. The actions needed to check for the peak total efficiency requirement would satisfy the remaining three compliance-check requirements because all are traceable to the same source: AMCA's online "FEG Finder" procedure on the CRP web pages (for most cases). http://www.amca.org/feg/feg-finder.aspx.

- As a last resort, checking the manufacturer's literature or calling the manufacturer. The AMCA Certified Ratings program does NOT require participating companies to reveal the actual FEG rating nor the rated peak total efficiency on the AMCA database. However, many choose to do so.

Cost Impact: Will not increase the cost of construction
Only the label requirement is being revised.

CE123-16 : C403.2.12.3-HICKMAN10980

CE124-16

IECC: C403.2.15, C403.2.16.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Delete without substitution:

~~**C403.2.15 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers.** *Refrigerated warehouse coolers* and *refrigerated warehouse freezers* shall comply with this section. *Walk-in coolers* and *walk-in freezers* that are not either site assembled or 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.~~
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-i 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* doors 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/ft^2 (76 W/m^2) 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.~~

~~**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.~~

Revise as follows:

C403.2.16 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and ~~walk-in~~ refrigerated warehouse freezers. ~~Site- assembled or site-constructed *walk-in coolers*~~ Refrigerated warehouse coolers, refrigerated warehouse freezers, walk-in coolers and ~~*walk-in freezers*~~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~~ Walk-in coolers and refrigerated warehouse coolers shall ~~be provided~~ have wall, ceiling and door insulation with an R-value of not less than 25. Walk-in freezers and refrigerated warehouse freezers shall have wall, ceiling and door insulation ~~having a thermal resistance~~ with an R-value of not less than ~~R-25, ceilings shall be provided~~ 32.

   Exception: Insulation is not required for glazed portions of doors or at structural members associated 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~~ the walls, ceiling or door frame.

   ~~**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 walk-in freezers 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, 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 coolers* and *walk-in freezers* combined in a single enclosure greater than 3,000 square feet (279 m^2) in floor area are exempt.
9. ~~Antisweat~~ Where antisweat heaters ~~that are not provided with anti-sweat~~ without antisweat heater controls are provided, they shall have a total door rail, glass ~~and~~ adn frame heater power draw of not ~~greater~~ more than 7.1 W/ft^2 (76 W/m^2) of door opening ~~for *walk-in freezers*,~~ in walk-in freezers and ~~not greater than 3.0~~ 30.0 W/ft^2 (32 W/m^2) of door opening for ~~*walk-in coolers*~~walk-in coolers.
10. ~~Antisweat~~ Where antisweat heater controls are provided, they shall ~~be capable of reducing the~~ reduce 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 proposal eliminates w hat appears to be duplicate code requirements in Sections C403.2.15 and C403.2.16.. There are slight differences. C403.2.16 had been exclusive to site built and parallels the ASHRAE 90.1 language. It w as limited in application to site built. C403.2.15 covered everything but site built. It came from the State of Washington code. While it w as generally the same text as ASHRAE 90.1, there w ere minor differences. The proposal merges the tw o into a single one – covers all categories previously covered by the tw o sections and then selects the clearer of the tw o parallel provisions. In generel C403.2.16 had better text except in items 3, 9 and 10.
This proposal w as submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC w as established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes w ith 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 2015 the SEHPCAC has held three tw o- or three-day open meetings and 25 w orkgroup calls, w hich included members of the SEHPCAC as w ell as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC w ebsite at: http://w w w .iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
We beleive the proposal is essentially editorial by merging 2 nearly identical exceptions.

CE124-16 : C403.2.15-COLLINS11443

CE125-16

IECC: C403.2.15, C403.2.15 (New), C403.2.15.1 (New), C403.2.16.

Proponent : Chris Mathis (chris@mathisconsulting.com)

2015 International Energy Conservation Code

Add new text as follows:

C403.2.15 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Sections C403.2.15.1 or C403.2.15.2, as appropriate.

C403.2.15.1 Walk-in coolers and walk-in freezers Walk-in coolers and walk-in freezers as defined at 10 CFR 431.302 shall comply with the applicable requirements of 10 CFR Part 431, Subpart R, and include systems that have an enclosed storage space refrigerated to temperatures above, at, or below 32 degrees Fahrenheit that can be walked into and have a total chilled storage area of less than 3,000 square feet.

> **Exception**: Products designed and marketed exclusively for medical, scientific, or research purposes.

Revise as follows:

~~C403.2.15~~ C403.2.15.2 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers. ~~*Refrigerated warehouse coolers*~~ Walk-in coolers and ~~*refrigerated warehouse freezers* shall comply with this section. *Walk-in coolers*~~walk-in freezers not covered under Section C403.2.15.1 and ~~*walk-in freezers* that are not either site assembled or site constructed~~ refrigerated warehouse coolers and refrigerated warehouse freezers 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.~~
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-i 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* doors 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/ft^2~~

~~(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.~~

~~**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.~~

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.
2. Doorways shall have strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when doors are open.
3. *Coolers* shall contain wall, ceiling, and door insulation of not less than R-25 and *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. *Freezers* shall contain floor insulation of not less than R-28.
5. Transparent reach-in doors for *freezers* and windows 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 *coolers* doors 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/ft^2 (76 W/m^2) of door opening for *freezers* and 3.0 W/ft^2 (32 W/m^2) of door opening for *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 *coolers* and *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.

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.

Delete without substitution:

~~**C403.2.16 Walk-in coolers and walk-in freezers.** 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 m^2) 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/ft^2 (76 W/m^2) of door opening for *walk-in freezers*, and not greater than 3.0 W/ft^2 (32 W/m^2) of door opening for *walk-in coolers*.~~
10. ~~Antisweat heater controls shall be capable of reducing 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: This section of the IECC is currently in conflict w ith, and preempted by, federal requirements for many w alk-in coolers and w alk-in freezers. The proposed changes to this section remove this conflict by removing specific code requirements for these products and by directly referencing the federal requirements. The section governing refrigerated w arehouse coolers and refrigerated w arehouse freezers has been simplified, removing reference to those federally-governed products. This change w ill make it easier on code officials by clearly indicating that they do not have to address the thermal performance of w alk-in systems that are governed by federal requirements.

Bibliography:

1. ENERGY INDEPENDENCE AND SECURITY ACT OF 2007, Section 312, Walk-in Coolers and Walk-in Freezers.
2. Code of Federal Regulations, 10 CFR 431.306
3. 2014-06-03 Energy Conservation Program: Energy Conservation Standards for Walk-In Coolers and Freezers; Final Rule

Cost Impact: Will not increase the cost of construction
This proposal will not increase the cost of construction. It may also reduce inspection time for code officials. This would potentially remove one or more items from the building inspection checklist when federally-governed products are present.

Analysis: A review of the standard(s) proposed for inclusion in the code, DOE CFR Part 431.302 and 431 Subpart R, 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 1, 2015.

CE125-16 : C403.2.15.1 (NEW)-MATHIS13371

CE126-16

IECC: C403.2.16, C403.2.16.1 (New), C403.2.16.1(1) (New), C403.2.16.1(2) (New), C403.2.16.1(3) (New).

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

2015 International Energy Conservation Code

C403.2.16 Walk-in coolers and walk-in freezers. 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 m^2) 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/ft^2 (76 W/m^2) of door opening for *walk-in freezers*, and not greater than 3.0 W/ft^2 (32 W/m^2) of door opening for *walk-in coolers*.
10. Antisweat heater controls shall be capable of reducing 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.

Add new text as follows:

TABLE C403.2.16.1(1)
Walk-in Cooler and Freezer Display Doors Efficiency Requirements

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 C403.2.16.1(2)
Walk-in Cooler and Freezer Non-Display Doors Efficiency Requirements

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	PD, M	$0.04 \times A_{nd} + 1.9$
Freight Door, Medium Temperature	PD, L	$0.12 \times A_{nd} + 5.6$

a. A_{nd} is the surface area of the non-display door.

TABLE C403.2.16.1(3)
Walk-in Cooler and Freezer Refrigeration Systems Efficiency Requirements

Class 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

C403.2.16.1 Performance standards. Effective June 5, 2017, walk-in coolers and walk-in freezers shall meet the requirements of Tables C403.2.16.1(1), C403.2.16.1(2) and C403.2.16.1(3).

Reason: Federal efficiency standards for walk-in coolers and freezers were established as part of the Energy Independence and Security Act of 2007, and the current requirements are shown in this section. However, as part of this law, DOE was required to create performance requirements to replace all of these design specifications. According to the US Code of Federal Regulations, the new requirements will take effect in June, 2017. Further information on the upcoming requirements can be found at the following web site:

http://www.ecfr.gov/cgi-bin/text-idx?SID=23ae18c05e2e7b66dd60f8d6e49d1e62&mc=true&node=sp10.3.431.r&rgn=div6

This proposal updates the energy code with the June 2017 performance requirements.

Cost Impact: Will increase the cost of construction
It is likely that the new performance requirements will increase costs compared to the previous design requirements. However, the performance requirements may allow more technology and design flexibilty for manufacturers such that they may reduce such costs.

CE126-16 : C403.2.16-ROSENSTOCK11764

CE127-16

IECC: C403.2.2.

Proponent : Duane Jonlin, Seattle Dept of Construction and Inspections, representing Seattle Dept of Construction and Inspections (duane.jonlin@seattle.gov)

2015 International Energy Conservation Code

Revise as follows:

C403.2.2 Equipment sizing. 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 C403.2.1. 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 have the capability to sequence the operation of each unit based on load.~~

Reason: If interpreted literally, the code as currently w ritten requires all heating and cooling equipment to be undersized. (If the equipment's capacity cannot exceed the calculated load, then in virtually every case the available equipment w ould be sized smaller than the calculated load.) This amendment clarifies w hat is common practice for most building departments.

Cost Impact: Will not increase the cost of construction
Clarification - no cost impact. This proposal clarifies the common interpretation of the intent of the section. If anything it reduces cost, by changing an impossible standard to a reasonable standard.

CE127-16 : C403.2.2-JONLIN12130

CE128-16

IECC: C403.2.16, C403.2.2, C403.2.4.1.2, C403.2.4.1.3, C403.2.4.2.1, C403.2.4.2.2, C403.2.4.2.3, C403.2.4.5, C403.2.4.7, C403.2.7, C403.2.8, C403.3.1, C403.3.3.1, C403.3.3.2, C403.3.3.3, C403.3.4.1, C403.4.1.3, C403.4.2, C403.4.2.3.1, C403.4.2.4, C403.4.2.6, C403.4.4, C403.4.4.1, C403.4.4.2, C403.4.4.5, C405.2.3.1, C405.2.4, C406.4.

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 International Energy Conservation Code

Revise as follows:

C403.2.2 Equipment sizing. The output capacity of heating and cooling equipment shall be not greater than the loads calculated in accordance with Section C403.2.1. 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 ~~have the capability~~ are configured to sequence the operation of each unit based on load.

C403.2.4.1.2 Deadband. Where used to control both heating and cooling, zone thermostatic controls shall be ~~capable of providing~~ configured to provide a temperature range or deadband of at least 5°F (2.8°C) within which the supply of heating and cooling energy to the zone is ~~capable of being~~ 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.

C403.2.4.1.3 Set point overlap restriction. 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 ~~provided with the capability~~ configured to prevent the heating set point from exceeding the cooling set point and to maintain a deadband in accordance with Section C403.2.4.1.2.

C403.2.4.2.1 Thermostatic setback ~~capabilities~~. Thermostatic setback controls shall ~~have the capability~~ 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).

C403.2.4.2.2 Automatic setback and shutdown ~~capabilities~~. 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 at least 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 ~~capable of being adjusted~~

configured to operate the system for up to 2 hours; or an occupancy sensor.

C403.2.4.2.3 Automatic start ~~capabilities~~. Automatic start controls shall be provided for each HVAC system. The controls shall be ~~capable of~~ configured to automatically adjusting the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy.

C403.2.4.5 Snow- and ice-melt system controls. Snow- and ice-melting systems shall include automatic controls ~~capable of shutting~~ configured to shut off the system when the pavement temperature is above 50°F (10°C) and no precipitation is falling and an automatic or manual control that ~~will allow~~ is configured to shutoff when the outdoor temperature is above 40°F (4°C).

C403.2.4.7 Economizer fault detection and diagnostics (FDD). Air-cooled unitary direct-expansion units listed in Tables C403.2.3(1) through C403.2.3(3) and variable refrigerant flow (VRF) units that are equipped with an economizer in accordance with Section C403.3 shall include a fault detection and diagnostics (FDD) 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 ±2°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 capable of providing~~ 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 ~~capable of reporting~~ configured to report faults to a fault management application accessible by day-to-day operating or service personnel, or annunciated locally on zone thermostats.
7. The FDD system shall be ~~capable of detecting~~ 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.

C403.2.7 Energy recovery ventilation systems. Where the supply airflow rate of a fan system exceeds the values specified in Tables C403.2.7(1) and C403.2.7(2), the system shall include an energy recovery system. The energy recovery system shall ~~have the capability~~ 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 which permit operation of the economizer as required by Section C403.3.

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 at least one of the following features:
   - 2.1. Variable-air-volume hood exhaust and room supply systems ~~capable of reducing~~ 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 at least 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, 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 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 C403.2.7(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.

C403.2.8 Kitchen exhaust systems. 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 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 C403.2.8 and shall comply with one of the following:

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

2.2. Demand ventilation systems on not less than 75 percent of the exhaust air that are ~~capable of~~ 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.

2.3. 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

C403.2.16 Walk-in coolers and walk-in freezers. 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 m^2) 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/ft^2 (76 W/m^2) of door opening for *walk-in freezers*, and not greater than 3.0 W/ft^2 (32 W/m^2) of door opening for *walk-in coolers*.
10. Antisweat heater controls shall be ~~capable of reducing~~ 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.

C403.3.1 Integrated economizer control. Economizer systems shall be integrated with the mechanical cooling system and be ~~capable of providing~~ configured to provide partial cooling even where additional mechanical cooling is required to provide the remainder of the cooling load. Controls shall not be capable of creating a false load in the mechanical cooling systems by limiting or disabling the economizer or any other means, such as hot gas bypass, except at the lowest stage of mechanical cooling.

Units that include an air economizer shall comply with the following:

1. Unit controls shall have the mechanical cooling capacity control interlocked with the air economizer controls such that the outdoor air damper is at the 100-percent open position when mechanical cooling is on and the outdoor air damper does not begin to close to prevent coil freezing due to minimum compressor run time until the leaving air temperature is less than 45°F (7°C).
2. Direct expansion (DX) units that control 75,000 Btu/h (22 kW) or greater of rated capacity of the capacity of the mechanical cooling directly based on occupied space temperature shall have not fewer than two stages of mechanical cooling capacity
3. Other DX units, including those that control space temperature by modulating the airflow to the space, shall be in accordance with Table C403.3.1.

C403.3.3.1 Design capacity. Air economizer systems shall be ~~capable of modulating~~ configured to modulate *outdoor air*and return air dampers to provide up to 100 percent of the design supply air quantity as *outdoor air*for cooling.

C403.3.3.2 Control signal. Economizer controls and dampers shall be ~~capable of being sequenced~~ configured to sequence the dampers with the mechanical cooling equipment and shall not be controlled by only mixed-air temperature.

> **Exception:**The use of mixed-air temperature limit control shall be permitted for systems controlled from space temperature (such as single-*zone* systems).

C403.3.3.3 High-limit shutoff. Air economizers shall be ~~capable of~~ configured to automatically ~~reducing~~ reduce *outdoor air*intake to the design minimum *outdoor air*quantity when *outdoor air* intake will no longer reduce cooling energy usage. High-limit shutoff control types for specific climates shall be chosen from Table C403.3.3.3. High-limit shutoff control settings for these control types shall be those specified in Table C403.3.3.3.

C403.3.4.1 Design capacity. Water economizer systems shall be ~~capable of cooling~~ configured to cool supply air by indirect evaporation and providing up to 100 percent of the expected system cooling load at *outdoor air* temperatures of not greater than 50°F (10°C) dry bulb/45°F (7°C) wet bulb.

Exceptions:

1. Systems primarily serving computer rooms in which 100 percent of the expected system cooling load at 40°F (4°C) dry bulb/35°F (1.7°C) wet bulb is met with evaporative water economizers.

2. Systems primarily serving computer rooms with dry cooler water economizers which satisfy 100 percent of the expected system cooling load at 35°F (1.7°C) dry bulb.
3. 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.

C403.4.1.3 Set points for direct digital control. For systems with direct digital control of individual zones reporting to the central control panel, the static pressure set point shall be reset based on the *zone* requiring the most pressure. In such case, the set point is reset lower until one zone damper is nearly wide open. The direct digital controls shall be capable of monitoring *zone* damper positions or shall have an alternative method of indicating the need for static pressure that is ~~capable of~~ configured to provide all of the following:

1. Automatically detecting any *zone* that excessively drives the reset logic.
2. Generating an alarm to the system operational location.
3. Allowing an operator to readily remove one or more zones from the reset algorithm.

C403.4.2 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 C403.4.2.1 through C403.4.2.3. 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 ~~capable of sequencing~~ configured to sequence operation of the boilers. Hydronic heating systems comprised 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.

C403.4.2.3.1 Temperature dead band. Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are ~~capable of providing~~ configured to provide a heat pump water supply temperature dead band of not less than 20°F (11°C) between initiation of heat rejection and heat addition by the central devices.

> **Exception:** Where a system loop temperature optimization controller is installed and can determine the most efficient operating temperature based on realtime conditions of demand and capacity, dead bands of less than 20°F (11°C) shall be permitted.

C403.4.2.4 Part-load controls. Hydronic systems greater than or equal to 500,000 Btu/h (146.5 kW) in design output capacity supplying heated or chilled water to comfort conditioning systems shall include controls that ~~have the capability~~ are configured to do all of the following:

1. Automatically reset the supply-water temperatures in response to varying building heating and cooling demand using coil valve position, zone-return water temperature, building-return water temperature or outside air temperature. The temperature shall be ~~capable of being~~ reset by not less than 25 percent of the design supply-to-return water temperature difference.
2. Automatically vary fluid flow for hydronic systems with a combined motor capacity of 10 hp (7.5 kW) or larger with three or more control valves or other devices by reducing the system design flow rate by not less than 50 percent by designed valves that modulate or step open and close, or pumps that modulate or turn on and off as a function of load.

3. Automatically vary pump flow on chilled-water systems and heat rejection loops serving water-cooled unitary air conditioners with a combined motor capacity of 10 hp (7.5 kW) or larger by reducing pump design flow by not less than 50 percent, utilizing adjustable speed drives on pumps, or multiple-staged pumps where not less than one-half of the total pump horsepower is capable of being automatically turned off. Pump flow shall be controlled to maintain one control valve nearly wide open or to satisfy the minimum differential pressure.

    Exceptions:

    1. Supply-water temperature reset for chilled-water systems supplied by off-site district chilled water or chilled water from ice storage systems.
    2. Minimum flow rates other than 50 percent as required by the equipment manufacturer for proper operation of equipment where using flow bypass or end-of-line 3-way valves.
    3. Variable pump flow on dedicated equipment circulation pumps where configured in primary/secondary design to provide the minimum flow requirements of the equipment manufacturer for proper operation of equipment.

C403.4.2.6 Pump isolation. Chilled water plants including more than one chiller shall ~~have the capability~~ be capable of and configured to reduce flow automatically through the chiller plant when a chiller is shut down. Chillers piped in series for the purpose of increased temperature differential shall be considered as one chiller.

Boiler plants including more than one boiler shall ~~have the capability~~ be capable of and configured to reduce flow automatically through the boiler plant when a boiler is shut down.

C403.4.4 Requirements for complex mechanical systems serving multiple zones. Sections C403.4.4.1 through C403.4.6.4 shall apply to complex mechanical systems serving multiple zones. Supply air systems serving multiple zones shall be variable air volume (VAV) systems that, during periods of occupancy, are designed and ~~capable of being controlled~~ configured to reduce primary air supply to each *zone* to one of the following before reheating, recooling or mixing takes place:

1. Thirty percent of the maximum supply air to each *zone*.
2. Three hundred cfm (142 L/s) or less where the maximum flow rate is less than 10 percent of the total fan system supply airflow rate.
3. 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 reheat/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 or site-solar energy source.
    2. *Zones* where special humidity levels are required to satisfy

process needs.

3. *Zones* with a peak supply air quantity of 300 cfm (142 L/s) or less and where the flow rate is less than 10 percent of the total fan system supply airflow rate.
4. *Zones* where the volume of air to be reheated, recooled or mixed is not greater than the volume of outside air required to provide the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*.
5. *Zones*or supply air systems with thermostatic and humidistatic controls ~~capable of operating~~ configured to operate in sequence the supply of heating and cooling energy to the*zones* and which are ~~capable of preventing~~ configured to 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.

C403.4.4.1 Single-duct VAV systems, terminal devices. Single-duct VAV systems shall use terminal devices capable of ~~reducing~~ and configured to reduce the supply of primary supply air before reheating or recooling takes place.

C403.4.4.2 Dual-duct and mixing VAV systems, terminal devices. Systems that have one warm air duct and one cool air duct shall use terminal devices that are ~~capable of reducing~~ configured to reduce the flow from one duct to a minimum before mixing of air from the other duct takes place.

C403.4.4.5 Supply-air temperature reset controls. Multiple-*zone*HVAC systems shall include controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperature. The controls shall be ~~capable of resetting~~ 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.

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. *Zones* with peak supply air quantities of 300 cfm (142 L/s) or less.

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 toplight *daylight zones* in accordance with Section C405.2.3.3 shall be controlled independently of lights in sidelight *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 r*eadily accessible*.
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 ~~capable of a complete~~ configured to completely shutoff of all controlled lights.
6. Lights in sidelight *daylight zones* in accordance with Section C405.2.3.2 facing different cardinal orientations [i.e., 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.

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. Display and accent light shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
2. Lighting in cases used for display case purposes shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
3. Hotel and motel sleeping units and guest suites shall have a master control device that is ~~capable of~~ configured to automatically switching off all installed luminaires and switched receptacles within 20 minutes after all occupants leave the room.

   Exception: Lighting and switched receptacles controlled by captive key systems.
4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided that the control device is readily accessible.
5. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
6. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

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 ~~capable of~~ configured for continuous dimming.
2. Luminaires shall b~~e capable of being~~ 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 of this section.
6. Functional testing of lighting controls shall comply with Section C408.

Reason: The overall intent of this code change proposal is to increase the likelihood that energy savings intended by the energy code will be realized. Much of the savings from energy codes is dependent on the presence and functionality of building controls for HVAC and lighting systems. The word "capable" alone is not the best mandatory language for controls, as control equipment can be provided that could be said to be capable of achieving the desired result even though the required software, hardware, and programming is not present and the setpoint is not correct or the programming is not even complete. Using only the word "capable" in the code provides a potential loophole. This change generally replaces the term "capable of" with "configured to" where related to control requirements. In some instances it is appropriate to retain "capable of" and add "configured to". Requiring the equipment to be "configured" to achieve certain operation at the time of inspection provides assurance that the required operation is achievable while not mandating any specific post-occupancy operation. It should be noted that "configured to" is already used in many places in the code to achieve this objective including Sections C403.2.4.3, C403.2.4.4, C403.2.4.6, C405.2.5, C405.9.2 and C409.4.1.

Cost Impact: Will not increase the cost of construction
The proposal is completely editorial in nature and does not alter any technical standard.

CE128-16 : C403.2.2-MAKELA12435

CE129-16

IECC: C403.2.3.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

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C403.2.3 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables ~~C403.2.3(1)~~ 6.8.1-1, ~~C403.2.3(2)~~ 6.8.1-2, ~~C403.2.3(3)~~ 6.8.1-3, ~~C403.2.3(4)~~ 6.8.1-4, ~~C403.2.3(5)~~ 6.8.1-5, ~~C403.2.3(6)~~ 6.8.1-6, ~~C403.2.3(7)~~ 6.8.1-7, ~~C403.2.3(8)~~ 6.8.1-9, 6.8.1-10, 6.8.1-14, and ~~C403.2.3(9)~~ 6.8.1-15 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 ~~C403.2.3(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 C403.2.3 (1)~~
~~MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS~~

~~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.~~

~~c. Minimum efficiency as of January 1, 2015.~~

~~TABLE C403.2.3 (2)~~
~~MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS~~

~~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 air conditioners less than 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.~~

~~c. Minimum efficiency as of January 1, 2015.~~

~~TABLE C403.2.3 (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~~

~~For SI: 1 British thermal unit per hour = 0.2931 W, °C = [(°F) - 32]/1.8, wb = wet bulb, db = wet 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.~~

~~c. Before January 1, 2015 the minimum efficiency shall be 13.8 - (0.300 x Cap/1000) EER.~~

~~TABLE C403.2.3 (4)~~
~~WARM-AIR FURNACES AND COMBINATION WARM-AIR FURNACES/AIR-CONDITIONING UNITS, WARM-AIR DUCT FURNACES AND UNIT HEATERS, MINIMUM EFFICIENCY REQUIREMENTS~~

~~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.~~ $\cancel{E_t}$ ~~= Thermal efficiency. See test procedure for detailed discussion.~~

~~e.~~ $\cancel{E_c}$ ~~= Combustion efficiency (100% less flue losses). See test procedure for detailed discussion.~~

~~f.~~ $\cancel{E_c}$ ~~= 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.~~ $\cancel{E_t}$ ~~= 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 C403.2.3 (5)~~
~~MINIMUM EFFICIENCY REQUIREMENTS: GAS- AND OIL-FIRED BOILERS~~

~~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.~~ $\cancel{E_c}$ ~~= Combustion efficiency (100 percent less flue losses).~~

~~e.~~ $\cancel{E_t}$ ~~= Thermal efficiency. See referenced standard for detailed information.~~

~~TABLE C403.2.3 (6)~~
~~MINIMUM EFFICIENCY REQUIREMENTS: CONDENSING UNITS, ELECTRICALLY OPERATED~~

~~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 C403.2.3 (7)~~
~~WATER CHILLING PACKAGES – EFFICIENCY REQUIREMENTS~~~~[a, b, d]~~

~~a. The requirements for centrifugal chiller shall be adjusted for nonstandard rating conditions in accordance with Section C403.2.3.1 and are only applicable for the range of conditions listed in Section C403.2.3.1. 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 C403.2.3 (8)~~
~~MINIMUM EFFICIENCY REQUIREMENTS: HEAT REJECTION EQUIPMENT~~

~~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 listed in Table 403.2.3(8) divided by the fan nameplate rated motor power.~~

~~c. 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 listed in Table 403.2.3(8) 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 and/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 C403.2.3 (9)~~
~~MINIMUM EFFICIENCY AIR CONDITIONERS AND CONDENSING UNITS SERVING COMPUTER ROOMS~~

~~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 C403.2.3 (10)~~
~~HEAT TRANSFER EQUIPMENT~~

~~NR = No Requirement.~~

~~a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.~~

Reference standards type: This is an update to reference standard(s) already in the ICC Code Books

Add new standard(s) as follows:

ANSI/ASHRAE/IES Standard 90.1-2016

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 does add two new tables for DOAS units that were previously not covered in the IECC. These DOAS requirements are in addendum cd to 90.1-2013

Dedicated outdoor air systems (DOAS) were introduced over 25 years ago and are now used in many buildings covered by the IECC and ASHRAE 90.1. However, the current IECC standard has no minimum energy efficiency requirements for this equipment. Through AHRI, manufacturers of DOAS developed Standard 920 (I-P) to establish common rating conditions for these products. In addition, AHRI is currently developing a certification program and will soon publish certified ratings on its directory of certified products.

This proposal establishes for the first time a product class for DOAS. The intent is to recognize the technology in Standard 90.1 and the IECC by requiring minimum energy efficiency standards. Integrated Seasonal Moisture Removal Efficiency (ISMRE) and Integrated Seasonal Coefficient of Performance (ISCOP) are proposed for a full range of product classes at standard rating conditions listed in AHRI Standard 920. These levels will be subject to further review and evaluation once a third-party certification is established and more data is available

Bibliography: ANSI/ASHRAE/IES Standard 90.1

Cost Impact: Will not increase 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 w ere previously uncovered. In some of those instances, the cost of construction may increase.

CE129-16 : C403.2.3-FERGUSON10453

CE130-16

IECC: C403.2.3.

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

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Revise as follows:

TABLE ~~C403.2.3~~ C403.2.3(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]
				~~Before 1/1/2016~~	~~As of 1/1/2016~~	
Air cooled (cooling mode)	b	All	Split System	~~13.0 SEER[c]~~	14.0 SEER[c]	AHRI 210/240
			Single Package	~~13.0 SEER[c]~~	14.0 SEER[c]	
Through-the-wall, air cooled	≤ 30,000 Btu/h[b]	All	Split System	~~12.0 SEER~~	12.0 SEER	
			Single Package	~~12.0 SEER~~	12.0 SEER	
Single-duct high-velocity air cooled	b	All	Split System	~~11.0 SEER~~	11.0 SEER	
Air cooled	≥ 65,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	~~11.0 EER~~ ~~11.2 IEER~~	11.0 EER 12.0 IEER	AHRI
		All other	Split System and Single Package	~~10.8 EER~~ ~~11.0 IEER~~	10.8 EER 11.8 IEER	
	≥ 135,000	Electric Resistance (or None)	Split System and Single Package	~~10.6 EER~~ ~~10.7 IEER~~	10.6 EER 11.6 IEER	

(cooling mode)	Btu/h and					340/360
		All other	Split System and Single Package	~~10.4 EER~~ ~~10.5 IEER~~	10.4 EER 11.4 IEER	
	≥ 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	~~9.5 EER~~ ~~9.6 IEER~~	9.5 EER 10.6 IEER	
		All other	Split System and Single Package	~~9.3 EER~~ ~~9.4 IEER~~	9.3 EER 9.4 IEER	
Water to Air: Water Loop (cooling mode)		All	86°F entering water	~~12.2 EER~~	12.2 EER	ISO 13256-1
	≥ 17,000 Btu/h and	All	86°F entering water	~~13.0 EER~~	13.0 EER	
	≥ 65,000 Btu/h and	All	86°F entering water	~~13.0 EER~~	13.0 EER	
Water to Air: Ground Water (cooling mode)		All	59°F entering water	~~18.0 EER~~	18.0 EER	ISO 13256-1
Brine to Air: Ground Loop (cooling mode)		All	77°F entering water	~~14.1 EER~~	14.1 EER	ISO 13256-1
Water to Water: WaterLoop (cooling mode)		All	86°F entering water	~~10.6 EER~~	10.6 EER	ISO 13256-2
Water to Water: Ground Water (cooling mode)		All	59°F entering water	~~16.3 EER~~	16.3 EER	
Brine to Water: Ground Loop		All	77°F entering fluid	~~12.1 EER~~	12.1 EER	

(cooling mode)						

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE[a]
				~~Before 1/1/2016~~	~~As of 1/1/2016~~	
Air cooled (heating mode)	b	—	Split System	~~7.7 HSPF[c]~~	8.2 HSPF[c]	AHRI 210/240
		—	Single Package	~~7.7 HSPF[c]~~	8.0 HSPF[c]	
Through-the-wall, (air cooled, heating mode)	≤ 30,000 Btu/h[b] (cooling capacity)	—	Split System	~~7.4 HSPF~~	7.4 HSPF	
		—	Single Package	~~7.4 HSPF~~	7.4 HSPF	
Small-duct high velocity (air cooled, heating mode)	b	—	Split System	~~6.8 HSPF~~	6.8 HSPF	
Air cooled (heating mode)	≥ 65,000 Btu/h and (cooling capacity)	—	47ºF db/43ºF wb outdoor air	~~3.3 COP~~	3.3 COP	AHRI 340/360
			17ºF db/15ºF wb outdoor air	~~2.25 COP~~	2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)	—	47ºF db/43ºF wb outdoor air	~~3.2 COP~~	3.2 COP	
			17ºF db/15ºF wb outdoor air	~~2.05 COP~~	2.05 COP	
Water to Air: Water Loop (heating mode)	(cooling capacity)	—	68°F entering water	~~4.3 COP~~	4.3 COP	

Water to Air: Ground Water (heating mode)	(cooling capacity)	—	50°F entering water	~~3.7 COP~~	3.7 COP	ISO 13256-1
Brine to Air: Ground Loop (heating mode)	(cooling capacity)	—	32°F entering fluid	~~3.2 COP~~	3.2 COP	
Water to Water: Water Loop (heating mode)	(cooling capacity)	—	68°F entering water	~~3.7 COP~~	3.7 COP	ISO 13256-2
Water to Water: Ground Water (heating mode)	(cooling capacity)	—	50°F entering water	~~3.1 COP~~	3.1 COP	
Brine to Water: Ground Loop (heating mode)	(cooling capacity)	—	32°F entering fluid	~~2.5 COP~~	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 ~~air conditioners~~ heat pumps less than 65,000 Btu/h are regulated by NAECA. SEER and HSPF values are those set by NAECA.

~~c. Minimum efficiency as of January 1, 2015.~~

Reason: The proposed changes updates the footnotes to Table C403.2.3(2) for heat pumps. This table shows values for heat pumps, not air conditioners. NAECA also provides the minimum HSPF requirements for single-phase heat pumps with a capacity of less than 65,000 Btu/h.
Footnote c is no longer needed, based on the values shown for equipment as of 1/1/2016.

Cost Impact: Will not increase the cost of construction
This proposal clarifies footnotes in a table and eliminates language that is no longer applicable. It does not change any of the requirements in the table or create any new requirements in the code.

CE130-16 : TABLE C403.2.3-ROSENSTOCK11748

CE131-16

IECC: C403.2.3.

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

2015 International Energy Conservation Code

Revise as follows:

TABLE ~~C403.2.3~~ C403.2.3(1) (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]
				~~Before 1/1/2016~~	~~As of 1/1/2016~~	
Air conditioners, air cooled	b	All	Split System	~~13.0 SEER~~	13.0 SEER	AHRI 210/240
			Single Package	~~13.0 SEER~~	14.0 SEER[c]	
Through-the-wall (air cooled)	≤ 30,000 Btu/h[b]	All	Split system	~~12.0 SEER~~	12.0 SEER	
			Single Package	~~12.0 SEER~~	12.0 SEER	
Small-duct high-velocity (air cooled)	b	All	Split System	~~11.0 SEER~~	11.0 SEER	
	≥ 65,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	~~11.2 EER~~ ~~11.4 IEER~~	11.2 EER 12.8 IEER	
		All other	Split System and Single Package	~~11.0 EER~~ ~~11.2 IEER~~	11.0 EER 12.6 IEER	
	≥ 135,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	~~11.0 EER~~ ~~11.2 IEER~~	11.0 EER 12.4 IEER	
		All other	Split System and	~~10.8 EER~~	10.8 EER	

Air conditioners, air cooled			Single Package	~~11.0 IEER~~	12.2 IEER	AHRI 340/360
	≥ 240,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	~~10.0 EER~~ ~~10.1 IEER~~	10.0 EER 11.6 IEER	
		All other	Split System and Single Package	~~9.8 EER~~ ~~9.9 IEER~~	9.8 EER 11.4 IEER	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	~~9.7 EER~~ ~~9.8 IEER~~	9.7 EER 11.2 IEER	
		All other	Split System and Single Package	~~9.5 EER~~ ~~9.6 IEER~~	9.5 EER 11.0 IEER	
Air conditioners, water cooled	b	All	Split System and Single Package	~~12.1 EER~~ ~~12.3 IEER~~	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	~~12.1 EER~~ ~~12.3 IEER~~	12.1 EER 13.9 IEER	AHRI 340/360
		All other	Split System and Single Package	~~11.9 EER~~ ~~12.1 IEER~~	11.9 EER 13.7 IEER	
	≥ 135,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	~~12.5 EER~~ ~~12.5 IEER~~	12.5 EER 13.9 IEER	
		All other	Split System and Single Package	~~12.3 EER~~ ~~12.5 IEER~~	12.3 EER 13.7 IEER	
	≥ 240,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	~~12.4 EER~~ ~~12.6 IEER~~	12.4 EER 13.6 IEER	
		All other	Split System and Single Package	~~12.2 EER~~ ~~12.4 IEER~~	12.2 EER 13.4 IEER	

	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	~~12.2 EER~~ ~~12.4 IEER~~	12.2 EER 13.5 IEER	
		All other	Split System and Single Package	~~12.0 EER~~ ~~12.2 IEER~~	12.0 EER 13.3 IEER	

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUB-CATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE[a]
				~~Before 1/1/2016~~	~~As of 1/1/2016~~	
Air conditioners, evaporatively cooled	b	All	Split System and Single Package	~~12.1 EER~~ ~~12.3 IEER~~	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	~~12.1 EER~~ ~~12.3 IEER~~	12.1 EER 12.3 IEER	AHRI 340/360
		All other	Split System and Single Package	~~11.9 EER~~ ~~12.1 IEER~~	11.9 EER 12.1 IEER	
	≥ 135,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	~~12.0 EER~~ ~~12.2 IEER~~	12.0 EER 2.2 IEER	
		All other	Split System and Single Package	~~11.8 EER~~ ~~12.0 IEER~~	11.8 EER 12.0 IEER	
	≥ 240,000 Btu/h and	Electric Resistance (or None)	Split System and Single Package	~~11.9 EER~~ ~~12.1 IEER~~	11.9 EER 2.1 IEER	
		All other	Split System and Single Package	~~11.7 EER~~ ~~11.9 IEER~~	11.7 EER 11.9 IEER	

	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	~~11.7 EER~~ ~~11.9 IEER~~	11.7 EER 11.9 IEER	
		All other	Split System and Single Package	~~11.5 EER~~ ~~11.7 IEER~~	11.5 EER 11.7 IEER	
Condensing units air cooled	≥ 135,000 Btu/h			~~10.5 EER~~ ~~11.8 IEER~~	10.5 EER 11.8 IEER	AHRI 365
Condensing units, water cooled	≥ 135,000 Btu/h			~~13.5 EER~~ ~~14.0 IEER~~	13.5 EER 14.0 IEER	
Condensing units, evaporatively cooled	≥ 135,000 Btu/h			~~13.5 EER~~ ~~14.0 IEER~~	13.5 EER 14.0 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 and EER values are those set by NAECA.

~~c. Minimum efficiency as of January 1, 2015.~~

Reason: Based on the requirements shown in the table (as of 1/1/2016), and since this version of the IECC will be published in late 2016 or early 2017, Footnote c is no longer needed.

Cost Impact: Will not increase the cost of construction
This proposal updates the footnote in the table, and does not change any of the requirements in the table, nor does it add any new requirements.

CE131-16 : TABLE C403.2.3-ROSENSTOCK11749

CE132-16

IECC: C403.2.3.

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

2015 International Energy Conservation Code

Revise as follows:

TABLE C403.2.3 (3) (3)

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[c]	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)		95°F db/ 75°F wb outdoor air	9.0 EER	AHRI 390
	≥ 65,000 Btu/h and	95°F db/ 75°F wb outdoor air	8.9 EER	
	≥ 135,000 Btu/h and	95°F db/ 75°F wb outdoor air	8.6 EER	
		95°F db/ 75°F wb outdoor		

		air	9.0 EER	
SPVHP (cooling mode)	≥ 65,000 Btu/h and	95°F db/ 75°F wb outdoor air	8.9 EER	
	≥ 135,000 Btu/h and	95°F db/ 75°F wb outdoor air	8.6 EER	
SPVHP (heating mode)		47°F db/ 43°F wb outdoor air	3.0 COP	AHRI 390
	≥ 65,000 Btu/h and	47°F db/ 43°F wb outdoor air	3.0 COP	
	≥ 135,000 Btu/h and	47°F db/ 75°F wb outdoor air	2.9 COP	
Room air conditioners, with louvered sides	< 6,000 Btu/h	—	~~9.7 SEER~~11.0 CEER	
	≥ 6,000 Btu/h and	—	~~9.7 EER~~11.0 CEER	
	≥ 8,000 Btu/h and	—	~~9.8 EER~~10.9 CEER	
	≥ 14,000 Btu/h and	—	~~9.7 EER~~10.7 CEER	
	≥ 20,000 Btu/h and < 25,000 Btu/h > 25,000 Btu/h	—	~~8.5 EER~~9.4 CEER 9.0 CEER	
	< 6,000 Btu/h > 6,000 Btu/h and < 8,000 Btu/h	—	10.0 CEER ~~9.0 EER~~10.0 CEER	
	≥ 8,000 Btu/h and < 11,000 Btu/h			ANSI/ AHAM RAC-

Room air conditioners, without louvered sides			~~8.5 EER~~9.6 CEER	1
	> 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	—	~~8.5 EER~~9.4 CEER	
Room air-conditioner heat pumps with louvered sides	< 20,000 Btu/h	—	~~9.0 EER~~9.8 CEER	
	≥ 20,000 Btu/h	—	~~8.5 EER~~9.3 CEER	
Room air-conditioner heat pumps without louvered sides	< 14,000 Btu/h	—	~~8.5 EER~~9.3 CEER	
	≥ 14,000 Btu/h	—	~~8.0 EER~~8.7 CEER	

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Room air conditioner casement only	All capacities	—	~~8.7 EER~~9.5 CEER	ANSI/ AHAM RAC-1
Room air conditioner casement-slider	All capacities	—	~~9.5 EER~~10.4 CEER	

For SI: 1 British thermal unit per hour = 0.2931 W, °C = [(°F) - 32]/1.8, wb = wet bulb, db = wet 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.

~~c. Before January 1, 2015 the minimum efficiency shall be 13.8 - (0.300 x Cap/1000) EER.~~

Reason: As of June 1, 2014, the federal efficiency requirements values for room air conditioners have been increased. In addition, the efficiency metric has been changed from EER (Energy Efficiency Ratio) to CEER (Combined Energy Efficiency Ratio), which is a metric that accounts for energy used in the "active" and "standby" modes of operation.
This proposal updates the table to reflect the current federal minimum efficiency standards.

Cost Impact: Will increase the cost of construction
The cost of room air conditioners that meet the most recent (2014) minimum standards is higher than the cost of room air conditioners that met the previous federal minimum standard.
The new room air conditioners are more energy efficient and will have lower operating costs than the air conditioners meeting the previous federal standard. According to a 2011 DOE analysis, the consumer median payback is between 2.1 and 10.1 years, depending on the product.

CE132-16 : TABLE C403.2.3-ROSENSTOCK11750

CE133-16

IECC: C403.2.4.1, C403.2.4.4.

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 International Energy Conservation Code

Revise as follows:

C403.2.4.1 Thermostatic controls. 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*. Controls in the same zone or in neighboring zones connected by openings larger than 10 percent of the floor area of either zone shall not allow for simultaneous heating and cooling. Each floor of a building shall be considered as a separate zone. Where humidification or dehumidification or both is provided, ~~at least~~ not less 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 *zone*s also served by an interior system provided that:
>
> 1. The perimeter system includes at least 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)~~;~~ and all of the following apply:
>   1.1. The perimeter system includes not less 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).
>   1.2. The perimeter system heating and cooling supply is controlled by a thermostat located within the zones served by the system.
>   1.3. Controls are configured to prevent the perimeter system from operating in a different heating or cooling mode from the other equipment within the zones or from neighboring zones connected by openings larger than 10 percent of the floor area of either zone.
> 2. ~~The~~ Any nonperimeter zones not separated from perimeter ~~system heating~~ zones by an interior wall with openings not larger than 10 percent of the perimeter floor zone area shall have setpoints and deadbands coordinated so that cooling ~~supply~~ in adjacent zones do not operate until the adjacent zone temperature is ~~controlled by thermostats located within~~ 5°F (2.8°C) higher than the ~~*zones* served by the system~~ perimeter zone temperature.

C403.2.4.4 Zone isolation. HVAC systems serving *zones* that are over 25,000 square feet (2323 m^2) in floor area ~~or~~ and 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 C403.2.4.2.2. 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.

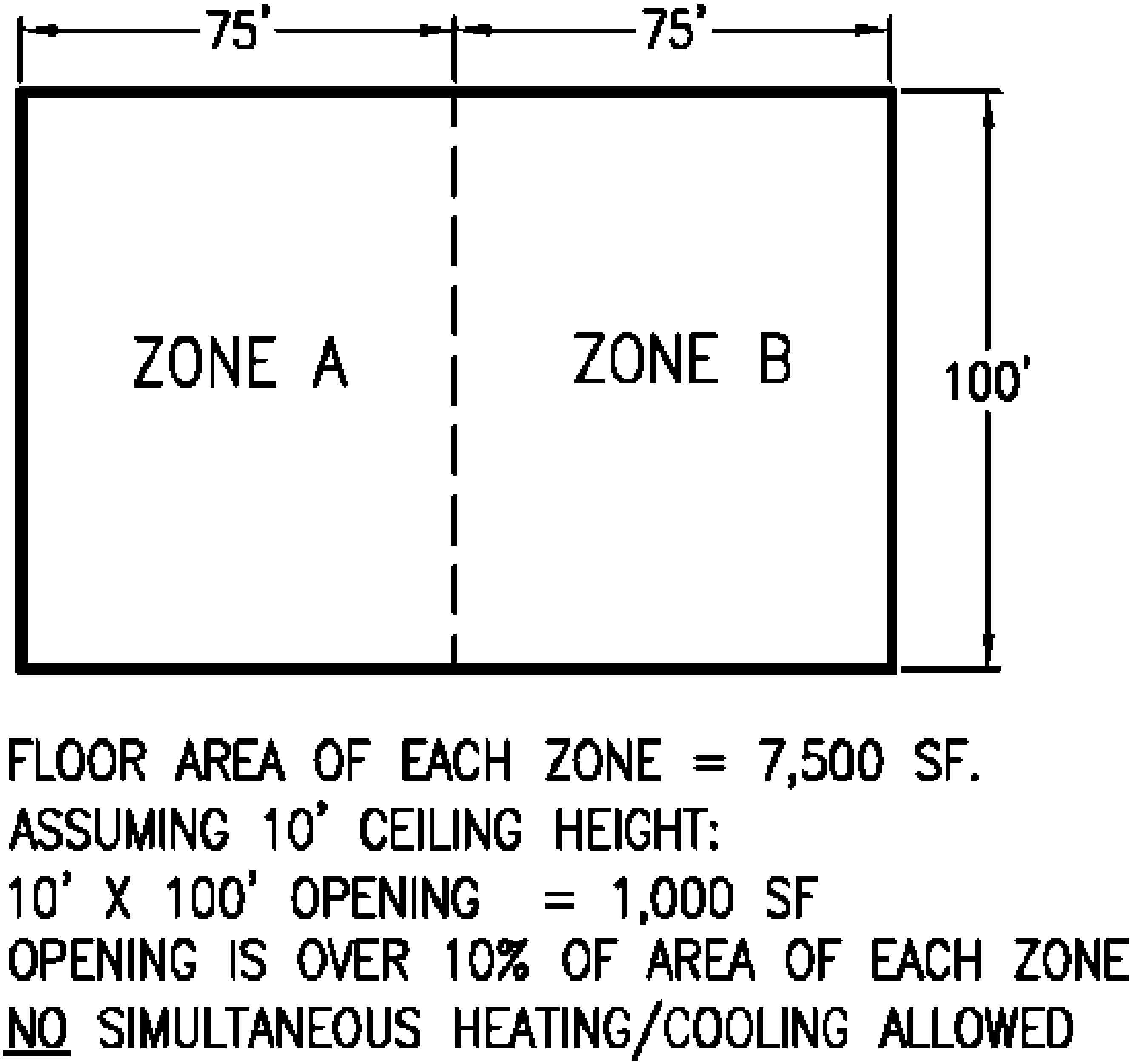
Reason: This proposal is targeted to reducing the incidence and impact of simultaneous heating and cooling in commercial building HVAC systems. In doing so this proposal restricts heating and cooling zones to nor more than one more floor. Commercial buildings are often designed with multiple temperature control zones. The zones are identified by the designer as areas that may function better if they have their own thermostat and the ability to call for heating or cooling independent of the other zones in the building. However, designs will often include neighboring zones that directly open into one-another. This often leads to conditions where one set of equipment is in heating mode while another set of equipment is in cooling at the same time. This proposal will explicitly disallow heating and cooling at the same time in the same zone or in neighboring zones that are connected by relatively large openings (>10% of the floor area of either zone).

Simultaneous heating and cooling is a common problem in multiple zone commercial buildings with heating and cooling systems. This has become more common recently with the move toward more open office floor plans as opposed to isolated closed offices. Open office floor plans are typically still designed with a core zone and a perimeter zone with separate heating and cooling controls. This leads to periods of time with one system in heating while another system is in cooling with no way to keep the air from mixing between the two zones. Note that this proposal still allows for multiple control points and multiple heating/cooling systems in the same zone or neighboring zones. It only restricts the ability of these systems to be in different modes at the same time.

This proposal also allows very large open floor plates to have cooling on one side and heating on the other as long as they are sufficiently large that the connection between them is ≤10% of the floor area on either side of the divide. See the sketches below:

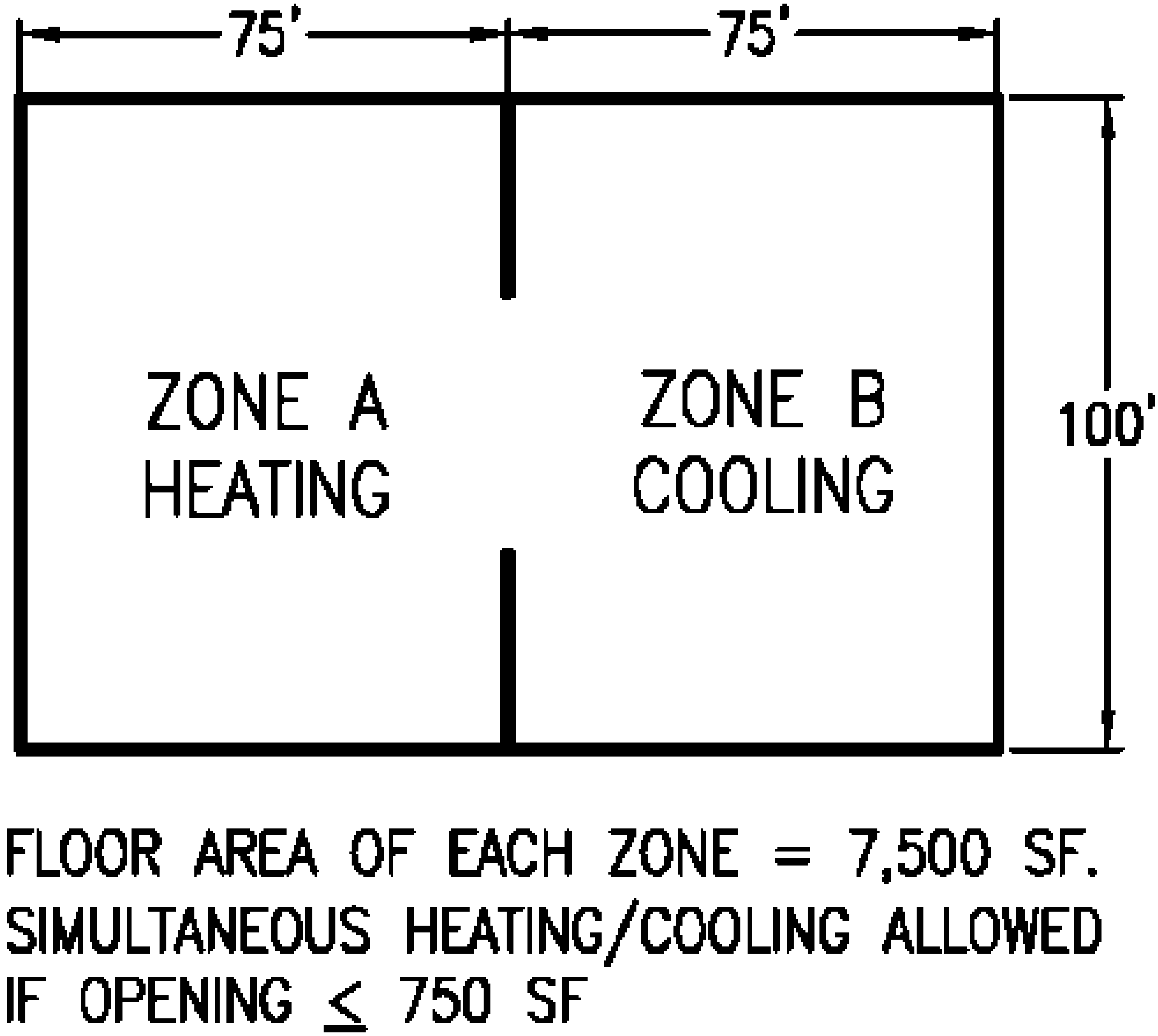
Example 1: No Simultaneous/Heating Allowed

In this first sketch the open floor plate does not allow for simultaneous heating and cooling in the neighboring zones because they are not sufficiently isolated from one another relative to their size. The opening between them is >10% of the floor area of either zone.



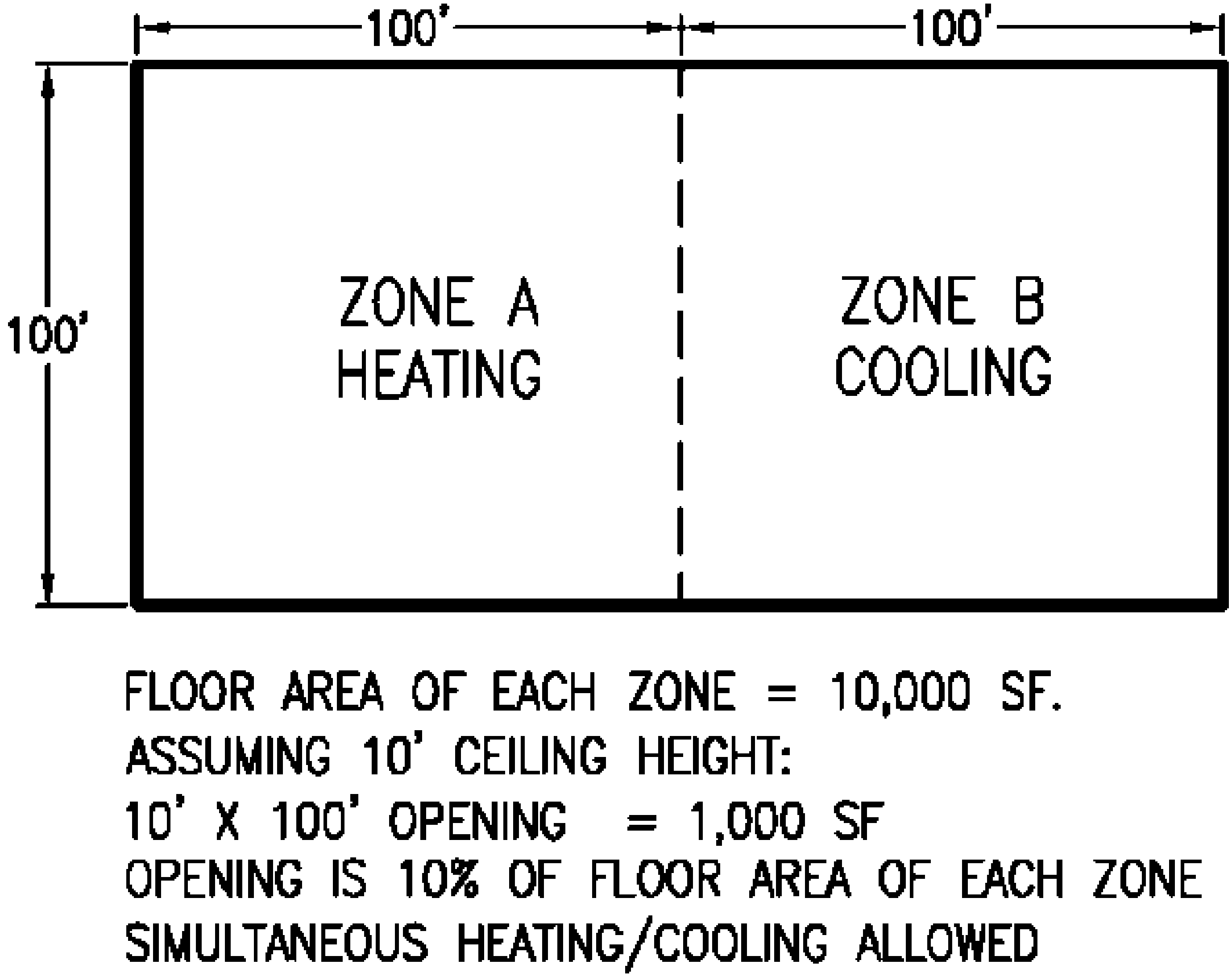
Example 2: Simultaneous/Heating Allowed

In this second sketch a partial dividing wall has been added which reduces the area of the connection between the zones to ≤10% of the floor area of either zone, so the controls on either side can be independent and simultaneous heating and cooling would be allowable.



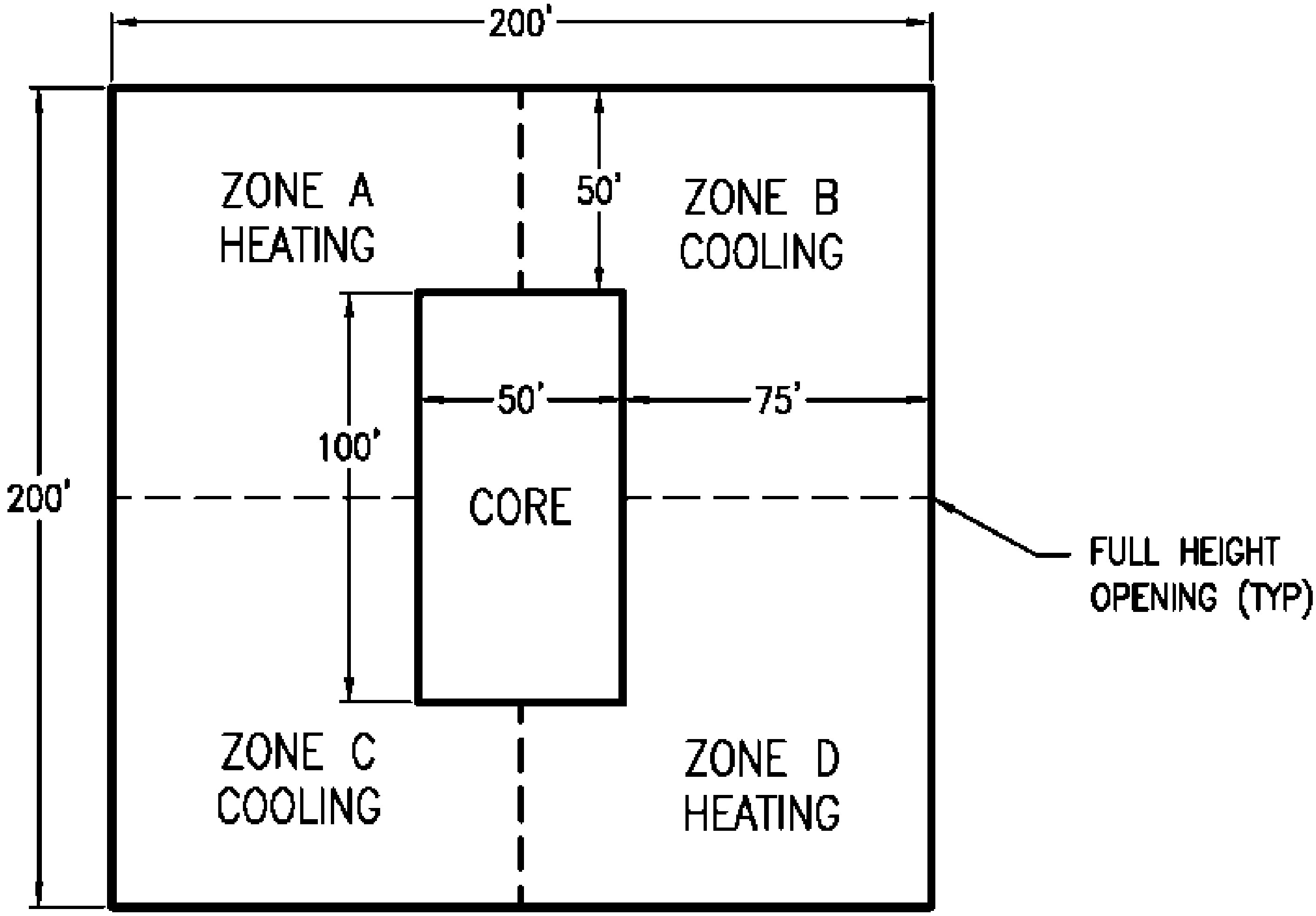
Example 3: Simultaneous/Heating Allowed

In this third sketch the floor plate is deep enough that the opening betw een the tw o zones is ≤10% of the floor area of either zone. Even w ithout a dividing w all, the zones w ould be permitted to operate independently in heating or cooling.



Example 4: Simultaneous/Heating Allowed

Finally, in this sketch of a very large floor plate the zoning would be permitted to be divided up into the four zones shown based on the size of the openings between zones being ≤10% of the area of either zone.



FLOOR AREA OF EACH ZONE = 8,750 SF.
ASSUMING 10' CEILING HEIGHT, OPENINGS:
ZONE A–C: 75' x 10' = 750 SF
ZONE B–D: 75' x 10' = 750 SF
ZONE A–B: 50' x 10' = 500 SF
ZONE C–D: 50' x 10' = 500 SF

OPENINGS ARE LESS THAN 10% OF EACH ZONE AREA
SIMULTANEOUS HEATING/COOLING ALLOWED

Cost Impact: Will not increase the cost of construction
This code change proposal will not require additional controls but will ensure that the controls that are associated with systems that are serving adjacent large spaces do not allow the systems to heat and cool at the same time. There are no cost increases for this proposal.

CE133-16 : C403.2.4.1-MAKELA12485

CE134-16

Part I:
IECC: C403.2.4.1.1.
Part II:
R403.1.2 (IRC N1103.1.2)

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 ORDERS FOR THESE COMMITTEES.

Proponent : Charles Foster, representing Self (cfoster20187@yahoo.com)

Part I

2015 International Energy Conservation Code

Delete without substitution:

~~**C403.2.4.1.1 Heat pump supplementary heat.** 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.~~

Part II

2015 International Energy Conservation Code

Delete without substitution:

~~**R403.1.2 (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.~~

Reason: This existing code section does not add any substantive guidance or requirements to the IECC and should be removed as superfluous. All heat pumps are installed w ith multi-stage thermostats. The first stage of the thermostat controls vapor compression heating provided by the heat pump's compressor. If the heat loss of the space being heated by the heat pump exceeds the heat pump's ability to supply heat by means of vapor compression, the temperature of the space w ill continue to fall. When such temperature drops approximately 1* F below the vapor compression thermostat set point, supplemental heating (ususally electric resistance heat but not alw ays) is called (energized) to assist vapor compression heating. When the space temperature rises approximately 1* F the supplmental heating stops leaving only the vapor compression heating operational.
Thus, the existing code language simply expresses the standard operation of an electric heat pump system as they have been designed and manufactured for the last 50 years and imposes no actual requirement.

In addition, the existing language could be interpreted as imposing a post installation obligation, effectively converting the section from a design specification to an operational specification. In doing so, inspectors w ould need to become "heat pump police" to ensure compliance w ith such an operational specification.

Cost Impact: Will not increase the cost of construction
This proposal w ould remove existing language from the IECC. In doing so, there w ould be no change in the w ay heat pumps systems are either installed or operated. Accordingly, it w ould have no impact on the cost of construction.

CE134-16 : C403.2.4.1.1-FOSTER11975

CE135-16

Part I:
IECC: C403.2.4.1.1.
Part II:
R403.1.2 (IRC N1103.1.2)

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

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

Part I

2015 International Energy Conservation Code

Revise as follows:

C403.2.4.1.1 Heat pump ~~supplementary~~ supplemental heat. Heat pumps having ~~supplementary~~ supplemental electric resistance heat shall have controls that~~, except during defrost,~~ prevent ~~supplementary~~ supplemental heat operation where the heat pump vapor compression cycle can provide the necessary heating ~~load~~ to satisfy the first stage of the thermostat control.

Exceptions:

1. Defrost operation.
2. Vapor compression cycle heating malfunction.
3. Thermostat malfunction.
4. Manual override of pre-programmed thermostat setting.

Part II

2015 International Energy Conservation Code

Revise as follows:

R403.1.2 (N1103.1.2) Heat pump supplementary 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~~ vapor compression cycle can ~~meet~~ provide the necessary heating ~~load~~ to satisfy the first stage of the thermostat control.

Exceptions:

1. Defrost operation.
2. Vapor compression cycle heating malfunction.
3. Thermostat malfunction.
4. Manual override of pre-programmed thermostat setting.

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 thermost 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.

Manual override. In commercial buildings where tenants or employees are in the space during nights, weekends, or holidays, they may be allowed to override the programmed thermostat settings. In some situations, the override could mean a thermostat setting is adjusted from 55 or 60 degrees F to over 68 or 70 degrees F. Such an override, especially during colder weather, will likely require the use of supplemental heat in conjunction with the compressor and fan motor to meet the tenant or employee comfort level.

It should also be noted that the efficiency standards for heat pumps (both commercial and residential) have increased significantly over the past 20 years, and will increase again for commercial heat pumps by 2018. 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: Will not increase the cost of construction
This will not increase 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 or install a heat pump.

CE135-16 : C403.2.4.1.1-ROSENSTOCK11770

CE136-16

IECC: 403.2.4.1.4 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Add new text as follows:

403.2.4.1.4 Heated or cooled vestibules 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.

Reason: *Vestibules or air curtains are required to be installed per C402.5.7 to reduce infiltration into the building. The benefit of a vestibule is negated if the vestibule is heated or cooled to the setpoint of the adjacent space. The proposed change limits heating and cooling energy use associated with vestibules. An exception for temperature limits is allowed when the vestibule is tempered with transfer air or heated with recovered energy. Transfer air tempering is beneficial because that conditioned air is destined to be exhausted anyway, and pressurizing the vestibule can reduce infiltration further.*

Approval of this code change proposal will ensure consistency with ASHRAE Standard 90.1-16, which will be adopted by reference as an alternative path to the 2018 IECC Commercial Provisions. This change was made via addendum ca to to ASHRAE Standard 90.1-2010 and addendum ag to ASHRAE Standard 90.1-2013.

Cost Impact: Will increase the cost of construction
If there is a heating or cooling system serving a vestibule, it will already have a thermostat based on requirements in section C403.2.4.1. The upgrade to a thermostat with setpoint limits or a locking cover is a modest cost ($20 to $45). In a DDC system, there would be no additional cost for the outside air lockout, and in an electromechanical control system the cost for an outside air lockout thermostat is modest ($40 to $70). These modest costs will be more than offset by reduced loss of heated or cooled air. If a transfer air fan into the vestibule were selected to condition the vestibule as allowed in the exception, that cost is likely to be less than the cost of providing a separate heating or cooling system for the vestibule.

CE136-16 : C403.2.4.1.4 (NEW)-FERGUSON11742

CE137-16

Part I:

IECC: , C104.1, C202, C202 (New), C303.3, C403.2.4.2, C403.2.4.7, C404.6, C404.9.1, C405.2.2.3, C405.2.3.1, C405.2.4, C408.3.1.3.

Part II:

IECC: , (New), 0, R104.1, R303.3, R403.10.1, R403.5.1.

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

Proponent : David Collins (dcollins@preview-group.com)

Part I

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

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.

Add new definition as follows:

SECTION C202 DEFINITIONS

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.

Revise as follows:

C104.1 General. Construction or work for which a permit is required shall be subject to inspection by the *code official* or his or her designated agent, and such construction or work shall remain ~~accessible and~~ exposed for inspection purposes until *approved*. It shall be the duty of the permit applicant to cause the work to remain ~~accessible and~~ exposed for inspection purposes. Neither the *code official* nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material, product, system or building component required to allow inspection to validate compliance with this code.

C303.3 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.

C403.2.4.7 Economizer fault detection and diagnostics (FDD). Air-cooled unitary direct-expansion units listed in Tables C403.2.3(1) through C403.2.3(3) and variable refrigerant flow (VRF) units that are equipped with an economizer in accordance with Section C403.3 shall include a fault detection and diagnostics (FDD) 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 ±2°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 capable of providing 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 capable of reporting faults to a fault management application ~~accessible~~ available for *access* by day-to-day operating or service personnel, or annunciated locally on zone thermostats.
7. The FDD system shall be capable of detecting 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.

C404.6 Heated-water circulating and temperature maintenance systems. Heated-water circulation systems shall be in accordance with Section C404.6.1. Heat trace temperature maintenance systems shall be in accordance with Section C404.6.2. Controls for hot water storage shall be in accordance with Section C404.6.3. 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*.

C404.9.1 Heaters. The electric power to all 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 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.

C405.2.2.3 Manual controls. *Manual controls* for lights shall comply with the following:

1. Shall be ~~readily accessible~~ in a location with *ready access* to occupants.
2. Shall be located where the controlled lights are visible, or shall identify the area served by the lights and indicate their status.

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 toplight *daylight zones* in accordance with Section C405.2.3.3 shall be controlled independently of lights in sidelight *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~~ r~~ in a location with~~*eadily accessible*~~ *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 capable of a complete shutoff of all controlled lights.
6. Lights in sidelight *daylight zones* in accordance with Section C405.2.3.2 facing different cardinal orientations [i.e., 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.

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. Display and accent light shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
2. Lighting in cases used for display case purposes shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
3. Hotel and motel sleeping units and guest suites shall have a master control device that is capable of automatically switching off all installed luminaires and switched receptacles within 20 minutes after all occupants leave the room.

    Exception: Lighting and switched receptacles controlled by captive key systems.
4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided that the control device is ~~readily accessible~~ in a location with *ready access*.
5. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
6. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

C408.3.1.3 Daylight responsive controls. Where daylight responsive controls are provided, the following shall be verified:

1. Control devices have been properly located, field calibrated and set for accurate setpoints and threshold light levels.
2. Daylight controlled lighting loads adjust to light level set points in response to available daylight.
3. The~~ locations of~~ calibration adjustment equipment are ~~readily accessible~~ located for *ready access* only to authorized personnel.

C403.2.4.2 Off-hour controls. 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 readily accessible~~ manual shutoff switch located with ready access.

SECTION R202 (N1101.6) DEFINITIONS

Delete without substitution:

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

Delete without substitution:

~~**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*").~~

Part II

2015 International Energy Conservation Code

Delete without substitution:

SECTION C202 DEFINITIONS

~~**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*").~~

Revise as follows:

R104.1 General. Construction or work for which a permit is required shall be subject to inspection by the code official or his or her designated agent, and such construction or work shall remain ~~accessible and~~ open for *access* exposed for inspection purposes until *approved*. It shall be the duty of the permit applicant to cause the work to remain ~~accessible and~~ exposed for inspection purposes. Neither the *code official* nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material, product, system or building component required to allow inspection to validate compliance with this code.

Add new definition as follows:

READY ACESS (TO)

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

ACCESS (TO)

That which enables a device, appliance or equipement to be reached by ready access or by a means that first requires the removal or movement of a panel, door or similar obstruction.

Revise as follows:

R303.3 (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 (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~~ R403.10.1(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 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 intent of this proposal is for clarification of terminology. This proposal will clarify where the provisions are for access for repair, not accessibility for persons with disabilities.
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.

There is a similar proposal for the IRC. A similar proposal was approved for the International Plumbing Code as part of Group A - P84-15

Cost Impact: Will not increase the cost of construction
This is a clarifiation of terminiology that will not change any construction requirements.

Analysis: Section R104.1 does not have a corresponding section in Chapter 11 of the IRC.

CE137-16 : C403.2.4.2-COLLINS11935

CE138-16

IECC: , C202 (New), C403.2.4.3 (New), C403.2.4.3.1 (New), C403.2.4.3.2 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

ISOLATION DEVICES Devices that isolate HVAC zones so that they can be operated independently of one another. Isolation devices include separate systems, isolation dampers, and controls providing shutoff at terminal boxes.

SECTION C202 DEFINITIONS

NETWORKED GUEST ROOM 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 status of each guest room according to a timed schedule, and is capable of controlling HVAC in each hotel and motel guest room separately.

Add new text as follows:

C403.2.4.3 Automatic control of HVAC systems serving guest rooms. In Group R-1 buildings containing over 50 guest rooms, each guest room shall be provided with controls complying with the provisions of Sections C403.2.4.3.1 and C403.2.4.3.2. Captive key card systems comply with these requirements.

C403.2.4.3.1 Temperature setpoint controls. Controls shall be provided on each HVAC system that are capable of and configured to automatically raise the cooling setpoint and lower the heating setpoint by not less than 4°F (2°C) from the occupant set-point within 30 minutes after the occupants have left the guest room. The controls shall also be capable of and configured to automatically raise the cooling setpoint to not lower than 80°F (27°C) and lower the heating set point to not higher than 60°F (16°C) when the guest room is unrented or has not been continuously unoccupied for over 16 hours or a networked guest room control system indicates that the guest room is unrented and the guest room is unoccupied for more than 30 minutes. A networked guest room control system that is capable of returning the thermostat set-points to default occupied set-points 60 minutes prior to the time a guest room 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.

C403.2.4.3.2 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 minutes of the occupants leaving the guest room or isolation devices shall be provided to each guest room that are capable of automatically shutting off the supply of outdoor air to and exhaust air from the guest room.

Exception: Guest room 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: *The proposed additional criteria to the IECC provides the ability to reduce building energy use through deeper thermostat setups and setbacks and ventilation control in unrented guestrooms without affecting occupant comfort or creating a conflict with the International Mechanical Code. The technology exists from multiple manufacturers to support the implementation of these provisions. For standalone controls, guest rooms are considered unrented if they are unoccupied for longer than 16 hours. For systems connected to a networked guest room control, the control can be configured to indicate whether the room is scheduled to be occupied and thus setbacks and ventilation can be turned off earlier when the guest room is scheduled to be unoccupied and the networked control can return setpoints to their default levels 60 minutes in advance of scheduled check-in.*

This proposal also requires that ventilation air to the guest room be shut off during unoccupied periods. This proposal includes an exception for a "purge cycle" that would provide ventilation air to the guest room one hour before scheduled check-in as indicated by a networked guest room control or through a timed outdoor air ventilation "purge cycle" one hour per day. The purge cycle exception allowed by this proposal allows for enhanced indoor air quality beyond the requirements of the International Mechanical Code, while still capturing the majority of the energy savings of the ventilation shut-off for the rest of the day. The controls would operate from an occupancy sensor, so that cleaning crews in unrented rooms would receive ventilation necessary during cleaning.

Cost Impact: Will increase the cost of construction
An analysis of the small hotel prototypes associated with the ASHRAE SSPC 90.1 activities indicates this change (which will be included in ASHRAE 90.1-2016 because this change was made via addendum j to ASHRAE 90.1-2013) results in savings and paybacks that meet ASHRAE SSPC 90.1 scalar thresholds for cost effectiveness for all climate zones for systems where the ventilation fan is simply switched off such as PTACs. For central ventilation and exhaust systems typically provided with fan coil units there is some additional cost for ventilation and exhaust dampers and pressure regulation devices. Even with these added costs the proposed measure meets the SSPC 90.1 cost effectiveness criteria. The situation where an energy recovery ventilation device is required was investigated, and it was also found that the measure meets the cost effective criteria even with reduced savings accounting for this measure. In the cost effectiveness analysis, added costs for a 77 room hotel or motel were estimated at $21,000 (single unit control) to $38,000 (central exhaust fan system control) with energy cost savings net of maintenance ranging from $3263 to $12,432, depending on climate zone and to average $5,887 annually across all U.S. climate zones

CE138-16 : C403.2.4.3 (NEW)-FERGUSON11678

CE139-16

IECC: C403.2.4.3.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

C403.2.4.3 Shutoff dampers. 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/ft^2 (20.3 L/s • m^2) 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:** Gravity (nonmotorized) dampers shall be permitted to be used <u>for exhaust and relief </u>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).

Gravity (nonmotorized) dampers shall have an air leakage rate not greater than 20 cfm/ft^2 (101.6 L/s • m^2) where not less than 24 inches (610 mm) in either dimension and 40 cfm/ft^2 (203.2 L/s • m^2) 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.

Reason: This proposal restricts the exception allow ing gravity dampers to exhaust and relief air streams, and consequently requires a positive shutoff damper for outside air intakes. Outside air intakes are under negative pressure w hen the system is operating and as a result w ill draw in the full outside air amount w hen a system operates during unoccupied periods to maintain setback heating temperatures. This additional outdoor requires additional heating and increases energy use

Cost Impact: Will increase the cost of construction
Based on an estimating, a typical 10" x 10" motorized vent damper w ith actuator costs around $111, installed. A gravity damper cost is expected to be around $44. The incremental cost is expected to be $67 for units affected by this code change proposal

CE139-16 : C403.2.4.3-FERGUSON13100

CE140-16

IECC: C403.2.6.

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

C403.2.6 Ventilation. Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the *International Mechanical Code* <u>or applicable codes or accreditation standards</u>. Where mechanical ~~ventilation~~*ventilation* is provided, the system shall ~~provide~~ <u>comply with one of</u> the ~~capability to reduce the~~ <u>following:</u>

1. <u>The system design</u> outdoor air ~~supply to the minimum required by Chapter 4~~ <u>intake flow rate shall not exceed 135 percent</u> of the ~~*International Mechanical Code*.~~<u>required minimum outdoor air intake flow rate.</u>
2. <u>The system shall utilize exhaust air energy recovery complying with Section C403.2.7.</u>

Reason: Currently Chapter 4 of the International Mechanical Code establishes the minimum outside air required for ventilation; how ever, there is no upper limit for ventilation in IECC prescriptive requirements; although there is a requirement that systems have the capability of being reduced to the minimum. This addendum offers the designer tw o options:

- Green building standards have established 130% of required minimum ventilation for indoor air quality credits. This option limits ventilation to 135%, providing a reasonable allow ance for accuracy of balancing.
- Should more ventilation be desired in a particular building, that additional ventilation can be provided, as long as heat recovery is used to offset the energy cost of higher ventilation rates.

In addition "or applicable codes or accreditation standards" is added as an option to IMC requirements, as hospitals and some other facilities may have higher ventilation standards for acreditation than those required in the IMC.

Field studies have show n that ventilation rates exceed minimums. A PIER study[1] of 40 buildings prepared for California Energy Commission found a median ventilation rate of 76 cfm per person, w hen minimum standards are in the 10 to 20 cfm per person range. A study[2] of ventilation rates in 100 U.S. commercial buildings did find that half w ere below minimum ventilation rates; how ever, this indicates that half w ere at or above minimum ventilation rates. The spread of ventilation rates based on peak CO_2 w as quite w ide w ith the upper quartile having ventilation rates more than 38% above the mean. So it is possible that a quarter of the buildings exceeded the limits in this proposal. These studies indicate there is potential for savings by placing reasonable limits on ventilation rates.

Energy Savings: An analysis of the DOE small office prototype show s that supplying 135% of the ventilation instead of 170% results in 0.6% total building energy cost savings in hot climates, 1.4% in moderate climates, and 3.1% in cold climates. The 70% increase above minimum required w as selected as a conservative indicator of potential savings at double the new requirement of no more than 35% over minimum. This is conservative compared to the previously referenced study[1] that show ed a median of 280% over minimum.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://w w w .energycodes.gov/development/2018IECC.

Bibliography:

1. Deborah Bennett, Xiangmei (May) Wu, and Amber Trout. "Indoor Environmental Quality and Heating,

Ventilating, and Air Conditioning Survey of Small and Medium Size Commercial Buildings: Field Study." University of California Davis for California Energy Commission, 2011. http://www.energy.ca.gov/2011publications/CEC-500-2011-043/CEC-500-2011-043.pdf.

2. Persily, Andrew K., J Gorfain, and G Brunner. "Analysis of US Commercial Building Envelope Air Leakage Database to Support Sustainable Building Design." In Indoor Air, 2005. http://fire.nist.gov/bfrlpubs/build05/PDF/b05053.pdf.

Cost Impact: Will not increase the cost of construction

There is no anticipated cost increase, as this represents a control/design requirement rather than a requirement for additional equipment. The current balancing requirements in code require that air systems be balanced, so this proposal simply adjusts the level to which outside air should be balanced. If ventilation is limited, there is a reduction in required heating or cooling peak capacity, thereby reducing costs. As an option, a building may still be permitted to exceed the ventilation threshold and choose to incur the cost of the heat recovery system; however this is a design option and not a requirement of code, so does not add to the cost impact created by the energy code.

Cost-effectiveness: This change is cost-effective in that it provides significant savings with no anticipated cost increase.

CE140-16 : C403.2.6-WILLIAMS12256

CE141-16

IECC: C403.2.6.1.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C403.2.6.1 Demand controlled ventilation. Demand control ventilation (DCV) shall be provided for spaces larger than 500 square feet (46.5 m^2) and with an average occupant load of 25 people <u>or greater</u> per 1,000 square feet (93 m^2) 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).

Exception: Demand control ventilation is not required for systems and spaces as follows:

1. Systems with energy recovery complying with Section C403.2.7.
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 for process loads only.

Reason: The existing text is an absolute number. If the average occupant load is 24.9 or 25.1 per 1000 square feet – then technically the section doesn't apply. It is generally being enforced that the 25 per 1000 square feet is the lowest density that triggers the requirement.

Cost Impact: Will not increase the cost of construction
The proposal is essentially editorial. The existing code's absolute figure has been treated as the lower limit in past practices. Installing the figrue now may result in application in situations which should have been covered perviously, but due to absolute figure may have been igrnored.

CE141-16 : C403.2.6.1-COLLINS11456

CE142-16

IECC: C403.2.6.1.

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

C403.2.6.1 Demand controlled ventilation. Demand control ventilation (DCV) shall be provided for spaces ~~larger than 500 square feet (46.5 m^2) and~~ with ~~an average~~ a design occupant load of 25 or more people per 1,000 square feet (93 m^2) 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~~ as follows:

1. ~~An~~ DCV that modulates the outdoor air ~~-side economizer.~~ in proportion to the number of people in the space shall be provided for spaces larger than 500 square feet (46 m^2) where the supply airflow rate minus any makeup or outgoing transfer air requirement is 1,200 cfm (566 L/s) or more and served by systems with one of more of the following:
   - 1.1. An air-side economizer.
   - 1.2. Automatic modulating control of the outdoor air damper.
   - 1.3. A design outdoor airflow greater than 3,000 cfm (1416 L/s).
2. ~~Automatic modulating control~~ Spaces larger than 150 square feet (14 m^2) but not exceeding 500 square feet (46 m^2) where the supply airflow rate minus any makeup or outgoing transfer air requirement is 200 cfm (95 L/s) or more shall be provided with one of the ~~outdoor air damper.~~ following:
   - 2.1. DCV that closes the ventilation damper or shuts off the ventilation fan when an occupant sensor indicates that the space has been vacant for 20 minutes; and that while the space is vacant, shuts off the air supply to the space or limits the air flow supplied to the makeup air requirement except where the space temperature is 2°F or more below the heating temperature setpoint or 2°F or more above the cooling temperature setpoint.
   - 2.2. DCV that modulates the outdoor air in proportion to the number of people in the space.

~~3. A design outdoor airflow greater than 3,000 cfm (1416 L/s).~~

~~**Exception:** Demand control ventilation is not required for systems and spaces as follows:~~

~~1. Systems with energy recovery complying with Section C403.2.7.~~

~~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 for process loads only.~~

Exception: Demand control ventilation is not required for systems as follows:

1. Systems with energy recovery complying with Section C403.2.7.
2. Systems installed for the sole purpose of providing makeup air to

satisfy exhaust requirements.

Reason: Demand controlled ventilation saves energy by reducing the heating and cooling of outside air for ventilation, and by reducing the fan energy for serving vacant spaces. The proposal clarifies language to meet the original intention of application to spaces where occupancy is 25 people or more per 1000 square feet. It also moves some exceptions into positive requirements. The last exception is reworded to improve clarity and compliance. The proposal further distinguishes between demand controlled ventilation (DCV) that modulates the ventilation air (usually with a CO_2 sensor) and lower-cost DCV that shuts off ventilation air when a space is vacant. The lower-cost shut-off DCV is cost-effective in smaller spaces that have high occupancy. For the lower-cost shut off method, readily available occupancy sensor thermostats are incorporated with a moderate standby temperature setback so that thermal loads will not keep the fan operating while the space is vacant.

In addition, the charging language is clarified to replace "average" with "design" occupant load and add "at least" to the threshold requirement. It is difficult to determine average load, especially before occupancy. We believe "at least" was part of the original intention for this provision and with the changes it better matches the ASHRAE 90.1 requirements. These issues have been a point of confusion for this section. The revisions result in code language that is easier to enforce.

Energy Savings: An analysis of energy impact shows that savings from controlling HVAC based on occupancy as proposed ranges from $20 to $257 per 150 square foot room. More details are found in the cost-effectiveness analysis referenced in the cost impact section.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

Bibliography:

1. PECI, and Taylor Engineering. (2011). "Light Commercial Unitary HVAC, 2013 California Building Energy Efficiency Standards, CODES AND STANDARDS ENHANCEMENT INITIATIVE (CASE)." California Utilities Statewide Codes and Standards Team for California Energy Commission.
2. Hart, R., and Liu, B. (2015). Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes. Pacific Northwest National Laboratories for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-23923 Rev1. https://www.energycodes.gov/development/commercial/methodology.
3. Hart, R. September 2015. "Cost-effectiveness Analysis of Occupant Standby Control for HVAC." https://www.energycodes.gov/development/2018IECC.

Cost Impact: Will increase the cost of construction

Based on a CASE study[1] conducted for California Title 24 in 2011, the added cost of occupancy sensor controlled thermostats in new construction is $178 per zone. The occupancy sensor is integral to the thermostat in some cases, and a separate unit in others. Low voltage occupancy sensors are available to allow for low cost HVAC controls installation. In the case of VAV boxes, the thermostat and occupancy sensor cost will cover a low-voltage occupancy sensor and an additional input into the box controller or integrating the HVAC DDC system with the occupancy sensors in the lighting control system.

Cost-effectiveness: The use of occupancy sensor control for high occupancy spaces down to 150 square feet was found cost-effective in the cited CASE study and similar provisions were included in California Title 24. PNNL performed a cost-effectiveness analysis using the established DOE methodology.[2] Results of the cost-effectiveness analysis showed that the average savings-to-investment ratio (SIR) ranges from 2.3 in small offices to 11.8 in large offices. A proposal 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 complete cost-effectiveness analysis is available at: https://www.energycodes.gov/development/2018IECC.[3]

CE142-16 : C403.2.6.1-

CE143-16

IECC: C403.2.6.3 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Add new text as follows:

C403.2.6.3 Ventilation air heating control. 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 temperature indicate that the majority of zones require cooling.

Reason: Dedicated outside air systems (DOAS) use significant heating energy w hen controlled to provide a "neutral" supply temperature that matches the space setpoint. In fact, for humidity control DOAS air is often cooled to remove moisture then reheated to a neutral temperature. In addition, w hen cooling is required in the building, the neutral air does not contribute to cooling like ventilation though a single air system w ould. This addendum limits heating the DOAS supply air to 60°F w hen the majority of the building is expected to require cooling. This can be established based either on zone conditions or outside air temperature. Zones that do not require cooling can provide heating to neutral w ith the zone conditioning system. Zones that do require cooling w ill benefit from the low er outside air temperature.

Cost Impact: Will increase the cost of construction
This represents a control requirement rather than a requirement for additional equipment, so there is no anticipated cost increase and cost effectiveness analysis is not required.

CE143-16 : C403.2.6.3 (NEW)-FERGUSON12576

CE144-16

IECC: C403.2.6.3 (New).

Proponent : Mike Moore (mmoore@newportventures.net)

2015 International Energy Conservation Code

Add new text as follows:

C403.2.6.3 Dwelling unit mechanical ventilation. Mechanical ventilation shall be provided for dwelling units in R-2 occupancies in accordance with the *International Mechanical Code.*

Exception: Mechanical ventilation is not required for dwelling units in R-2 occupancies where one or more of the following conditions apply:
1. The dwelling unit does not have mechanical cooling and it is in *Climate Zone* 1 or 2.
2. The dwelling unit is intended to be thermally conditioned for less than 876 hours per year.

Reason: Section C402.5 mandates air sealing for all buildings, setting a target of 0.4 cfm/ft at 75 Pa. This leakage target can be confirmed through blower door testing or through other methods. When applied to an individual dwelling unit, the IECC's target leakage rate corresponds to about 0.6 ACH50, which is a fifth of the leakage rate permitted for dwelling units covered under the residential chapter.* When the residential chapter of the IECC adopted air tightness requirements in 2012, it also mandated a requirement for mechanical ventilation to be provided (R403.6). The rationale in adopting such a requirement was that the IECC should not set air tightness targets without also ensuring that minimum acceptable indoor air quality is provided. This proposal closes a gap in the code by ensuring that tight dwelling units built under the commercial chapter of the IECC are also provided with mechanical ventilation to deliver minimum acceptable indoor air quality.** The total incremental cost for adding mechanical ventilation is as low as $70 based on retail equipment pricing for an ENERGY STAR exhaust fan. This cost is very small when compared to the estimated $300 billion annual cost of negative health effects from poor residential indoor air quality.[1,2,3,4,5]

*Assumes the typical dwelling unit has 8 ft ceilings, 30 ft of exterior wall, 1000 ft2 of conditioned floor area, and a pressure exponent, n, of 0.65.

**The IMC currently has a requirement for mechanical ventilation of dwelling units in commercial buildings. However, the requirement is only triggered IF a blower door test is conducted at 50 Pa and the total leakage of the dwelling unit is 5 ACH_{50} or less. Because this metric is different from the blower door test referenced by IECC C402.5, and because no blower door test is required by IECC C402.5, there is no effective requirement in either the IMC or IECC for mechanical ventilation of air sealed dwelling units in commercial buildings. Like the residential chapter, the IECC's commercial chapter should take responsibility to provide direction to the IMC as to when mechanical ventilation is required.

Bibliography: 1. Logue JM, Price PN, Sherman MH, and Singer BC. 2012. A Method to Estimate the Chronic Health Impact of Air Pollutants in U.S. Residences. Environmental Health Perspectives 120(2): 216-222.

2. Turner WJN, Logue JM, and Wray CP. 2012. Commissioning Residential Ventilation Systems: A Combined Assessment of Energy and Air Quality Potential Values.

3. Brown DW. 2008. Economic value of disability-adjusted life years lost to violence: estimates for WHO Member States. Rev. Panam Salud Publica, 24, 203-209.

4. Lvovsky K, Huges G, Maddison D, Ostro B, and Pearce D. 2000. Environmental costs of fossil fuels: a rapid assessment method with application to six cities. Washington,D.C.: The World Bank Environment Department.

5. Highfill T and Bernstein E. 2014. Using Disability Adjusted Life Years to Value the Treatment of Thirty Chronic Conditions in the U.S. from 1987-2010. U.S. Department of Commerce Bureau of Economic Analysis WP 2014-9.

Cost Impact: Will increase the cost of construction
The incremental cost of a whole-house mechanical ventilation system can be as low as $70, based on the incremental cost of an ENERGY STAR versus an entry-level exhaust fan. This cost is very small when compared to the estimated $300 billion annual cost of negative health effects from poor residential indoor air quality.[1,2,3,4,5]

CE144-16 : C403.2.6.3 (NEW)-MOORE11065

CE145-16

IECC: C403.2.7.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

C403.2.7 Energy recovery ventilation systems. Where the supply airflow rate of a fan system exceeds the values specified in Tables C403.2.7(1) and C403.2.7(2), the system shall include an energy recovery system. The energy recovery system shall have the capability 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 which permit operation of the economizer as required by Section C403.3.

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 at least one of the following features:
    - 2.1. Variable-air-volume ~~hood~~ laboratory exhaust and room supply systems capable of reducing exhaust and makeup ~~air volume~~ airflow rates or that incorporate a heat recovery system to ~~50 percent or less of design values.~~ precondition makeup air from laboratory exhaust that meet the following:
        - 2.1. A + B x (E/M)≥ 50%
            - 2.1.1. A is the percentage that the exhaust makeup airflow rates can be reduced from design conditions.
            - 2.1.2. B is the percentage of sensible recovery effectiveness or the change in dry-bulb temperature of the outdoor air supply divided by the difference between the outdoor air and return air dry-bulb temperatures expressed as a percentage.
            - 2.1.3. E is the exhaust airflow rate through the heat recovery device at design conditions.
            - 2.1.4. M is the makeup airflow rate of the system design conditions.
    - 2.2. Direct makeup (auxiliary) air supply equal to at least 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, no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. Variable-air-volume laboratory exhaust and room supply systems that are required to have minimum circulation rates to comply with code or accreditiation standards shall be capable of reducing zone exhaust and makeup airflow rates to the regulated minimum circulation values or the

minimum required to maintain pressurization relationship requirements. Nonregulated zones shall be capable of reducing exhaust and makeup airflow rates to 50% of the zone design values or the minimum required to maintain pressurization relationship requirements.

4. Systems serving spaces that are heated to less than 60°F (15.5°C) and are not cooled.
5. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy.
6. Heating energy recovery in Climate Zones 1 and 2.
7. Cooling energy recovery in Climate Zones 3C, 4C, 5B, 5C, 6B, 7 and 8.
8. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.
9. 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.
10. Systems expected to operate less than 20 hours per week at the *outdoor air* percentage covered by Table C403.2.7(1).
11. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
12. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.

Reason: The current language in the IECC is similar to past language in ASHRAE 90.1. This language had a short coming in that it did not provide adequate alternatives for laboratory designs to comply w ith. Effectively, in most applications the only means of compliance w as to achieve a 50% airflow rate reduction. Limiting the amount of cooling to no less than 3 degree F below space temperature does not provide dehumidification capability in humid climates. Also, complying w ith the intial charging requirement of 50% change in enthalpy of the outside air relative to the return air is limited to total energy recovery devices (i.e. dessicant w heels). The proposed language recognizes common design practices for laboratory w here both variable air volume and sensible energy recovery (run-around loops utilizing a coil in the outside air intake and coil in the exhaust air stream w ith glycol solution circulated betw een the tw o coils), w hich is addressed by option 1. Also it recognized applications w ith low air change rates w here airflow rate turndow n is very limited, w hich is addressed by the 3rd option

Cost Impact: Will not increase the cost of construction
This proposals allow s for alternatives for the requirement therefore increases flexibility and does not increase the cost of construction.

CE145-16 : C403.2.7-FERGUSON12888

CE146-16

IECC: C403.2.9 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Add new text as follows:

C403.2.9 Laboratory exhaust systems Buildings with laboratory exhaust systems having a total exhaust rate greater than 5,000 cfm shall be provided with not less than one of the following:

1. A VAV laboratory exhaust and room supply system capable of reducing exhaust and makeup air flow rates to the minimum required by the *International Mechanical Code*
2. A VAV laboratory exhaust and room supply system capable of reducing exhaust and makeup air flow rates by not less than 50 percent of design condition.
3. A heat recovery system to precondition makeup air from laboratory exhaust with a *sensible recovery effectiveness of not less than 50 percent.*
4. Direct makeup auxiliary air supply that is not less than 75 percent of the exhaust air flow rate and that is not heated above room setpoint or cooled below room setpoint and that does not utilize non-adiabatic humidification.

Reason: As currently written there are three (3) options to reduce energy for laboratory exhaust systems for systems larger than 15,000 cfm. One method is the ability to reduce exhaust and makeup air flow rates by at least 50%. This is the most utilized method for compliance however some designs (i.e. those with minimal exhaust hoods and equipment loads) have relatively low design airflow rates and turning down the airflow rates by 50% result in air changes that are extremely low and in some cases below levels required by accredited standards. Another method for compliance required a minimum 50% total heat recovery effectiveness which in most cases cannot be achieved by a run-around loop which is the predominant method of heat recovery for lab exhaust systems. The last method for compliance cannot be utilized for systems that must have dehumidification capability and as a result is not able to be utilized in many climate zones. In addition to revising these requirements the working group had consensus that the 15,000 cfm threshold should be reduced to 5,000 cfm in that systems of this size still represent multi hood and/or multi zone spaces and the components utilized in 5,000 cfm systems are normally the same type of components utilized in 15,000 cfm and larger systems.
During the last code cycle there were some issues raised on this proposal (CE 227) due to the possibility of a lab that meets requirement 3 (uses heat recovery to precondition makeup air from lab exhaust) that gets repurposed into a lab that deals with toxic fumes/substances. In that situation, there is a potential for lab exhaust to be recirculated into the space with some heat recovery devices.

However, this is specifically not permitted by Section 510.4 of the IMC as the system would now be a hazardous exhaust system. That section states "Hazardous exhaust systems shall not share common shafts with other duct systems, except where such systems are hazardous exhaust systems originating in the same fire area. "

This provision would prevent the concern raised during the previous code cycle for this type of system.

Cost Impact: Will not increase the cost of construction
This will not increase the cost of construction as it clarification one option for compliance.

CE146-16 : C403.2.9 (NEW)-FERGUSON11746

CE147-16

Part I:
C202 (New), C403.2.9
Part II:
R202 (New) [IRC N1101.6 (New)], R403.3.1 (IRC N1103.3.1)

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

Proponent : Jay Peters, representing AQC Industries / TheBlueDuct (peters.jay@me.com)

Part I

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

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:

C403.2.9 Duct and plenum insulation and sealing. Supply and return air ducts and plenums shall be insulated with a minimum of R-6 insulation where located in unconditioned spaces and where located outside the building with a minimum of R-8 insulation in *Climate Zones* 1 through 4 and a minimum of 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*. Where located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by a minimum of R-8 insulation in *Climate Zones* 1 through 4 and a minimum of 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*.

Part II

2015 International Energy Conservation Code

R202 (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 (N1103.3.1) Insulation (Prescriptive). Supply and return ducts in attics shall be insulated to a minimum of R-8 where 3 inches (76 mm) in diameter and greater and R-6 where less than 3 inches (76 mm) in diameter. Supply and return ducts in other portions of the building shall be insulated to a minimum of R-6 where 3 inches (76 mm) in diameter or greater and R-4.2 where less than 3 inches (76 mm) in diameter. Ducts buried beneath a building shall be insulated to an R-value of not less than R-8 where 3 inches (76 mm) in diameter and greater and R-6 where less than 3 inches (76 mm) in diameter or shall maintain an equivalent *thermal distribution efficiency.*

> **Exception:** Ducts or portions thereof located completely inside the ~~*building thermal envelope.*~~ building thermal envelope.

Reason:

Ducts located under a building are subjected to different conditions than those within attics or crawlspaces and this proposal attempts to address them.Temperatures are rarely (almost never) as extreme in underground locations as they are in attics. ***Thermal Distribution Efficiency (TDE)*** is a valid method for proving the true efficiency of an underground duct system. This is the most relevant thermal test because it directly measures what ultimately impacts the energy cost - the difference between the entering and leaving temperature of air as it moves through the ducting system. Determining the thermal distribution efficiency (TDE) of air ducts constructed of different materials and insulated with different types or thicknesses of insulating materials is relevant to current technologies.

Historically, in order to assure sufficient thermal efficiency of traditionally un-insulated underground ducts, separate insulating boards with known R-Values per ASTM C518 were commonly placed in the excavated trenches, and loosely surrounding the ductwork. This was normally ineffective, but with the advent of pre-insulated underground ductwork, an improved thermal performance was provided by integrating insulating properties directly into the factory built underground ductwork. The challenge then became to measure and compare thermal efficiencies of separately/loosely-insulated round ductwork with pre-insulated ductwork, because measuring thermal performance with round surfaces, dynamic air flows, effects of convective, radiative and conductive heat transfer, the effects of thermal mass, etc., all added to the complexity well beyond the simple R-Value measure provided by the overly simple ASTM C518 test procedure. One method of scientifically measuring the TDE and certifying the value is through the NSF Protocol P374. This Protocol P 374 was created as a method to assure equivalent thermal efficiency in comparison among all approaches and systems being used, measuring what was really intended by the code, performance.

The ASTM C518 standard for an added duct insulation value does not address new and innovative products that combine duct and insulation in one product. The ASTM C518 test is designed for static, no air movement, conditions of flat insulation. In contrast, the NSF protocol P374 was developed to test air ducts insulation value with dynamic, air movement, conditions which better represents the usage of any product including new and innovative materials. Also, this test accounts for ducts of shapes other than flat (round, etc.) where the ASTM C518 test does not.

NSF International has stated that it stands firmly behind the technical and scientific merit of NSF Protocol P374 and that it allows for a true measurement of the duct's overall performance and ability to meet the intent of the model codes. It is a far superior method to determine the code's actual intent by taking important considerations into account that the ASTM 518 cannot measure when determining the thermal performance of underground ducts. With this in mind, it is imperative to recognize the TDE as an option for cutting edge products to meet the intent of the code.

Cost Impact:

Part I: Will not increase the cost of construction
This could actually decrease the cost of construction by allowing for a true scientific test of the duct's performance and possibly removing unnecessary and arbitrary insulation requirements in certiain installations.

Part II: Will not increase the cost of construction
This option may actually reduce the cost of construction by allowing duct materials to prove their Thermal Distribution Efficiency in lieu of adding unnecessary and arbitrary insulation requirements in some cases.

CE147-16 : C403.2.9-PETERS13392

CE148-16

IECC: C403.2.9.1.1, C403.2.9.1.2, C403.2.9.1.3.

Proponent : Vickie Lovell, InterCode Incorporated, representing Ductmate Industries (vickie@intercodeinc.com)

2015 International Energy Conservation Code

Revise as follows:

C403.2.9.1.1 ~~Low-pressure duct systems.~~ Duct Sealing 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), mastic-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.~~

Delete without substitution:

~~**C403.2.9.1.2 Medium-pressure duct systems.** 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 C403.2.9. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the *International Mechanical Code*.~~

Revise as follows:

~~C403.2.9.1.3~~ C403.2.9.1.2 ~~High-pressure duct systems~~ Duct testing. Ducts and plenums designed to operate at static pressures greater than 3 inches water gauge (747 Pa) ~~shall be insulated and sealed in accordance with Section C403.2.9. 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 at least 25 percent of the duct area have been tested and that all tested sections comply with the requirements of this section.

Reason: This proposal is intended to clean up the commercial energy section on duct sealing. The current language is redundant in places, and it does not provide straightforward guidance on how ducts are to be sealed. This proposal removes redundancies and unnecessary text, cleans up an incorrect pointer and makes the section more user-friendly.

1. The IECC requires duct sealing regardless of the pressure inside the duct as stated in C403.2.9.
2. The IECC does not make any distinction between the types of duct systems based on the pressure inside the duct. There is no need for these subsections.

3. The pointer in C403.2.9.1.3 to C403.2.8 for "duct insulation and sealing" of high pressure duct systems has been removed. C403.2.9.1.3 sends the code user there for information on insulation and sealing, but the information is not there. It is in this section - C403.2.9, not C403.2.8.
4. The requirements for duct and plenum insulation have been removed from this section because it is already covered in C403.2.9.
5. The requirement that says all pressure classifications specific to the duct system shall be indicated on the construction documents is in all three of the current subsections dealing with duct pressure. This requirement has been moved to the charging section and is still applicable to all types of duct systems.
6. The exception for joints and seams has been deleted because the code user is directed to go to the Mechanical Codes for that information.
7. This proposed language is consistent with the language for duct sealing in ASHRAE 90.1.

Cost Impact: Will not increase the cost of construction
This proposal does not increase the cost of construction because this is only reorganization of existing text.

CE148-16 : C403.2.9.1.1-LOVELL12429

CE149-16

IECC: C403.2.9.1, C403.2.9.1.3.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

C403.2.9.1 Duct construction. Ductwork shall be constructed and erected in accordance with the *International Mechanical Code*.

Revise as follows:

C403.2.9.1.3 High-pressure duct systems. 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 C403.2.9. 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 at least 25 percent of the duct area have been tested and that all tested sections comply with the requirements of this section.

Reason: Section C403.2.9.1 has a gap with respect to whether a duct system with the exact static pressure of 3 inches of w.g. is a medium or high pressure duct. Traditional practice is to consider 3 inches w.g. or greater treats these within the high pressure category. This is a 'gap' that has been in the code since 2009. The fix should be considered editorial.

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction

No cost impact is expected as the change is primarily editorial clarification as to the appropriate category of regulation that applies to ducts with exactly 3 inches w.g. pressure.

CE149-16 : C403.2.9.1.3-COLLINS11457

CE150-16
IECC: C403.2.12.1.
Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code
Revise as follows:

TABLE C403.2.12.1 (2)
FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT

DEVICE	ADJUSTMENT
Credits	
~~Fully ducted return and/or exhaust air systems~~ Return air or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms	0.5 inch w.c. (2.15 in w.c. for laboratory and vivarium systems)
Return and/or exhaust airflow control devices	0.5 inch w.c.
Exhaust filters, scrubbers or other exhaust treatment	The pressure drop of device calculated at fan system design condition
Particulate filtration credit: MERV 9 thru 12	0.5 inch w.c.
Particulate filtration credit: MERV 13 thru 15	0.9 inch. w.c.
Particulate filtration credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2x clean filter pressure drop at fan system design condition.
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition.
Biosafety cabinet	Pressure drop of device at fan system design condition.
Energy recovery device, other than coil runaround loop	~~(2.2 × energy recovery effectiveness) – 0.5 inch w.c. for each airstream.~~ For each airstream (2.2 * Energy Recovery

	Effectiveness – 0.5 in)
Coil runaround loop	0.6 inch w.c. for each airstream.
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design conditions.
Sound attenuation section (fans serving spaces with design background noise goals below NC35)	0.15 inch w.c.
Exhaust system serving fume hoods	0.35 inch w.c.
Laboratory and vivarium exhaust systems in high-rise buildings	0.25 inch w.c./100 feet of vertical duct exceeding 75 feet.
Deductions	
Systems without central cooling device	- 0.6 in. w.c.
Systems without central heating device	- 0.3 in. w.c.
Systems with central electric resistance heat	- 0.2 in. w.c.

For SI: 1 inch w.c. = 249 Pa, 1 inch = 25.4 mm.

w.c. = water column, NC = Noise criterion.

Reason: This proposal makes changes to be consistent with addenda G and Q to 90.1-2013.
The wording in the 2015 IECC regarding the fan power pressure drop limitation adjustment can be interpreted in two ways. This change is intended to clarify which equation is the one that that was originally used in the economic analysis performed in the development of ASHRAE 90.1 upon which this provision in the IECC is based. This change was made via addendum g to ASHRAE Standard 90.1-13.There is no cost impact of this proposal as it's a clarification of the equation.

The proposed change related to addednum q limits the systems that can take advantage of the fan power pressure allowance for fully ducted return and/or exhaust air systems. For example, a rooftop unit with a ducted return in a small commercial office building or with a concentric diffuser currently qualifies for the fully ducted fan power credit, but would not if this proposed change is approved. The change recognizes that common practice is to use a plenum return with lower pressure drop than a fully ducted return system. Where there is an accreditation or pressure maintenance need to use ducted returns the credit is allowed. Where a designer wishes to use a ducted return in other situations, it can be accommodated by increasing fan efficiency or improving ductwork design.

Cost Impact: Will not increase the cost of construction
Generally, a plenum return is a lower cost construction option and is typically used in most building design. Where a ducted return is required for accreditation or pressure maintenance, there is no change in requirements. In the case where a designer elects to use a higher cost ducted return outside the excepted conditions, that choice of a higher cost system does incur additional costs for larger ductwork or a higher efficiency fan; however, selection of

that higher cost path (ducted return vs. a plenum return) is the option of the designer and not a requirement of the energy code. Based on this, no added cost is estimated for this proposal.

CE150-16 : TABLE C403.2.12.1-FERGUSON11736

CE151-16

IECC: C403.2.3.

Proponent : Frank Morrison, representing Baltimore Aircoil Company (fmorrison@baltimoreaircoil.com); Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE C403.2.3 (8)
MINIMUM EFFICIENCY REQUIREMENTS: HEAT REJECTION EQUIPMENT

EQUIPMENT TYPE[a]	TOTAL SYSTEM HEAT REJECTION CAPACITY AT RATED CONDITIONS	SUBCATEGORY OR RATING CONDITION[i]	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	CTI ATC-105 and CTI STD-201 RS
Centrifugal fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥ 20.0 gpm/hp	CTI ATC-105 and CTI STD-201 RS
Propeller or axial fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 14.0 gpm/hp	CTI ATC-105S and CTI STD-201 RS
Centrifugal fan closed- circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 7.0 gpm/hp	CTI ATC-105S and CTI 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·hp	CTI ATC-106
Centrifugal fan evaporative	All	Ammonia Test Fluid 140°F entering gas temperature	≥ 110,000 Btu/h·hp	CTI ATC-106

condensers		96.3°F condensing temperature 75°F entering wb		
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·hp	CTI ATC-106
Centrifugal 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·hp	CTI 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·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 listed in Table 403.2.3(8) divided by the fan nameplate-rated motor power.

c. 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 listed in Table 403.2.3(8) 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 and/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.

Reference standards type: This is an update to reference standard(s) already in the ICC Code Books

Add new standard(s) as follows:

Cooling Technology Institute (CTI)

2611 FM 1960 West, Suite A-101, Houston, TX 77068-3730; P.O. Box 73383, Houston, TX

77273-3383
Referenced Standards:

CTI STD-201 RS (15) Performance Rating of Evaporative Heat Rejection Equipment

CTI STD-201 OM (15) Operations Manual for Thermal Performance Certification of Evaporative Heat Rejection Equipment

Reason: Reference to CTI Standard 201 in Table C403.2.3 (8), Minimum Efficiency Requirements: Heat Rejection Equipment, has been updated. The standard has been divided into Standard 201 RS and Standard 201 OM. Standard 201 RS sets forth a program whereby the Cooling Tower Institute will certify that all models of a line of evaporative heat rejection equipment offered for sale by a specific manufacturer will perform thermally in accordance with the manufacturer's published ratings. Standard 201 OM is a manual to guide program participants in complying with the provisions of the latest edition of Standard 201 RS. Taken together, STD-201 RS (15) and STD-201 OM (15) are functionally equivalent to the original STD-201.

For the purpose of this table, STD-201 RS and either CTI ATC-105 (Acceptance Test Code for open circuit cooling towers) or CTI ATC-105S (Acceptance Test Code for closed circuit cooling towers) are the proper reference standards for rating and testing this equipment. References to the appropriate test codes (ATC-105 and ATC-105S) remain unchanged. The Section on References should also be updated to reflect this change to STD-201. STD-201 OM, the Operating Manual for the CTI Thermal Certification Program, can also be added to the Informative Reference Section if applicable.

Finally, note that all referenced CTI Standards included in the IECC have been developed using the consensus procedure outlined in the CTI Operating Procedure 304 (copy attached).

Cost Impact: Will not increase the cost of construction
This change will not increase the cost of construction; change updates table to the most recent CTI Standard for Performance Rating.

CE151-16 : TABLE C403.2.3-MORRISON10554

CE152-16

IECC: C403.2.3.

Proponent : Frank Morrison (fmorrison@baltimoreaircoil.com); Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE C403.2.3 (8)
MINIMUM EFFICIENCY REQUIREMENTS: HEAT REJECTION EQUIPMENT

EQUIPMENT TYPE[a]	TOTAL SYSTEM HEAT REJECTION CAPACITY AT RATED CONDITIONS	SUBCATEGORY OR RATING CONDITION[i]	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	CTI ATC-105 and CTI STD-201
Centrifugal fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥ 20.0 gpm/hp	CTI ATC-105 and CTI STD-201
Propeller or axial fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ ~~14.0~~15.4 gpm/hp	CTI ATC-105S and CTI STD-201
Centrifugal fan closed- circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 7.0 gpm/hp	CTI ATC-105S and CTI STD-201
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·hp	CTI ATC-106
Centrifugal fan evaporative	All	Ammonia Test Fluid 140°F entering gas temperature 96.3°F condensing temperature	≥ 110,000 Btu/h·hp	CTI ATC-106

condensers		75°F entering wb		
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·hp	CTI ATC-106
Centrifugal 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·hp	CTI 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·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 listed in Table 403.2.3(8) divided by the fan nameplate-rated motor power.

c. 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 listed in Table 403.2.3(8) 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 and/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.

Reason: Evaporatively cooled heat rejection devices are a key part of the most efficient cooling systems on the market. An increase in the minimum efficiency of closed circuit axial fan cooling towers from the current 14.0 gpm/HP to 15.4 gpm/HP (at the rated condition of 102°F entering water temperature, 90°F leaving water temperature, and 75°F entering wet bulb temperature), a 10% increase, is proposed to further increase the overall system efficiency, taking advantage of technological advances by the Industry. Such an increase will remove lower efficiency models from the market without unnecessarily causing market shifts due to first cost pressures in the absence of a limitation on the use of lower efficiency systems in the Code.

Note that this is a consensus based proposal supported by the ASHRAE TC 8.6 Working Group on Codes and Standards. ASHRAE Technical Committee 8.6 is concerned with open circuit cooling towers, closed circuit cooling towers, evaporative condensers, spray ponds, and other types of contact type liquid to air exchangers as well as the optimal use of these devices in various cooling systems in Commerical, Industrial, Refrigeration, Process, and Power applications, including the associated water treatment requirements.

Cost Impact: Will not increase the cost of construction
The impact of having to select more energy efficient models will have a negligible effect on the cost of construction.

CE152-16 : TABLE C403.2.3-MORRISON12658

CE153-16

IECC: C403.2.3.

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

2015 International Energy Conservation Code

Revise as follows:

TABLE ~~C403.2.3~~ C403.2.3(4) (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	—	~~78%~~80% AFUE or 80%E_t[c]	DOE 10 CFR Part 430 or ANSI Z21.47
	≥ 225,000 Btu/h	Maximum capacity[c]	80%E_t[f]	ANSI Z21.47
Warm-air furnaces, oil fired	< 225,000 Btu/h	—	~~78%~~83% AFUE or 80%E_t[c]	DOE 10 CFR 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_c	ANSI Z83.8
Warm-air unit heaters, gas fired	All capacities	Maximum capacity[b]	80%E_c	ANSI Z83.8
Warm-air unit heaters, oil fired	All capacities	Maximum capacity[b]	80%E_c	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_c = 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.

Reason: New (and increased) federal minimum efficiency standards went into effect for residential oil-fired warm-air furnaces in May, 2013. New and increased federal minimum efficiency standards for residential gas-fired warm-air furnaces went into effect in November, 2015.
This proposal updates the table to reflect the new minimum federal standards.

More information about the new federal standards can be found at the following DOE web site:

https://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/72

The AFUE of residential furnaces shall not be less than the following starting on the compliance date shown in the table:

Table 2. Energy Conservation Standards for Non-Weatherized Furnaces and Weatherized Gas and Oil-Fired Furnaces

Furnace Product Class	AFUE[1] (percent)	Compliance Date
(A) Non-weatherized gas furnaces (not including mobile home furnaces)	80	November 19, 2015
(B) Mobile Home gas furnaces	80	November 19, 2015
(C) Non-weatherized oil-fired furnaces (not including mobile home furnaces)	83	May 1, 2013

Cost Impact: Will increase the cost of construction
The furnaces that meet the new federal standards have a higher initial cost than the furnaces that met the previous standards. However, the furnaces that meet the new standards will have a lower operating cost.

CE153-16 : TABLE C403.2.3-ROSENSTOCK11752

CE154-16

IECC: C403.2.3.

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

2015 International Energy Conservation Code

Revise as follows:

TABLE ~~C403.2.3~~ C403.2.3(5) (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]	~~80%~~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_c	
	Oil-fired[c]	< 300,000 Btu/h[g]	~~80%~~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_c	
Boilers, steam	Gas-fired	< 300,000 Btu/h[f]	~~75%~~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	

		< 300,000 Btu/h	~~80%~~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.

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_c = 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.

Reason: As a result of the Energy Independence and Security Act of 2007, updated standards for residential boilers were implemented for products that were manufactured (or imported) as of September 1, 2012. In addition to the increased AFUE requirements, other design and control requirements were added to the federal standard. These other requirements are reflected in new footnotes f and g.
This proposal ensures that the table reflects the current minimum federal standards and design requirements for residential products that may be used in commercial buildings.

Cost Impact: Will increase the cost of construction
The boilers that meet the most recent federal efficiency standards and design requirements will have higher initial costs than the boilers that met the previous federal standards. However, they will have lower annual energy costs than the products meeting the previous standards.

CE154-16 : TABLE C403.2.3-ROSENSTOCK11759

CE155-16

IECC: C403.2.7.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE ~~C403.2.7~~ C403.2.7(1) (1)
ENERGY RECOVERY REQUIREMENT (Ventilation systems operating less than 8,000 hours per year)

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	≥10% and	≥ 20% and	≥ 30% and	≥ 40% and 50%	≥ 50% and 60%	≥ 60% and 70%	≥ 70% and 80%	≥ 80%
	DESIGN SUPPLY FAN AIRFLOW RATE (cfm)							
3B, 3C, 4B, 4C, 5B	NR	NR	NR	NR	NR	NR	NR	NR
1B, 2B, 5C	NR	NR	NR	NR	≥ 26,000	≥ 12,000	≥ 5,000	≥ 4,000
6B	≥ 28,000	≥ 26,5000	≥ 11,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,500	≥ 1,500
1A, 2A, 3A, 4A, 5A, 6A	≥ 26,000	≥ 16,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,000	≥ 1,000	> 120
7, 8	≥ 4,500	≥ 4,000	≥ 2,500	≥ 1,000	> 140	> 120	> 100	> 80

For SI: 1 cfm = 0.4719 L/s.

NR = Not Required.

TABLE ~~C403.2.7~~ C403.2.7(2) (2)
ENERGY RECOVERY REQUIREMENT (Ventilation systems operating not less than 8,000 hours per year)

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	≥ 10% and	≥ 20% and	≥ 30% and	≥ 40% and	≥ 50% and	≥ 60% and	≥ 70% and	≥ 80%
	Design Supply Fan Airflow Rate (cfm)							

3C	NR	NR	NR	NR	NR	NR	NR	NR
1B, 2B, 3B, 4C, 5C	NR	≥ 19,500	≥ 9,000	≥ 5,000	≥ 4,000	≥ 3,000	≥ 1,500	~~>~~≥ 120
1A, 2A, 3A, 4B, 5B	≥ 2,500	≥ 2,000	≥ 1,000	≥ 500	~~>~~≥ 140	~~>~~≥ 120	~~>~~≥ 100	~~>~~≥ 80
4A, 5A, 6A, 6B, 7, 8	~~>~~≥ 200	~~>~~≥ 130	~~>~~≥ 100	~~>~~≥ 80	~~>~~≥ 70	~~>~~≥ 60	~~>~~≥ 50	~~>~~≥40

For SI: 1 cfm = 0.4719 L/s.

NR = Not required

Reason: This addendum increases the minimum ERV requirements from zero to a reasonable minimum size for smaller units. There are small HVAC units (for example, PTACS in apartment buildings) w here energy recovery is currently required w ith very small amounts of supply air. With this addendum, the supply air requirements at various outside air fractions are reduced so at least 40 cfm of outside air is available for recovery for continuous ventilation systems in the coldest climate zones. This airflow limit matches the smallest typical ERV unit available and ventilation requirements for residential units larger than 500 square feet, representing about tw o-thirds of the multi-family units (https://w w w .census.gov/construction/chars/mfu.html). There continues to be a requirement for most dw elling units to have energy recovery in the colder climates. In w armer climates, a larger unit is used as

Cost Impact: Will not increase the cost of construction
There is no increased cost, as the need for heat recovery on smaller units is eliminated.

CE155-16 : TABLE C403.2.7-FERGUSON13101

CE156-16

IECC: C403.3, C403.3.3, C403.3.4.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C403.3 Economizers (Prescriptive). ~~Each cooling system~~
<u>Economizers</u> shall ~~include either an air or water economizer complying~~ <u>comply</u> with Sections C403.3.1 through C403.3.4

> ~~**Exceptions:** Economizers are not required for the systems listed below.~~
>
> 1. ~~In cooling systems for buildings located in Climate Zones 1A and 1B.~~
> 2. ~~In climate zones other than 1A and 1B, where individual fan cooling units have a capacity of less than 54,000 Btu/h (15.8 kW) and meet one of the following:~~
>   - ~~2.1. Have direct expansion cooling coils.~~
>   - ~~2.2. The total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).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. ~~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.~~
> 4. ~~Systems that serve residential spaces where the system capacity is less than five times the requirement listed in Table C403.3(1).~~
> 5. ~~Systems expected to operate less than 20 hours per week.~~
> 6. ~~Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.~~
> 7. ~~Where the cooling efficiency meets or exceeds the efficiency requirements in Table C403.3(2).~~
> 8. ~~Chilled-water cooling systems that are passive (without a fan) or use induction where the total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).~~
> 9. ~~Systems that include a heat recovery system in accordance with Section C403.4.5.~~

<u>. An air or water economizer shall be provided for the following cooling systems.</u>

<u>1. Chilled water systems with a total cooling capacity, less cooling capacity provided with air economizers, as specified in Table C403.3(1).</u>

<u>2. Individual fan systems with cooling capacity greater than or equal to 54,000 Btu/h in buildings having other than a Group R occupancy, .</u>

<u>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.</u>

3. Individual fan systems with cooling capacity greater than or equal to 270,000 Btu/h 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^{o}F (1.7^{o}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 C403.3(2).
6. Systems that include a heat recovery system in accordance with Section C403.4.5.

C403.3.3 Air economizers. ~~Air~~ Where economizers are required by Section C403.3, air economizers shall comply with Sections C403.3.3.1 through C403.3.3.5.

C403.3.4 Water-side economizers. Where economizers are required by Section C403.3, water-side economizers shall comply with Sections C403.3.4.1 and C403.3.4.2.

Reason: The proposal corrects gaps and conflicts in the economizer provisions which resulted from the confluence of changes approved for the 2015 edition. It attempts to move away from a provision that is dominated by a list of 9 exceptions.
Finally it clarifies that the use of the term 'residential' in the existing exception 4 to be consistent with other provisions of the code such as the building envelope tables which uses the term Group R.

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The intent is editorial correction to existing provisions and changes approved in the 2015 code. The proponent believes there is no impact on the cost of construction. The one potential on impact of cost would depend on local interpretation of the overlap between Exceptions 1 and 2 to Section C403.3 where both Climate Zones 1A and 1B are exempt and Table C403.3(1) where only Climate zone 1A is exempt.

CE156-16 : C403.3-COLLINS11447

CE157-16

Part I:
IECC: C101.4.1, C101.5, C202, C202 (New), C403.3, C406.7, C407.5.1, C407.5.2.3.
Part II:
IECC: R101.4.1, R101.5.

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 ORDERS FOR THESE COMMITTEES.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

Part I

2015 International Energy Conservation Code

Revise as follows:

C101.4.1 Mixed ~~occupancy.~~ Residential and Commercial buildings Where a building includes both r~~*residential*~~ *esidential building* and *commercial building*~~occupancies,~~ portions, each ~~occupancy~~ portion shall be separately considered and meet the applicable provisions of IECC—Commercial Provisions or IECC—Residential Provisions.

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

SECTION 202 DEFINITIONS

STOREFRONT. A ~~nonresidential~~ system of doors and windows mulled as a composite fenestration structure that has been designed to resist heavy use. *Storefront*systems include, but are not limited to, exterior fenestration systems that span from the floor level or above to the ceiling of the same story on commercial buildings, with or without mulled windows and doors.

Add new definition as follows:

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.

Revise as follows:

C403.3 Economizers (Prescriptive). Each cooling system shall include either an air or water economizer complying with Sections C403.3.1 through C403.3.4

Exceptions: Economizers are not required for the systems listed below.

1. In cooling systems for buildings located in Climate Zones 1A and 1B.
2. In climate zones other than 1A and 1B, where individual fan cooling units have a capacity of less than 54,000 Btu/h (15.8 kW) and meet one of the following:
   - 2.1. Have direct expansion cooling coils.
   - 2.2. The total chilled water system capacity less the capacity of fan

units with air economizers is less than the minimum specified in Table C403.3(1).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. 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.
4. Systems that serve ~~residential~~ Group R occupancy spaces where the system capacity is less than five times the requirement listed in Table C403.3(1).
5. Systems expected to operate less than 20 hours per week.
6. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.
7. Where the cooling efficiency meets or exceeds the efficiency requirements in Table C403.3(2).
8. Chilled-water cooling systems that are passive (without a fan) or use induction where the total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).
9. Systems that include a heat recovery system in accordance with Section C403.4.5.

C406.7 Reduced energy use in service water heating. Buildings shall 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~~: Buildings with residential occupancies~~.
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.

TABLE C407.5.1 (2)
HVAC SYSTEMS MAP

CONDENSER COOLING SOURCE[a]	HEATING SYSTEM CLASSIFICATION[b]	STANDARD REFERENCE DESIGN HVC SYSTEM TYPE[c]		
		Single-zone Residential System	Single-zone Nonresidential System	All Other
Water/ground	Electric resistance	System 5	System 5	System 1
	Heat pump	System 6	System 6	System 6
	Fossil fuel	System 7	System 7	System 2

Air/none	Electric resistance	System 8	System 9	System 3
	Heat pump	System 8	System 9	System 3
	Fossil fuel	System 10	System 11	System 4

a. Select "water/ground" where the proposed design system condenser is water or evaporatively cooled; select "air/none" where the condenser is air cooled. Closed-circuit dry coolers shall be considered air cooled. Systems utilizing district cooling shall be treated as if the condenser water type were "water." Where no mechanical cooling is specified or the mechanical cooling system in the proposed design does not require heat rejection, the system shall be treated as if the condenser water type were "Air." For proposed designs with ground-source or groundwater-source heat pumps, the standard reference design HVAC system shall be water-source heat pump (System 6).

b. Select the path that corresponds to the proposed design heat source: electric resistance, heat pump (including air source and water source), or fuel fired. Systems utilizing district heating (steam or hot water) and systems with no heating capability shall be treated as if the heating system type were "fossil fuel." For systems with mixed fuel heating sources, the system or systems that use the secondary heating source type (the one with the smallest total installed output capacity for the spaces served by the system) shall be modeled identically in the standard reference design and the primary heating source type shall be used to determine *standard* reference design HVAC system type.

c. Select the standard reference design HVAC system category: The system under "single-zone residential system" shall be selected where the HVAC system in the proposed design is a single-zone system and serves a ~~residential space~~ Group R occupancy. The system under "single-zone nonresidential system" shall be selected where the HVAC system in the proposed design is a single-zone system and serves other than ~~residential spaces~~ Group R occupancies. The system under "all other" shall be selected for all other cases.

C407.5.2.3 ~~Multifamily residential~~ Group R-2 occupancy buildings. ~~Residential~~ Group R-2 occupancy spaces shall be modeled using one thermal block per space except that those facing the same orientations are permitted to be combined into one thermal block. Corner units and units with roof or floor loads shall only be combined with units sharing these features.

Part II

2015 International Energy Conservation Code

Revise as follows:

R101.4.1 Mixed ~~occupancy.~~ Residential and Commercial buildings Where a building includes both *residential* building and *commercial* building ~~occupancies~~ portions, each ~~occupancy~~ portion shall be separately considered and meet the applicable provisions of the IECC —Commercial Provisions or IECC—Residential Provisions.

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

Reason: The code is split in Commercial and Residential halves. The definitions of commercial buildings and residential buildings rely on the occupancy categories found in the IBC. While used in the Commercial provisions the terms 'Group R' and 'residential' are not defined. Group R occupancies can occur in a building defined as a Commercial Building. Non-residential occupancies can not, by definition, occur in a Residential Building. People with an IBC background – when using the IECC-C and encountering the word 'residential' are likely to consider one of the Group R occupancies. People with an ASHRAE background, on the other hand, will also include such things as nursing home rooms and hospital patient rooms as 'residential'. The result is inconsistent application.
This proposal would end the issue by defining 'Group R' as those having one of the IBC Group R occupancies that can occur in a Commercial building and then it either removes or replaces the word 'residential' in various provisions. Group R is already used in various places in the code, most notably the building envelope (insulation) assembly tables.

Specific amendments:

1. The definitions of entrance door and storefront (a type of door) both have the word 'nonresidential' removed. The truth is these types of doors are often found on Group R buildings such as hotels and larger apartment buildings. Removal of the term 'non-residential' will not change how the fenestration industry considers these doors.

2. Section C101.4.1 and R101.4.1 are both now titled Mixed occupancy - but the discussion is not about mixed occupancy as someone used to the IBC would consider a mixed occupancy, but is addressing when a building might meet the definitions of Residential Building and Commercial Building. This controls which half of the code is used - not provisions within each half of the code.

3. Section C406.7: The text is removed because it is redundant. Group R-2 buildings are residential occupancy buildings.

4. C407.5.2.3 In this case the term Multifamily residential building appeared to be applying to Group R-2 apartments and not other types of residential occupancy. If the committee believes this applies to hotels, motels and Group R-4 care facilities - then the term Group R should be used instead of Group R-2.

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The intent of the proposal is editorial in nature. To the extent that people had previously interpreted 'residential' to apply to hospital patient room and nursing home sleeping units, there may be some increase in cost for envelope insulation or HVAC systems.

Analysis: This proposal does not impact Chapter 11 of the IRC.

CE157-16 : C403.3-COLLINS11666

CE158-16

IECC: C403.3.

Proponent : Kent Browning, KWR Engineering Services LLC, representing KWR Engineering Services LLC (kwr-services@engineer.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE 403.3(2)
EQUIPMENT EFFICIENCY PERFORMANCE EXCEPTION FOR ECONOMIZERS

CLIMATE ZONES	COOLING EQUIPMENT PERFORMANCE IMPROVEMENT (EER OR IPLV)
2A, 2B	10% efficiency improvement
3A, 3B	15% efficiency improvement
4A, 4B	20% efficiency improvement

Reason: This change proposal is to allow the prescriptive economizer to be replaced by more efficient cooling equipment in moist climates (climate zone suffix A) just as they are currently allowed in dry climates (climate zone suffix B). Table C403.3(2) is revised to add the moist climate zones to the existing dry climate zones.
Currently, the IECC allows a required economizer to be replaced with more efficient cooling equipment, but only in dry climate zones (suffix B). Generally, there are more available hours for ecomonical economizer operation in dry climates (suffix B) than there are in moist climate zones (suffix A). For example, the TMY3 (Typical Meteorological Year 1991-2005) data shows that Austin, TX (climate zone 2A) has 2030 hours at 50F > Tdb > 65F when the dew point is less than 55F. Phoenix AZ (climate zone 2B) has 2165 hours at those conditions. Dallas Tx (climate zone 3A) has 1432 hours while Midland TX (climate zone 3B) has 1796 hours at those conditions. The locations and set points can be argued but the trend is consistent - Dry climate zones are better suited to the economizer function. Unfortunately, the IECC curently only allows the economizer to be replaced with more efficient equipment where the economizer is most useful (in dry climates). It would be more energy efficient to allow the economizer to be replaced by more efficient equipment in moist climate zones where the economizer is less useful.

Additionally, in moist climates many service technicians will disable the economizer as the first step of troubleshooting. Once disabled, the economizers are rarely re-enabled. The result is many economizers do not function after the first service call. Conversely, higher efficiency equipment will alway reduce energy consumption, even after servicing. It would save more energy to allow the economizer to be replaced by more energy efficient equipment.

The fault detection and monitoring of the economizer function required in paragraph C403.2.4.7 are a step in the right direction. However, those steps don't help when the same technician that disabled the economizer is the person who monitors the signals.

Bibliography: Typical Meteorological Year 1991-2005 can be found at - http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/by_state_and_city.html

Cost Impact: Will not increase the cost of construction
Allowing the option of more energy efficient cooling equipment instead of an economizer does not increase the cost because the designer / builder / owner has the option of using either alternative. The decision can be made to use the cheaper option - economizer or higher efficiency equipment.

CE158-16 : TABLE C403.3-BROWNING13353

CE159-16

IECC: C403.4.1.1.

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

2015 International Energy Conservation Code

Revise as follows:

TABLE C403.4.1.1
~~EFFECTIVE DATES FOR~~ FAN CONTROL IN COOLING SYSTEMS

COOLING SYSTEM TYPE	FAN MOTOR SIZE	MECHANICAL COOLING CAPACITY
DX cooling	Any	~~≥ 75,000 Btu/h (before 1/1/2016)~~
		≥ 65,000 Btu/h ~~(after 1/1/2016)~~
Chilled water and evaporative cooling	≥ 5 hp	Any
	≥ $^{1}/_{4}$ hp	Any

For SI: 1 British thermal unit per hour = 0.2931 W; 1 hp = 0.746 kW.

Reason: This proposal updates the table based on the requirements in effect as of 1/1/2016. Information on requirements before 1/1/2016 is no longer needed.

Cost Impact: Will not increase the cost of construction
This proposal updates the table based on provisions that were already included in the 2015 IECC.

CE159-16 : TABLE C403.4.1.1-ROSENSTOCK11772

CE160-16

IECC: C403.4.2.3.2, C403.4.2.3.2.1, C403.4.2.3.2.2.

Proponent : Frank Morrison (fmorrison@baltimoreaircoil.com); Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

C403.4.2.3.2 Heat rejection. ~~Heat rejection equipment shall comply with Sections C403.4.2.3.2.1 and C403.4.2.3.2.2.~~
The following shalll 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 cooling tower is used in conjunctionwith a separate heat exchanger to isolate the open-cirucit 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.

Delete without substitution:

~~**C403.4.2.3.2.1 Climate zones 3 and 4.** For *Climate Zones* 3 and 4:~~

1. ~~Where a closed-circuit cooling tower is used directly in the heat pump loop, either an automatic valve shall be installed to bypass all but a minimal flow of water around the tower, or lower leakage positive closure dampers shall be provided.~~
2. ~~Where an open-circuit tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the tower.~~
3. ~~Where an open- or closed-circuit cooling tower is used in conjunction with a separate heat exchanger to isolate the cooling tower from the heat pump loop, then heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop.~~

~~**C403.4.2.3.2.2 Climate zones 5 through 8.** For *Climate Zones* 5 through 8, where an open- or closed-circuit cooling tower is used, a separate heat exchanger shall be provided to isolate the cooling tower from the heat pump loop, and heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop and providing an automatic valve to stop the flow of fluid.~~

Reason:
Heat rejection for a hydronic heat pump loop can be provided by a closed circuit cooling tow er, an open circuit cooling tow er / heat exchanger combination, or an open circuit cooling tow er. This change is justified as the heat rejection requirements for hydronic heat pump systems for all three heat rejection types should apply equally to climate zones 3 through 8, rather than separate requirements for Climate Zones 3 and 4 and Climate Zones 5 through 8. This is because the requirements for all of these climate zones are similar, w ith the intent to minimize heat

loss when the loop is in heating mode in colder weather.

The additional heat exchanger currently called for in C403.4.3.3.2.2 for climate zones 5 through 8 is unnecessary for reducing heat loss for systems utilizing any of the three options for heat rejection mentioned above. This requirement adds substantial, unnecessary cost to such systems, especially the case where a closed circuit cooling tower is utilized (a closed circuit tower combines the functions of a heat exchanger and cooling tower in one compact unit). For the case where an open tower is used without an isolation heat exchanger, there is a requirement for a bypass around the tower to prevent unnecessary heat loss in the proposed text.

Besides correcting the discrepancy in this section, this new language makes the IECC language consistent with ASHRAE/IES 90.1-2010 while at the same time simplifying the code language. As that standard is an alternative path to compliance with the IECC and there is a desire to maintain equivalency of the IECC with Standard 90.1, this issue must be addressed. Note that the requirements for hydronic heat pump heat loss have been in Standard 90.1 for many years and this change will bring the requirements in line with Standard 90.1.

Cost Impact: Will not increase the cost of construction

The code change proposal will not increase the cost of construction. In the case of a closed circuit cooling tower used in a water source heat pump loop, this code change will actually reduce the cost of construction for these systems in Climate Zones 5 though 8 by not requiring an unnecessary isolation heat exchanger. Note that a closed circuit cooling tower combines a heat exchanger and tower in one compact device. Heat loss is minimized by the use of positive closure dampers or by bypassing the flow around the closed circuit cooling tower in climate zones 3 through 8.

CE160-16 : C403.4.2.3.2-MORRISON10569

CE161-16

IECC: C403.4.2.4, C403.4.2.5 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

C403.4.2.4 ~~Part-load~~ Chilled- and hot-water temperature reset controls. ~~Hydronic systems greater than or equal to 500,000~~
Chilled- and hot-water system with a design capacity exceeding 300,000 Btu/h (~~146.5~~ 87.9 kW) in design output capacity supplying heated or chilled water to comfort conditioning systems shall include controls that have the capability to ~~do all~~ automatically reset supply water temperatures by representative building loads or by outdoor air temperature. Where direct digital control is used to control valves, the output shall be reset based on valve position until one valve is completely open or the setpoint limits of the system equipment or application have been reached.

Exceptions: Reset controls are not required under the following conditions:

1. ~~Automatically reset the supply-water temperatures in response to varying building heating and cooling demand using coil valve position, zone-return water temperature, building-return water temperature or outside air temperature. The temperature shall be capable of being reset by not less than 25 percent of the design supply-to-return water temperature difference.~~
2. ~~Automatically vary fluid flow for hydronic systems with a combined motor capacity of 10 hp (7.5 kW) or larger with three or more control valves or other devices by reducing the system design flow rate by not less than 50 percent by designed valves that modulate or step open and close, or pumps that modulate or turn on and off as a function of load.~~
3. ~~Automatically vary pump flow on chilled-water systems and heat rejection loops serving water-cooled unitary air conditioners with a combined motor capacity of 10 hp (7.5 kW) or larger by reducing pump design flow by not less than 50 percent, utilizing adjustable speed drives on pumps, or multiple-staged pumps where not less than one-half of the total pump horsepower is capable of being automatically turned off. Pump flow shall be controlled to maintain one control valve nearly wide open or to satisfy the minimum differential pressure.~~

   ~~**Exceptions:**~~

   1. ~~Supply-water temperature reset for chilled-water systems supplied by off-site district chilled water or chilled water from ice storage systems.~~
   2. ~~Minimum flow rates other than 50 percent as required by the equipment manufacturer for proper operation of equipment where using flow bypass or end-of-line 3-way valves.~~
   3. ~~Variable pump flow on dedicated equipment circulation pumps where configured in primary/secondary design to provide the minimum flow requirements of the equipment manufacturer for proper operation of equipment.~~

1. Where chilled-water supply is already cold, such as chilled water supplied from a district cooling or thermal energy storage system, such that blending would be

required to achieve the reset chilled-water supply temperature

2. Where a specific temperature is required for a process
3. Water temperature reset is not required where valve position is used to comply with Section C403.4.2.5

Add new text as follows:

C403.4.2.5 Variable flow hydronic systems Chilled- and hot-water systems that have three or more control valves designed to modulate or step open and close as a function of load shall be designed for variable flow and shall be capable of reducing pump flow rates to not more than the larger of 25 percent of the design flow or the minimum flow specified by the heating or cooling equipment manufacturer for proper operation. Individual chilled water pumps serving variable flow systems having motors exceeding 5 hp (3.7 kW) shall have controls or devices that can limit pump motor demand to not more than 30 percent of design wattage at 50 percent of design water flow. All controls and devices shall be controlled as a function of desired flow or to maintain a minimum required differential pressure. Differential pressure shall be measured at the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure. The differential pressure setpoint shall be not more than 110 percent of that required to achieve design flow through the heat exchanger. Where differential pressure control is used to comply with this section and direct digital controls are used, the setpoint shall be capable of being automatically reset downward based on valve positions until one valve is wide open.

Exception: Differential pressure setpoint reset is not required where valve position is used to comply with Section C403.4.2.4.

Reason: *This proposal lowers the threshold where temperature reset is required in hydronic systems from 500 MBH to 300 MBH. Variable flow is required for all systems with three or more control valves, not just those with pumping greater than 10 hp. The VSD requirement is changed from combined 10 hp to individual 5 hp motors. Approval of this code change proposal will ensure consistency with ASHRAE Standard 90.1-16, which will be adopted by reference as an alternative path to the 2018 IECC Commercial Provisions. This change was made via addendum ak to ASHRAE Standard 90.1-13.*

Cost Impact: Will increase the cost of construction
The requirement represents standard design practice, in that hydronic systems are generally variable flow and have temperature reset with DDC controls. In some cases 5 or 7.5 hp pumps may require variable speed drives where they were not required before adding between $2625 and $3150 to the project cost (Means 2014). The added cost is expected to be more than offset by electrical savings for these hydronic pumps that run many hours per year.

CE161-16 : C403.4.2.4-FERGUSON11743

CE162-16

IECC: C403.4.2.4, C403.4.2.4 (New).

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

C403.4.2.4 Part-load controls. Hydronic systems greater than or equal to 500,000 Btu/h (146.5 kW) in design output capacity supplying heated or chilled water to comfort conditioning systems shall include controls that ~~have the capability~~ are configured to do all of the following:

1. Automatically reset the supply-water temperatures in response to varying building heating and cooling demand using coil valve position, zone-return water temperature, building-return water temperature or outside air temperature. The temperature shall be capable of being reset by not less than 25 percent of the design supply-to-return water temperature difference.
2. Automatically vary fluid flow for hydronic systems with a combined pump motor capacity of ~~10~~ 2 hp (~~7.5~~ 1.5 kW) or larger with three or more control valves or other devices by reducing the system design flow rate by not less than 50 percent or as required by ~~designed~~ the equipment manufacturer for proper operation of equipment by valves that modulate or step open and close, or pumps that modulate or turn on and off as a function of load.
3. Automatically vary pump flow on heating-water systems, chilled-water systems and heat rejection loops serving water-cooled unitary air conditioners ~~with a combined motor capacity of 10 hp (7.5 kW) or larger by reducing pump design flow by not less than 50 percent, utilizing adjustable speed drives on pumps, or multiple-staged pumps where not less than one-half of the total pump horsepower is capable of being automatically turned off. Pump flow shall be controlled to maintain one control valve nearly wide open or to satisfy the minimum differential pressure.~~

    ~~**Exceptions:**~~

    ~~1. Supply-water temperature reset for chilled-water systems supplied by off-site district chilled water or chilled water from ice storage systems.~~
    ~~2. Minimum flow rates other than 50 percent as required by the equipment manufacturer for proper operation of equipment where using flow bypass or end-of-line 3-way valves.~~
    ~~3. Variable pump flow on dedicated equipment circulation pumps where configured in primary/secondary design to provide the minimum flow requirements of the equipment manufacturer for proper operation of equipment.~~

    as follows:

    6.1. Where pumps operate continuously or operate based on a time schedule, pumps with nominal output motor power of 2 hp or more shall have a variable speed drive.

    6.2. Where pumps have automatic direct digital control configured to operate pumps only when zone heating or cooling is required, a variable speed drive shall be provided for pumps with motors having the same or greater nominal output power indicated in Table C403.4.2.4 based on the climate zone and system served.

7. Where a variable speed drive is required by item 3 of this Section, pump motor power

input shall be not more than 30 percent of design wattage at 50 percent of the design water flow. Pump flow shall be controlled to maintain one control valve nearly wide open or to satisfy the minimum differential pressure.

Exceptions:

1. Supply-water temperature reset is not required for chilled-water systems supplied by off-site district chilled water or chilled water from ice storage systems.
2. Variable pump flow is not required on dedicated coil circulation pumps where needed for freeze protection.
3. Variable pump flow is not required on dedicated equipment circulation pumps where configured in primary/secondary design to provide the minimum flow requirements of the equipment manufacturer for proper operation of equipment.
4. Variable speed drives are not required on heating water pumps where more than 50% of annual heat is generated by an electric boiler.

Add new text as follows:

TABLE C403.4.2.4
VARIABLE SPEED DRIVE (VSD) REQUIREMENTS FOR DEMAND-CONTROLLED PUMPS

CHILLED WATER AND HEAT REJECTION LOOP PUMPS IN THESE CLIMATE ZONES	HEATING WATER PUMPS IN THESE CLIMATE ZONES	VSD REQUIRED FOR MOTORS WITH RATED OUTPUT OF AT LEAST
0a, 0b, 1a, 1b, 2b		≥2 HP
2a, 3b		≥3 HP
3a, 3c, 4a, 4b	7, 8	≥5 HP
4c, 5a, 5b, 5c, 6a, 6b	3c, 5a, 5c, 6a, 6b	≥7.5 HP
	4a, 4c, 5b	≥10 HP
7, 8	4b	≥15 HP
	2a, 2b, 3a, 3b	≥25 HP
	1b	≥100 HP
	0a, 0b, 1a	≥200 HP

[Note (not new code language): Climate Zones 0a and 0b to be included in table above only if another proposal introducing these new very hot climate zones is approved.]

Reason: This proposal reduces the threshold where variable flow and variable speed drives (VSD) are required for pumping systems. The pump threshold is reduced from 10 to 2 hp for continuous operation and time schedule controlled pumps. Pumps that have operation controlled by direct digital control based on zone demand result in a varied threshold based on climate zone. Requirements for heating pump VSDs are added.

Variable flow systems use less pumping energy than constant flow systems. Variable pumping systems also produce larger system temperature differences that can enhance chiller efficiency and condensing boiler efficiency (although these effects are not included in the savings calculations). Variable flow systems can reduce flow either by throttling flow and then having the pump "ride the pump curve" to reduce flow and energy at higher pressure or by using a VSD. Using a variable speed drive provides similar flow control at a lower energy cost, as pressure differential is reduced.

In addition to threshold adjustments, the proposal:

- Restates the minimum flow exception as a condition requirement, removing the exception with the result of the same code requirement.
- An exception for pump flow controls on coils requiring freeze protection is added.
- Adds the words "is not required" to exceptions 1 and 3 to clarify the scope of the exception.

The first and third exceptions had the words "is not required" added to them, Exception 2 was deleted after having the intent added to the provisions above, then a new exception for freeze protection was added as exception 2 and exception 4 is new]

Energy Savings: Operation of variable flow systems is less expensive than constant flow systems and variable speed drives increase the savings compared to throttling control. An analysis of energy impact shows that annual savings from expanding the use of motor speed control in the proposal ranges from $1,303 to $401 for 10 to 3 horsepower heating pumps and from $1821 to $386 for 10 to 2 horsepower cooling pumps in typical HVAC systems. Savings for larger pumps are proportional. More details are found in the cost-effectiveness analysis referenced in the cost impact section.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at:
https://www.energycodes.gov/development/2018IECC.

Bibliography:

1. Hart, R., and Liu, B. (2015). *Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes.* Pacific Northwest National Laboratories for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-23923 Rev1. https://www.energycodes.gov/development/commercial/methodology.
2. Wang, W. and R. Hart. December 2015. "Cost-effectiveness Analysis of Pump VSD." https://www.energycodes.gov/development/2018IECC.

Cost Impact: Will increase the cost of construction

The cost of variable frequency drives continues to drop. Incremental cost for VSD and associated controls ranges from $5,101 to $3,920 for 10 to 2 horsepower pumps. Costs for larger pumps are proportional. There is no cost for reducing the threshold where variable flow systems are required, as 2-way valves that vary flow are less costly than 3-way valves used in a constant flow system.

Cost-effectiveness: PNNL performed a cost-effectiveness analysis using the established DOE methodology.[1] Results of the cost-effectiveness analysis showed that at the requirement thresholds proposed, the savings-to-investment ratio (SIR) was greater than 1.2 in typical heating and cooling HVAC systems. A proposal is cost-effective when the SIR is greater than or equal to 1.0, indicating that the present value of savings is equal to or greater than the incremental cost. The complete cost-effectiveness analysis is available at: https://www.energycodes.gov/development/2018IECC.[2]

CE163-16

IECC: C403.4.2.6.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C403.4.2.6 Pump isolation. Chilled water plants including more than one chiller shall have the capability to reduce flow automatically through the chiller plant when a chiller is shut down. Chillers piped in series for the purpose of increased temperature differential shall be considered as one chiller.

Boiler ~~plants~~ systems including more than one boiler shall have the capability to reduce flow automatically through the boiler ~~plant~~ system when a boiler is shut down.

Reason: There are many provisions throughout Section C403 w hich address boilers and boiler controls. The SEHPCAC initially considered w hether to consolidate the boiler provisions, but opted instead to propose reorganization of all of C403 found in a different proposal. The provisions addressing boilers are updated nearly every edition. In the 2015 code requirements for boiler turndow n w ere added to Section C403.4.2.5 to apply to boiler systems. Boiler system is a defined term added to the code in 2015. The term 'boiler plant' used in section C403.4.2.6 is not defined. In the context it appears to mean an interconnected system of boilers. Boiler plant is not defined in the IMC or IFGC. Boiler plant is also not defined in ASHRAE 90.1. To reduce confusion of application the proposal replaces boiler plant w ith boiler system.

This proposal w as submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC w as established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes w ith 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 2015, the SEHPCAC has held three tw o- or three-day open meetings and 25 w orkgroup calls, w hich included members of the SEHPCAC as w ell as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC w ebsite at: http://w w w .iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction

The change is editorial in nature in that it modernizes text to a currently defined term. There is no technical change to the code requirements.

CE163-16 : C403.4.2.6-COLLINS11442

CE164-16

IECC: C403.4.3, C403.4.3.1, C403.4.3.2, C403.4.3.2.1, C403.4.3.2.2.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C403.4.3 Heat rejection equipment. ~~Each fan powered by a motor of 7.5 hp (5.6 kW) or larger~~ Heat rejection equipment such as air-cooled condensers, dry coolers, open-circuit cooling towers, closed-circuit cooling towers and evaporative condensers used for comfort cooling applications shall ~~have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device~~ comply with this section.

> **Exception:** ~~Factory-installed heat~~ Heat rejection devices ~~within HVAC~~ where energy usage is included in the equipment ~~tested and rated~~ efficiency ratings listed in ~~accordance with~~ Tables C403.2.3(6) and C403.2.3(7).

~~**C403.4.3.2.1**~~ **C403.4.3.1 Fan** ~~**motors not less than 7.5 hp.**~~ **speed control** Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability and be configured to operate ~~that fan~~ at two-thirds of full speed or less, and shall have controls that will automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

> ~~**Exception**~~ **Exceptions**:~~The following fan motors over 7.5 hp (5.6 kW) are exempt:~~
>
> 1. Condenser fans serving multiple refrigerant circuits.
> 2. Condenser fans serving flooded condensers.
> 3. Installations located in *Climate Zones* 1 and 2.

Delete without substitution:

~~**C403.4.3.1 General.** Heat rejection equipment such as air-cooled condensers, dry coolers, open-circuit cooling towers, closed-circuit cooling towers and evaporative condensers used for comfort cooling applications shall comply with this section.~~

> ~~**Exception:** Heat rejection devices where energy usage is included in the equipment efficiency ratings listed in Tables C403.2.3(6) and C403.2.3(7).~~

~~**C403.4.3.2 Fan speed control.** The fan speed shall be controlled as provided in Sections C403.4.3.2.1 and C403.4.3.2.2.~~

Revise as follows:

~~**C403.4.3.2.2**~~ **C403.4.3.2 Multiple-cell heat rejection equipment.** Multiple-cell heat rejection equipment with variable speed fan drives shall be controlled ~~in both~~ to operate the maximum number of fans allowed that comply with the ~~following manners:~~

> ~~1. To operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components.~~
> ~~2. So all fans can operate at the same fan speed required for the instantaneous cooling~~

~~duty, as opposed to staged (on/off) operation.~~

~~Minimum~~ manufacturer's requirements for all system components and so that all fans operate at the same fan speed required for the instantaneous cooling duty, as opposed to staged on and off operation. The minimum fan speed shall be the minimum allowable speed of the fan drive system in accordance with the manufacturer's recommendations.

Reason: Removes duplicative language and ensures consistency between the IECC Commercial Provisions and the criteria in standard 90.1 and to address a question posed by an IECC user regarding the differences between the two documents related to this criterion. Section 6.5.5 of 90.1-13 covers heat rejection equipment. In updating the 2012 IECC to be consistent with those provisions per ASHRAE code change CE255-13 it has been determined that the text in the 2015 IECC can be further clarified beyond what was submitted by ASHRAE during the last code development cycle. The proposed code change addresses comments received by ICC on this provision in the IECC, mirrors the criteria in 90.1-13 and significantly simplifies the provisions associated with heat rejection equipment. This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The proposal is editorial in that it removes duplicated criteria.

CE164-16 : C403.4.3-COLLINS11795

CE165-16

IECC: C403.4.3, C403.4.3.1, C403.4.3.2, C403.4.3.2.1, C403.4.3.2.2.

Proponent : Frank Morrison (fmorrison@baltimoreaircoil.com); Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

C403.4.3 Heat rejection equipment. ~~Each fan powered by a motor of 7.5 hp (5.6 kW) or larger~~ Heat rejection equipment including air-cooled condensers, dry coolers, open-circuit cooling towers, closed-circuit cooling towers and evaporative condensers shall ~~have~~ comply with this section.

Exception: Heat rejection devices where energy usage is included in the ~~capability to operate that fan at two thirds of full speed or less,~~ equipment efficiency ratings listed in Tables C403.2.3(6) and ~~shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device~~ C403.2.3(7).

> ~~**Exception:** Factory-installed heat rejection devices within HVAC equipment tested and rated in accordance with Tables C403.2.3(6) and C403.2.3(7).~~

C403.4.3.1 ~~General~~ Fan speed control. ~~Heat~~
Each fan system powered by an individual motor or array of motors with a connected power, including the motor service factor, totaling 5 hp (3.7 kW) or more shall have controls and devices configured to automatically modulate the fan speed to control the leaving fluid temperature or condensing temperature and pressure of the heat rejection ~~equipment such as air-cooled condensers, dry coolers, open-circuit~~ device. Fan motor power input shall be not more than 30% of design wattage at 50% of the design airflow.

Exceptions:

1. Fans serving multiple refrigerant or fluid cooling ~~towers, closed-circuit cooling towers and evaporative~~ circuits.

2. Condenser fans serving flooded condensers ~~used for comfort cooling applications shall comply with this section~~.

> ~~**Exception:** Heat rejection devices where energy usage is included in the equipment efficiency ratings listed in Tables C403.2.3(6) and C403.2.3(7).~~

C403.4.3.2 ~~Fan speed control~~ Multiple-cell heat rejection equipment. Multiple-cell heat rejection equipment with variable speed fan drives shall be controlled to operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components and so that all fans operate at the same fan speed required for the instantaneous cooling duty, as opposed to staged on and off operation. The minimum fan speed shall be ~~controlled as provided~~ the minimum allowable speed of the fan drive system in ~~Sections C403.4.3.2.1 and C403.4.3.2.2~~ accordance with the manufacturer's recommendations.

Delete without substitution:

~~**C403.4.3.2.1 Fan motors not less than 7.5 hp.** Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.~~

> ~~**Exception:** The following fan motors over 7.5 hp (5.6 kW) are exempt:~~
> 1. ~~Condenser fans serving multiple refrigerant circuits.~~
> 2. ~~Condenser fans serving flooded condensers.~~
> 3. ~~Installations located in *Climate Zones* 1 and 2.~~

~~**C403.4.3.2.2 Multiple-cell heat rejection equipment.** Multiple-cell heat rejection equipment with variable speed fan drives shall be controlled in both of the following manners:~~

1. ~~To operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components.~~
2. ~~So all fans can operate at the same fan speed required for the instantaneous cooling duty, as opposed to staged (on/off) operation.~~

~~Minimum fan speed shall be the minimum allowable speed of the fan drive system in accordance with the manufacturer's recommendations.~~

Reason:
This proposal reduces the threshold w here variable speed drives (VSD) are required for heat rejection fan systems. The fan threshold is reduced from 7.5 to 5 hp. It also revises the exceptions for variable frequency drives on tow er fans and clarifies that the hp threshold applies to arrays of fans. Variable flow systems use less fan energy than constant flow systems.

For tow er fans, the exception for climate zones 1 & 2 is eliminated. These exceptions w ere originally developed w hen VSD costs w ere high. Due to the control complexities associated w ith evaporative condensers, closed circuit cooling tow ers, dry coolers, etc. that have multiple refrigerant or fluid cooling circuits w ith common fans serving different systems and flooded condensers, the first tw o exceptions are continued, especially as these represent a small portion of the market and operators can still use variable speed technology if the particular system can accommodate such technology.

Additionally, motors on heat rejection equipment often are supplied w ith service factors in order to allow for startup and operation in all climates w ith no motor overload. To be sure to capture the energy savings per the intent of the Code, the maximum motor horsepow er (kW) based on the service factor (motor nameplate horsepow er [or kW] times the service factor) w ould be used to establish compliance w ith this requirement. For example, a heat rejection device w ith four parallel operating motors, each labeled at 1.0 HP w ith a service factor of 1.5, w ould be capable of operating at 6.0 HP (1.5 SF times 1.0 HP). Under the current requirement, the heat rejection device w ould not call for variable speed control. How ever, w hen including the service factor, the device w ould now require variable speed control.

Energy Savings: Operation of variable flow systems is less expensive than constant flow systems and variable speed drives increase the savings compared to throttling control. An analysis of the energy impact show s that savings from expanding the use of motor speed control on heat rejection equipment in the proposal is $407 for 7.5 horsepow er fans in typical HVAC systems. More details are found in the cost-effectiveness analysis referenced in the cost impact section.

Cost Impact: Will increase the cost of construction

PNNL performed a cost-effectiveness analysis using DOE's methodology. The cost of variable frequency drives continues to drop. Incremental cost for VSD and associated controls is $3,670 for fans powered by 5.0 horsepower motors. Energy savings for the 5.0 horsepower motor with VSD is $407 per year for a simple payback of 9.02 years. The Savings to Investment Ratio (SIR) is 1.4 in typical HVAC&R systems indicating that the present value of the savings is greater than the incremental cost. The complete cost-effectiveness analysis is attached with this proposal.

CE165-16 : C403.4.3-MORRISON10603

CE166-16

IECC: C403.4.4, C403.4.4 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Add new text as follows:

C403.4.4 Requirements for complex mechanical systems serving multiple zones Sections C403.4.4.1 through C403.4.7 shall apply to mechanical systems.

Revise as follows:

~~**C403.4.4**~~ **C403.4.4.1** ~~**Requirements for complex mechanical systems serving multiple zones**~~ **Zone controls.** ~~Sections C403.4.4.1 through C403.4.6.4 shall apply to complex mechanical systems serving multiple zones.~~
Supply air systems serving multiple zones shall be variable air volume (VAV) systems that~~,~~ ~~during periods of occupancy, are designed and~~ have zone controls capable of ~~being controlled~~ and configured to reduce ~~primary~~ the volume of air ~~supply to~~ that is reheated, resolved, or mixed in each *zone* to one of the following ~~before reheating, recooling~~ :

1. Twenty percent of the *zone* design peak supply for systems with DDC and 30 percent for other systems.
2. Systems with DDC where items 2.1 through 2.3 apply.

   2.1 The airflow rate in dead band between heating and cooling does not exceed 20 percent of the *zone* design peak supply rate or higher allowed rates under items 3, 4, or 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 dead band flow rate.

   2.3 The second stage of heating modulates the airflow rate from the dead band 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 reheat and 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 ~~mixing takes place~~ entire air distribution systems are exempted from the requirement for VAV control:

1. ~~Thirty~~*Zones* or supply air systems where not less than 75 percent of the ~~maximum supply~~ energy for reheating or for providing warm air ~~to each *zone*~~in mixing systems is provided from a site-recovered energy source including condenser heat or from a site-solar energy source.
2. ~~Three hundred cfm (142 L/s)~~ Systems that prevent reheating, recooling, mixing or ~~less where~~ simultaneous supply of air that has been previously cooled, either mechanically or through the ~~maximum flow rate is less than 10 percent~~ use of ~~the~~

~~total fan system supply airflow rate~~ <u>economizer systems, and air that has been previously mechanically heated</u>.

~~3. 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 reheat/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 or site-solar energy source.
2. *Zones* where special humidity levels are required to satisfy process needs.
3. *Zones* with a peak supply air quantity of 300 cfm (142 L/s) or less and where the flow rate is less than 10 percent of the total fan system supply airflow rate.
4. *Zones* where the volume of air to be reheated, recooled or mixed is not greater than the volume of outside air required to provide the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*.
5. *Zones* or supply air systems with thermostatic and humidistatic controls capable of operating in sequence the supply of heating and cooling energy to the *zones* and which are capable of preventing 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: *The proposed change reflects advances in control strategies for VAV zone control. The dual maximum method with recommended control sequence results in better control of supply air temperature and an improvement in ventilation effectiveness, possibly resulting in less minimum ventilation air being required in a multiple-zone system.*

This is consistent with changes made to 90.1 in addenda s and ck.

Cost Impact: Will not increase the cost of construction
The sequences listed in the exception are readily available as standard practice and do not add any costs to construction.

CE166-16 : C403.4.4-FERGUSON11739

CE167-16

IECC: C403.4.4.6.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

C403.4.4.6 Multiple-zone VAV system ventilation optimization control. Multiple-zone VAV systems with direct digital control of individual zone boxes reporting to a central control panel shall have automatic controls configured to reduce outdoor air intake flow below design rates in response to changes in system*ventilation*efficiency (*Ev*) as defined by the International Mechanical Code.

Exceptions:

1. VAV systems with zonal transfer fans that recirculate air from other zones without directly mixing it with outdoor air, dual-duct dual-fan VAV systems, and VAV systems with fan-powered terminal units.
2. ~~Systems having exhaust air energy recovery complying with Section C403.2.7.~~
3. Systems where total design exhaust airflow is more than 70 percent of total design outdoor air intake flow requirements.

Reason: *Previously, Ventilation optimization was generally excepted wherever ERV was installed, as the savings for optimization overlap with the savings for ERV. The change proposed here removes the exception to the VAV system ventilation optimization when ERV is installed. Additional analysis of the interaction between ventilation optimization and exhaust recoveryventilation (ERV) has determined that in all climates, having VAV system ventilation optimization in*
addition to ERV is cost effective.
Approval of this code change proposal will ensure consistency with ASHRAE Standard 90.1-16, which will be adopted by reference as an alternative path to the 2018 IECC Commercial Provisions. This change was made via addendum j to ASHRAE Standard 90.1-13.

Cost Impact: Will increase the cost of construction
Ventilation optimization is required only where an appropriate DDC system is already included in the building design. ERV is not required by this change, so the added cost is only to program the ventilation optimization into the DDC system. This is a standard protocol already required by code elsewhere, so the basic standard DDC programming is readily available and custom programming should not be required. The additional setup cost for four systems in a building with a total of 22 zones is estimated at $3,000. Additional analysis of the savings interaction between ventilation optimization and exhaust recovery ventilation (ERV) has determined that in all climates, having VAV system ventilation optimization in addition to ERV is cost effective. The annual savings for the prototype 22 zone office building was found to range from $406 to $7,039, depending on climate zone and to average $2,624 annually across all U.S. climate zones.

CE167-16 : C403.4.4.6-FERGUSON11737

CE168-16

IECC: C403.4.4.7 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Add new text as follows:

C403.4.4.7 Parallel-flow fan-powered VAV air terminal control. Parallel-flow fan-powered VAV air terminals shall have automatic controls configured to:

1. Turn off the terminal fan except when space heating is required or where required for ventilation.
2. Turn on the terminal fan as the first stage of heating before the heating coil is activated
3. During heating for warmup or setback temperature control, either:
   - 3.1. Operate the terminal fan and heating coil without primary air.
   - 3.2. Reverse the terminal damper logic and provide heating from the central air handler by primary air.

Reason: This proposal addresses control of fans in fan powered parallel VAV boxes. The fan is only required during heating; however, these fans may be programmed to run continuously during occupied hours. The addendum also requires the fan operation to be used as the first stage of heating and allows fan operation in response to DCV ventilation requests. Use of primary air for setback and warmup heating during unoccupied hours is not allowed unless the terminal logic is reversed and primary air provides central heating rather than cooling

Cost Impact: Will not increase the cost of construction
This represents a setup of controls and does not require new equipment, so there is no anticipated cost increase and cost effectiveness analysis is not required.

CE168-16 : C403.4.4.7 (NEW)-FERGUSON13121

CE169-16

Part I:

IECC: C403.4.6 (New), C403.4.6.1 (New), C403.4.6.2 (New), C403.4.6.3 (New).

Part II:

R403.13 (New) [IRC N1103.13 (New)], R403.13.1 (New) [IRC N1103.13.1 (New)], R403.13.2 (New) [IRC N1103.13.2 (New)] , R403.13.3 (New) [IRC N1103.13.3 (New)], R403.13.4 (New) [IRC N1103.13.4 (New)]

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 ORDERS FOR THESE COMMITTEES.

Proponent : Edmond Murray, representing Aztec Solar Inc (ed@aztecsolar.com)

Part I

2015 International Energy Conservation Code

Add new text as follows:

C403.4.6 Solar thermal systems for space heating. Where solar thermal systems are installed as part of space heating systems they shall comply with ICC 900/SRCC 300 and Sections C403.4.6.1 through C403.4.6.3.

C403.4.6.1 Collector tilt Collectors shall be installed with a minimum slope of 30 degrees from horizontal.

C403.4.6.2 Collector azimuth Collectors installed in the northern hemisphere shall be oriented within 30 degrees of true south. Collectors installed in the southern hemisphere shall be oriented within 30 degrees of true north.

C403.4.6.3 Shading Collectors shall be located such that they are not shaded by external obstructions during the heating season in accordance with ICC 900/SRCC 300.

Part II

2015 International Energy Conservation Code

Add new text as follows:

R403.13 (N1103.13) Solar thermal systems for space heating Solar systems installed as a part of space heating systems shall comply with Sections R403.13.1 through R403.13.4.

R403.13.1 (N1103.13.1) Solar thermal systems standard. Solar systems installed as a part of space heating system shall comply with ICC 900/SRCC 300.

R403.13.2 (N1103.13.2) Solar collector tilt. The slope of a solar collector shall be not less than 30 degrees from horizontal.

R403.13.3 (N1103.13.3) Collector azimuth. Where installed in the northern hemisphere the orientation of a solar collector shall be within 30 degrees of true south. Where installed in the southern hemisphere the orientation of a solar collector shall be within 30 degrees of true north.

R403.13.4 (N1103.13.4) Solar collector shading. The location of a solar collector shall not be shaded by external obstructions during the heating season as specified in ICC 900/ SRCC 300.

Reference standards type: This is an update to reference standard(s) already in the ICC Code Books

Add new standard(s) as follows:

ICC 900/SRCC 300-2015 Solar Thermal System Standard

Reason: Solar Space heating systems will not work without the proper orientation or slope.

Cost Impact: Will increase the cost of construction

There may be a cost increase for a rack if the roof faces the wrong direction. The rack cost should be no more than $1,000.00.

CE169-16 : C403.4.6 (NEW)-MURRAY12484

CE170-16

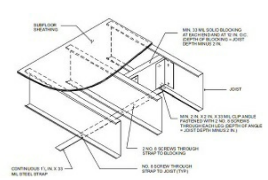
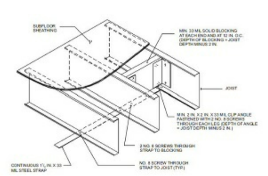
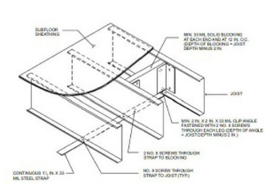
IECC: C404.2.

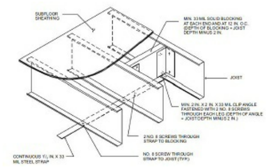
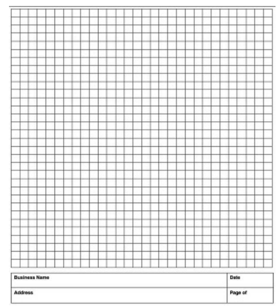
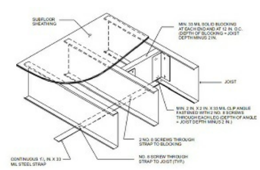
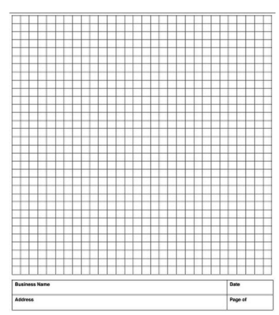
Proponent : Karen Hobbs (khobbs@nrdc.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE C404.2
MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT

EQUIPMENT TYPE	SIZE CATEGORY (input)	SUBCATEGORY OR RATING CONDITION	PERFORMANCE REQUIRED[a, b]	TEST PROCEDURE
Water heaters, electric	≤ 12 kW[d]	Resistance	0.97 - 0.00 132V, EF	DOE 10 CFR Part 430
	> 12 kW	Resistance	(0.3 + 27/V_m), %/h	ANSI Z21.10.3
	≤ 24 amps and ≤ 250 volts	Heat pump	0.93 - 0.00 132V, EF	DOE 10 CFR Part 430
Storage water heaters, gas	≤ 75,000 Btu/h	≥ 20 gal	0.67 - 0.0019V, EF	DOE 10 CFR Part 430
	> 75,000 Btu/h and ≤ 155,000 Btu/h			ANSI Z21.10.3
	> 155,000 Btu/h			
Instantaneous water heaters, gas	> 50,000 Btu/h and c	≥ 4,000 (Btu/h)/gal and	0.62 - 0.00 19V, EF	DOE 10 CFR Part 430
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and	80% E_t	ANSI Z21.10.3
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal		
	≤ 105,000 Btu/h	≥ 20 gal	0.59 - 0.0019V, EF	DOE 10 CFR Part 430

Storage water heaters, oil	≥ 105,000 Btu/h			ANSI Z21.10.3
Instantaneous water heaters, oil	≤ 210,000 Btu/h	≥ 4,000 Btu/h/gal and	0.59 - 0.0019V, EF	DOE 10 CFR Part 430
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and	80% E_t	ANSI Z21.10.3
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal		
Hot water supply boilers, gas and oil	≥ 300,000 Btu/h and	≥ 4,000 Btu/h/gal and	80% E_t	ANSI Z21.10.3
Hot water supply boilers, gas	≥ 300,000 Btu/h and	≥ 4,000 Btu/h/gal and ≥ 10 gal		
Hot water supply boilers, oil	> 300,000 Btu/h and	> 4,000 Btu/h/gal and > 10 gal		
Pool heaters, gas and oil	All	—	82% E_t	ASHRAE 146
Heat pump pool heaters	All	—	4.0 COP	AHRI 1160
Unfired storage tanks	All	—	Minimum insulation requirement R-12.5 (h ·	(none)

			$ft^2 \cdot °F)/Btu$	
Showerheads	All	--	1.8 gallons per minute (gpm)	--

For SI: °C = [(°F) - 32]/1.8, 1 British thermal unit per hour = 0.2931 W, 1 gallon = 3.785 L, 1 British thermal unit per hour per gallon = 0.078 W/L.

a. Energy factor (EF) and thermal efficiency (Et) are minimum requirements. In the EF equation, V is the rated volume in gallons.

b. Standby loss (SL) is the maximum Btu/h based on a nominal 70°F temperature difference between stored water and ambient requirements. In the SL equation, Q is the nameplate input rate in Btu/h. In the equations for electric water heaters, V is the rated volume in gallons and Vm is the measured volume in gallons. In the SL equation for oil and gas water heaters and boilers, V is the rated volume in gallons.

c. Instantaneous water heaters with input rates below 200,000 Btu/h shall comply with these requirements where the water heater is designed to heat water to temperatures 180°F or higher.

d. Electric water heaters with an input rating of 12 kW (40,950 Btu/hr) or less that are designed to heat water to temperatures of 180°F or greater shall comply with the requirements for electric water heaters that have an input rating greater than 12 kW (40,950 Btu/h).

Reason: Showerheads operating at 1.8 gpm at 80 psi are commonly available and perform as well as showerheads operating at 2.5 gpm. The WaterSense specification for showerheads was adopted in 2010, including a maximum flow rate of 2.0 gpm at 80 psi. Based on the most recent reports by WaterSense partners, more than 800 models from 45 brands currently meet the proposed standard, demonstrating the widespread availability and commercial viability of these types of showerheads (Source: MaP Testing: http://www.map-testing.com/).
In August, 2015, the California Energy Commission (CEC) approved a new standard for showerheads of 1.8 gallons per minute maximum flow rate starting July 1, 2018. By 2028, the CEC estimates that this standard would result in annual savings of 38 billion gallons of water; 202 million therms of natural gas; 1,322 gigawatt-hours of electricity; and 702 million dollars of savings for California alone (California Energy Commission, "Staff Analysis of Water Efficiency Standards for Showerheads," Docket Number 15-AAER-05, August 7, 2015, p. 14, http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-05/TN205654_20150807T151426_Staff_Analysis_Of_Water_Efficiency_Standards_For_Showerheads.pdf).

The Natural Resources Defense Council (NRDC) estimates that significant water and energy savings could accrue nationwide if this revised flow rate for showerheads became effective for the residential sector in 2016 (we recognize that the revisions contained in this proposal would become effective in 2018; we will provide updated savings estimates to staff after the submittal deadline): 421 million gallons of water per day by 2030; 7,928 GWh (Gigawatt Hours) per year by 2030; 569 million therms of natural gas per year by 2030.

Bibliography: California Energy Commission, "Staff Analysis of Water Efficiency Standards for Showerheads," Docket Number 15-AAER-05, August 7, 2015, http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-05/TN205654_20150807T151426_Staff_Analysis_Of_Water_Efficiency_Standards_For_Showerheads.pdf

Cost Impact: Will not increase the cost of construction
As noted above, showerheads operating at the flow rates proposed are commonly available and perform as well as less efficient fixtures. For showerheads, more than 800 models from 45 brands currently meet the proposed standard (Source: MaP Testing; http://www.maptesting.com/). According to EPA WaterSense, "Showerheads are available at a variety of price points and ranges in cost may be due to a number of factors including style or functional design" (Source: EPA WaterSense: http://www.epa.gov/WaterSense/pubs/faq_showerheads.html). Consumer Reports found that, "If you think you have to spend top dollar to get a strong performer, think again. Our top-rated multisetting showerhead costs a

quarter of the price of the model that finished second" (Source: Consumer Reports: http://w w w .consumerreports.org/cro/show erheads/buying-guide.htm).

The California Energy Commission (CEC), in its staff analysis for its 1.8 gpm standard, found that "the incremental cost for show erheads is zero because there is no cost premium for a compliant product (meaning that an efficient product and an inefficient product cost th same, all other variables constant) (California Energy Commission, p. 15). Further, the CEC found that "consumers should immediately see savings on their utility bill upon installing a compliant product" (California Energy Commission, p. 15).

CE170-16 : TABLE C404.2-HOBBS11696

CE171-16

IECC: C404.2.

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

2015 International Energy Conservation Code

Revise as follows:

TABLE C404.2
MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT

EQUIPMENT TYPE	SIZE CATEGORY (input)	SUBCATEGORY OR RATING CONDITION	PERFORMANCE REQUIRED[a, b]	TEST PROCEDURE
Water heaters, electric	≤ 12 kW[d]	Tabletop, > 20 gallons and < 120 gallons	0.93 - 0.00132V, EF	DOE 10 CFR Part 430
		Resistance > 20 gallons and < 55 gallons	~~0.97 - 0.00 132V~~ 0.960 - 0.0003V, EF	
		Grid-enabled > 20 gallons and < 120 gallons	1.06 - 0.00168V, EF	
	> 12 kW	Resistance	(0.3 + 27/V_m), %/h	ANSI Z21.10.3
	≤ 24 amps and ≤ 250 volts	Heat pump > 55 gallons and ≤ 120 gallons	~~0.93 - 0.00 132V~~ 2.057 - 0.00113V, EF	DOE 10 CFR Part 430
Storage water heaters,	≤ 75,000 Btu/h	≥ 20 gallons and < 55 gallons	~~0.62 - 0.00 19V~~ 0.675 - 0.0015V, EF	DOE 10 CFR Part 430
		> 55 gallons and < 100 gallons	~~0.62 - 0.00 19V~~ 0.8012 - 0.00078V, EF	

gas				
	> 75,000 Btu/h and ≤ 155,000 Btu/h		80% E_t (Q/800 + 110 V)SL, Btu/h	ANSI Z21.10.3
	> 155,000 Btu/h		80% E_t (Q/800 + 110 V)SL, Btu/h	
Instantaneous water heaters, gas	> 50,000 Btu/h and c	≥ 4,000 (Btu/h)/gal and	~~0.62~~ <u>0.82</u> - 0.0019*V*, EF	DOE 10 CFR Part 430
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and	80% E_t	ANSI Z21.10.3
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	80% E_t (Q/800 + 110 V)SL, Btu/h	
Storage water heaters, oil	≤ 105,000 Btu/h	≥ 20 gal and <u><</u> 50 gallons	~~0.59~~ <u>0.68</u> - 0.0019*V*, EF	DOE 10 CFR Part 430
	≥ 105,000 Btu/h		80% E_t (Q/800 + 110 V)SL, Btu/h	ANSI Z21.10.3
Instantaneous water heaters, oil	≤ 210,000 Btu/h	≥ 4,000 Btu/h/gal and	0.59 - 0.0019V, EF	DOE 10 CFR Part 430
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and	80% E_t	ANSI Z21.10.3
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	78% E_t (Q/800 + 110 V)SL, Btu/h	
Hot water supply boilers, gas and oil	≥ 300,000 Btu/h and	≥ 4,000 Btu/h/gal and	80% E_t	ANSI Z21.10.3
Hot water supply boilers,	≥ 300,000 Btu/h and	≥ 4,000 Btu/h/gal and ≥ 10 gal	80% E_t (Q/800 + 110 V)SL,	

gas			Btu/h	
Hot water supply boilers, oil	> 300,000 Btu/h and	> 4,000 Btu/h/gal and > 10 gal	78% E_t (Q/800 + 110 V)SL, Btu/h	
Pool heaters, gas and oil	All	—	82% E_t	ASHRAE 146
Heat pump pool heaters	All	—	4.0 COP	AHRI 1160
Unfired storage tanks	All	—	Minimum insulation requirement R-12.5 (h · ft^2 · °F)/Btu	(none)

For SI: °C = [(°F) - 32]/1.8, 1 British thermal unit per hour = 0.2931 W, 1 gallon = 3.785 L, 1 British thermal unit per hour per gallon = 0.078 W/L.

a. Energy factor (EF) and thermal efficiency (Et) are minimum requirements. In the EF equation, V is the rated volume in gallons.

b. Standby loss (SL) is the maximum Btu/h based on a nominal 70°F temperature difference between stored water and ambient requirements. In the SL equation, Q is the nameplate input rate in Btu/h. In the equations for electric water heaters, V is the rated volume in gallons and Vm is the measured volume in gallons. In the SL equation for oil and gas water heaters and boilers, V is the rated volume in gallons.

c. Instantaneous water heaters with input rates below 200,000 Btu/h shall comply with these requirements where the water heater is designed to heat water to temperatures 180°F or higher.

d. Electric water heaters with an input rating of 12 kW (40,950 Btu/hr) or less that are designed to heat water to temperatures of 180°F or greater shall comply with the requirements for electric water heaters that have an input rating greater than 12 kW (40,950 Btu/h).

Reason: New federal standards for residential type water heaters went into effect as of April 16, 2015. This proposal updates the values and equations in the table to reflect the new federal minimum standards for these products.
More information about these standards can be found at the following web site:

https://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/27

Cost Impact: Will increase the cost of construction
The new federal standard significantly increased the initial cost of residential water heaters, especially for large storage water heaters with a rated volume above 55 gallons.

CE171-16 : TABLE C404.2-ROSENSTOCK11773

CE172-16
IECC: C404.2.1.
Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org)

2015 International Energy Conservation Code

Revise as follows:

C404.2.1 High input-rated 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 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 ~~site-solar~~*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: This proposal adds clarifications and updates to Exception 1 in Section C404.2.1.
It clarifies that systems that provide at least 25% will qualify for the exception, not systems only providing 25%.

It also updates the exception to allow all types of renewable energy systems to comply, not just certain technologies. This update alllows multiple technologies to be considered and/or used for this exception.

Cost Impact: Will not increase the cost of construction
This proposal clarifies and updates provisions in this exception, but it does not change the requirement. It also allows the use of alternate renewable technologies, or multiple renewable technologies, and may lower the cost of this exception.

CE172-16 : C404.2.1-ROSENSTOCK11854

CE173-16

IECC: C404.3.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C404.3 Heat traps~~.~~ for hot water storage tanks ~~Water-heating equipment not supplied~~ Storage tank-type water heaters and hot water storage tanks that have vertical water pipes connecting to the inlet and outlet of the tank shall be provided with integral heat traps at those inlets and ~~serving noncirculating systems~~ outlets or shall ~~be provided with~~ have pipe configured heat traps ~~on~~ in the ~~supply~~ piping connected to those inlets and ~~discharge piping~~ outlets. Tank inlets and outlets associated with ~~the equipment~~ solar water heating system circulation loops shall not be required to have heat traps.

Reason: The existing text is confusing as to the intent of the provision and how to design a complying installations. This section has its origin in ASHRAE 90.1 but the IECC doesn't exactly say w hat 90.1 intended. Here's w hat is in ASHRAE 90.1-2007

> **7.4.6 Heat traps.** Vertical pipe risers serving storage w ater heaters and storage tanks not having integral heat traps and serving a nonrecirculating system shall have heat traps on both the inlet and outlet piping as close as practical to the storage tank. A heat trap is a means to counteract the natural convection of heated w ater in a vertical pipe run. The means is either a device specifically designed for the purpose or an arrangement of tubing that forms a loop of 360 degrees or piping that from the point of connection to the w ater heater (inlet or outlet) includes a length of piping directed dow nw ard before connection to the vertical supply w ater or hot-w ater distribution system, as applicable.

Although this language has a fair amount of commentary text (w hich cannot be placed in ICC code text), it does explain better about w hat the IECC Section C404.3 is supposed to be conveying.

The IECC Commentary has a few figures (that are attributed to DOE) to explain w hat is intended.

The final sentence is added to clarify application to solar w ater heating systems.

This proposal w as submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC w as established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes w ith 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 2015, the SEHPCAC has held three tw o- or three-day open meetings and 25 w orkgroup calls, w hich included members of the SEHPCAC as w ell as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC w ebsite at: http://w w w .iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The intent is editorial. The existing text is unclear and the revision is intended to provide better, more enforceable provisions w ithout changing the technical requirement.

CE173-16 : C404.3-COLLINS11454

CE174-16

Part I:
IECC: 0, C404.7.
Part II:
R403.5.2 (IRC N1103.5.2)

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

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee (SEHPCAC@iccsafe.org)

Part I

2015 International Energy Conservation Code

Revise as follows:

C404.7 Demand recirculation controls. ~~A~~ Demand recirculation water ~~distribution system having 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 shall be a *demand recirculation water system*. Pumps~~ systems shall have controls that comply with both of the following:

1. The ~~control~~ 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 ~~control~~ controls shall limit the temperature of the water entering the cold-water piping to not greater than 104°F (40°C).

SECTION C202 DEFINITIONS

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

Part II

2015 International Energy Conservation Code

Revise as follows:

R403.5.2 (N1103.5.2) Demand recirculation water systems. ~~A~~ Demand recirculation water ~~distribution system having 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 shall be a *demand recirculation water system*. Pumps~~ systems shall have controls that comply with both of the following:

1. The ~~control~~ 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 ~~control~~ controls shall limit the temperature of the water entering the cold water piping to ~~104~~ not greater than104ºF (40ºC).

SECTION R202 DEFINITIONS

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

Reason: The proposal suggests three actions:

1. It removes language from C404.7, R403.5.2 and N1103.5.2 which is definitional in nature and creates a definition of Demand Recirculation Water System in Sections C202, R202 and N1101.6.
2. It changes the requirement from the pump having to have controls to the system having to have the controls. If one reads the second control requirement – it would seem this is a system requirement – not a requirement that applies to the pumps in the system.
3. Item 2 currently limits the water temperature of water entering the cold water piping to 'exactly' 104 degrees. We believe the intent is for that limit to be a maximum temperature.

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The proposal is editorial in nature. It will have no impact on the cost of construction.

CE174-16 : C404.7-COLLINS11455

CE175-16

Part I:
IECC: C404.9 (New).
Part II:
R403.5.5 (New) [IRC N1103.5.5 (New)]

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 ORDERS FOR THESE COMMITTEES.

Proponent : Anthony Floyd, Energy Code Specialist, representing City of Scottsdale (afloyd@scottsdaleaz.gov)

Part I

2015 International Energy Conservation Code

Add new text as follows:

C404.9 Shower heads (Mandatory). The flow rate of fixed and handheld shower heads shall not exceed 2.0 gpm at 80 psi.

Part II

2015 International Energy Conservation Code

Add new text as follows:

R403.5.5 (N1103.5.5) Shower heads (Mandatory). The flow rate of fixed and handheld shower heads shall not exceed 2.0 gpm at 80 psi.

Reason: The Natural Resources Defense Council (NRDC) estimates that significant energy and water savings could accrue nationwide if these revised flow rates for showerheads became effective in 2018 (savings estimates apply to residential). Energy and water savings potential for showerheads: 1,553 MWh (Megawatt hours) of electricity per year by 2030; 112 million therms of natural gas per year by 2030; and 86 million gallons of water per day by 2030. Showerheads operating at 2.0 gpm at 80 psi are commonly available and perform as well or better than showerheads operating at 2.5 gpm. The WaterSense specification for showerheads was adopted in 2010, including a maximum flow rate of 2.0 gpm at 80 psi. Based on the most recent reports by WaterSense partners, more than 800 models from 45 brands currently meet the proposed standard, demonstrating the widespread availability and commercial viability of these types of showerheads (Source: MaP Testing: http://www.map-testing.com/).

In August, 2015, the California Energy Commission (CEC) approved a standard of 2.0 gpm, the same standard in this proposal, for fixed and handheld showerheads, as well as horizontal body sprayers. In its analysis, staff found that the 2.0 gpm standard would "significantly reduce energy and water consumption" (California Energy Commission, "Staff Analysis of Water Efficiency Standards for Showerheads," Docket Number 15-AAER-05, p. 13, August 7, 2015; available at: http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-05/TN205654_20150807T151426_Staff_Analysis_Of_Water_Efficiency_Standards_For_Showerheads.pdf). Staff also estimated savings that track with NRDC's savings estimate. CEC staff estimated that "Californians would save 24 billion gallons of water, 127 million therms of natural gas, and 829 GWh of electricity per year" (California Energy Commission, p. 13).

Bibliography:

Part I: California Energy Commission, "Staff Analysis of Water Efficiency Standards for Showerheads," Docket Number 15-AAER-05, p. 13, August 7, 2015; available at: http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-05/TN205654_20150807T151426_Staff_Analysis_Of_Water_Efficiency_Standards_For_Showerheads.pdf.

Cost Impact: Will increase the cost of construction
According to EPA WaterSense, "Showerheads are available at a variety of price points and ranges in cost may be due to a number of factors including style or functional design" (Source: EPA WaterSense: http://www.epa.gov/WaterSense/pubs/faq_showerheads.html). Consumer Reports found that, "If you think you have to spend top dollar to get a strong performer, think again. Our top-rated multisetting showerhead costs a quarter of the price of the model that finished second" (Source: Consumer Reports: http://www.consumerreports.org/cro/showerheads/buying-guide.htm).
The California Energy Commission (CEC), in its staff analysis for its 2.0 gpm standard, found that "the incremental cost for showerheads is zero because there is no cost premium for a compliant product meaning that an efficient product and an inefficient product cost the same, all other variables constant. (California Energy Commission, p. 15). Further, the CEC found that "consumers should immediately see savings on their utility bill upon installing a compliant product" (California Energy Commission, p. 15).

CE175-16 : C404.9 (NEW)-FLOYD13382

CE176-16

Part I:
IECC: C404.9.3.
Part II:
R403.10.3 (IRC N1103.10.3)

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 ORDERS FOR THESE COMMITTEES.

Proponent : Jennifer Hatfield, J. Hatfield & Associates, PL, representing Association of Pool & Spa Professionals (jhatfield@apsp.org)

Part I

2015 International Energy Conservation Code

Revise as follows:

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 70 percent of the energy for heating, computed over an operating season, is from ~~site-recovered energy such as from~~ a heat pump or <u>a</u> solar energy source, covers or other vapor-retardant means shall not be required.

Part II

2015 International Energy Conservation Code

Revise as follows:

R403.10.3 <u>(N1103.10.3)</u> 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 70 percent of the energy for heating, computed over an operation season, is from ~~site-recovered energy, such as from~~ a heat pump or <u>a</u> solar energy source, covers or other vapor-retardant means shall not be required.

Reason:

Part I: The original intent of this exception w as that w hen an air-source sw imming pool heat pump w as installed on a pool or spa, it w ould not require a vapor retardant cover. Because an air-source sw imming pool heat pump transfers heat from the air to the pool, it is a more energy efficient w ay to heat a pool over other types of heaters. The language included the term "site recovered energy" w ithout the know lege that this term is defined in ASHRAE 90.1 and as defined w ould not include air-source sw imming pool heat pumps. If this exception w ere to be interpreted to require a heat pump that uses site-recovered energy, as defined in ASHRAE 90.1, then one w ould find that such a product does not exist in the sw imming pool industry.

Therefore, this proposal eliminates that terminology to clarify that the intent here is if a pool or permanent spa utilizes a heat pump or solar energy source for more than 70% of the energy used in heating the pool or permanent spa, than one is exempt from the vapor retardant cover requirement. This change also ensures consistency w ith the change made to the 2018 International Sw imming Pool & Spa Code (proposal SP 7) in the Group A hearings and is also w hat is being proposed for the corresponding residential section of the IECC as w ell as Chapter 11 of the IRC (See Part II of this proposal number).

Part II: The original intent of this exception was that when an air-source swimming pool heat pump was installed on a pool or spa, it would not require a vapor retardant cover. Because an air-source swimming pool heat pump transfers heat from the air to the pool, it is a more energy efficient way to heat a pool over other types of heaters. The language included the term "site recovered energy" without the knowlege that this term is defined in ASHRAE 90.1 and as defined would not include air-source swimming pool heat pumps. If this exception were to be interpreted to require a heat pump that uses site-recovered energy, as defined in ASHRAE 90.1, then one would find that such a product does not exist in the swimming pool industry.

Therefore, this proposal eliminates that terminology to clarify that the intent here is if a pool or permanent spa utilizes a heat pump or solar energy source for more than 70% of the energy used in heating the pool or permanent spa, than one is exempt from the vapor retardant cover requirement. This change also ensures consistency with the change made to the 2018 International Swimming Pool & Spa Code (proposal SP 7) in the Group A hearings and is also what is being proposed for the corresponding commercial section of the IECC (See Part I of this proposal number)..

Cost Impact: Will not increase the cost of construction
This is only a clarification of the original intent of this section. This change does not require additional materials or labor for construction.

CE176-16 : C404.9.3-HATFIELD12796

CE177-16

Part I:
IECC: C404.9.3.
Part II:
R403.10.3 (IRC N1103.10.3)

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

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

Part I

2015 International Energy Conservation Code

Revise as follows:

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 ~~70~~ <u>75</u> percent of the energy for heating, computed over an operating season<u> of at least 3 calendar months</u>, is from site-recovered energy such as from a heat pump or ~~solar~~ <u>on-site renewable</u> energy ~~source~~ <u>system</u>, covers or other vapor-retardant means shall not be required.

Part II

2015 International Energy Conservation Code

Revise as follows:

R403.10.3<u> (N1103.10.3)</u> 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 ~~70~~ <u>75</u> percent of the energy for heating, computed over an operation season<u> of at least 3 calendar months</u>, is from site-recovered energy, such as from a heat pump or ~~solar energy source~~<u>*on-site renewable energy* system</u>, covers or other vapor-retardant means shall not be required.

Reason: This proposal makes the follow ing changes:
<u>Revise the exception from 70% to 75%</u>. This revision is based on information provided by the US Department of Energy, w hich can be found at the follow ing w eb sites:

http://energy.gov/energysaver/sw imming-pool-covers

http://energy.gov/energysaver/heat-pump-sw imming-pool-heaters (see Table 1. Costs by Location of Heating Outdoor Pools w ith a Heat Pump)

http://energy.gov/energysaver/gas-sw imming-pool-heaters (see Table 2. Costs of Outdoor Pool Gas Heating by Location)

Based on the tables show n, for many cities and pool w ater temperatures, the energy savings from using covers is on the order of 75-90%. By increasing the requirement to 75%, the exception w ill help to create more of an energy savings balance betw een not using the cover and on-site energy systems.

<u>Add in parameters for "operating season"</u>. As show n on the DOE w eb site, the estimated operating season can be

anywhere from 3 months to 12 months, depending on the location of the pool. Adding in the words "of at least 3 months" ensures that the on-site systems can provide the required amount of energy while the pool is being operated.

Allow the use of other on-site renewable energy systems. The phrase "such as" provides examples of site-recovered energy systems. By using the term "*on-site renewable energy*", which is a defined term in Section C202, it provides more technical options that can qualify. Since this is a list, the new language provides more information and clarification.

Cost Impact: Will increase the cost of construction
For this exception, since the requirement has been increased from 70% to 75%, the estimated increase in cost for this option would be approximately 7 percent.

CE177-16 : R403.10.3-ROSENSTOCK11885

CE178-16

IECC: C405, C405.1, C405.2.2, C405.2.3, C405.2.4, C405.4.1.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

SECTION C405 ELECTRICAL POWER AND LIGHTING SYSTEMS

Revise as follows:

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

> ~~**Exception:** Dwelling units within commercial buildings shall not be required to comply with Sections C405.2 through C405.5, provided that they comply with Section R404.1.~~

Dwelling units within multi-family buildings shall comply with Section R404.1. All other dwelling units shall comply with either Section C405.4 or Section R404.1 for lighting power. Sleeping units shall comply with either Section C405.4.or Section R404.1 for lighting power and Item 3 of Section C405.2.4 for lighting controls.. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.2.15 or C403.2.16.

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 C405.2.2.1.

> **Exception:** Where a *manual control* provides light reduction in accordance with Section C405.2.2.2, automatic controls shall not be required for the following:
>
> ~~1. *Sleeping units*.~~
> ~~2. Spaces where patient care is directly provided.~~
> ~~3. Spaces where an automatic shutoff would endanger occupant safety or security.~~
> ~~4. Lighting intended for continuous operation.~~
> ~~5. Shop and laboratory classrooms.~~
>
> 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.

C405.2.3 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 sidelight *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 toplight *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. ~~2. Dwelling units and sleeping units.~~
3. <u>3.</u> Lighting that is required to have specific application control in accordance with Section C405.2.4.
4. Sidelight daylight zones on the first floor above grade in Group A-2 and Group M occupancies.

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. Display and accent light shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
2. Lighting in cases used for display case purposes shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
3. ~~Hotel and motel sleeping~~ <u>Sleeping</u> units ~~and guest suites~~ shall have ~~a master~~ control ~~device~~ <u>devices or systems</u> that ~~is capable of~~ automatically ~~switching~~ <u>switch</u> off all installed luminaires and switched receptacles within 20 minutes after all occupants ~~leave~~ <u>have left</u> the ~~room~~ <u>sleeping unit</u>.

   <u>**Exceptions:**</u>

   ~~**Exception:**~~ <u>1.</u> Lighting and switched receptacles controlled by captive key systems.

   <u>2. Spaces where patient care is directly provided.</u>
4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided that the control device is readily accessible.
5. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
6. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

C405.4.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-9.

$TCLP = [SL + LV + LTPB + \text{Other}]$ **(Equation 4-9)**

where:

TCLP	=	Total connected lighting power (watts).
SL	=	Labeled wattage of luminaires for screw-in lamps.
LV	=	Wattage of the transformer supplying low-voltage lighting.
LTPB	=	Wattage of line-voltage lighting tracks and plugin busways as the specified wattage of the luminaires, but at least 30 W/lin. ft. (100 W/lin m), or the wattage limit of the system's circuit breaker, or the wattage limit of other permanent current-limiting devices on 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.

Exceptions:

1. The connected power associated with the following lighting equipment is not

included in calculating total connected lighting power.

1.1. Professional sports arena playing field lighting.

~~1.2.~~ ~~Lighting in sleeping units, provided that the lighting complies with Section R404.1.~~

<u>1.3.</u> Emergency lighting automatically off during normal building operation.

1.4. 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.

1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark.

1.6. Casino gaming areas.

1.7. Mirror lighting in dressing rooms.

2. Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device:
   2.1. Task lighting for medical and dental purposes.
   2.2. Display lighting for exhibits in galleries, museums and monuments.
3. Lighting for theatrical purposes, including performance, stage, film production and video production.
4. Lighting for photographic processes.
5. Lighting integral to equipment or instrumentation and installed by the manufacturer.
6. Task lighting for plant growth or maintenance.
7. Advertising signage or directional signage.
8. In restaurant buildings and areas, lighting for food warming or integral to food preparation equipment.
9. Lighting equipment that is for sale.
10. Lighting demonstration equipment in lighting education facilities.
11. Lighting *approved* because of safety or emergency considerations, inclusive of exit lights.
12. Lighting integral to both open and glass-enclosed refrigerator and freezer cases.
13. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.
14. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
15. Exit signs.

Reason: There is probably no part of the 2015 IECC lighting requirements that is more confusing than the treatment of sleeping unit and dwelling unit lighting.

In the 2015 IECC, sleeping units have the option of either complying with the lighting power density requirements in Tables C405.4.2(1) and C405.4.2(2) or complying with Section R404.1. Dwelling units also have this choice, with one important clarification: there is no category for individual apartment "living" units in multifamily buildings in Table C405.4.2(2), and the lighting within apartment "living" units was not included in the models when the "multifamily" category was derived in Table C405.4.2(1). Therefore, dwelling units must always be excluded from lighting power density calculations in multifamily buildings, and R404.1 must be followed instead.

Part of this confusion originates with the exclusion of dwelling units from the scope of 90.1. This gets baked into the lighting power density numbers which find their way into the IECC. For example, when the "multifamily" category in Table C405.4.2(1) is derived, it does not include lighting in the apartment units. But when the "dormitory" category in the same table is derived, it does include the lighting within the dormitory units, regardless of whether these are sleeping units or dwelling units. Very few people know this, and it is almost impossible to decipher from reading the code.

The second source of confusion is in the structure of the code, with numerous exceptions hidden in different locations. These requirements do not appear to conflict with each other, but you could spend a great deal of time with the code book before you uncovered them all.

Most users of the code probably don't realize that when Section C405.2.1 requires all rooms 300 square feet or less to be provided with occupant sensor controls, with no exception for sleeping or dwelling units. This means that under current code many hotel and motel guest rooms, dormitories, patient rooms in hospitals, etc. are required to have occupant sensor controls. Rather than sending users of the code through the entirety of C405.2, and including exceptions in every section for dwelling and sleeping units, it makes more sense to consolidate these controls requirements in one location. Note that dwelling units within multifamily buildings would not need to meet this requirement, as they are exempt in C405.1.

Consolidation of these requirements in C405.1 seems to make sense, since these two space types really are different, and most of what follows in C405.2 through C405.5 is not applicable.

This proposal was submitted by the ICC Sustainability 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 2015 the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The proposal clarifies the application of lighting controls to dwelling units and sleeping units. The existing text is confusing and will likely result in over use of automatic controls.

CE178-16 : C405-COLLINS11593

CE179-16

IECC: C405.1, C405.2.2, C405.2.3, C405.2.4, C405.4.1.

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2015 International Energy Conservation Code

Revise as follows:

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

> ~~**Exception:** Dwelling units within commercial buildings shall not be required to comply with Sections C405.2 through C405.5, provided that they comply with Section R404.1.~~ *Dwelling units* within multi-family buildings shall comply with Section R404.1. All other *dwelling units* shall comply with either Section R404.1, or with Sections C405.2.4 and C405.4. *Sleeping units* shall comply with Section C405.2.4, and with either Section R404.1 or C405.4. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.2.15 or C403.2.16.

~~Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.2.15 or C403.2.16.~~

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 C405.2.2.1.

> **Exception:** Where a *manual control* provides light reduction in accordance with Section C405.2.2.2, automatic controls shall not be required for the following:
>
> ~~1.~~ ~~*Sleeping units*.~~
> 2. Spaces where patient care is directly provided.
> 3. Spaces where an automatic shutoff would endanger occupant safety or security.
> 4. Lighting intended for continuous operation.
> 5. Shop and laboratory classrooms.

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 sidelight *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 toplight *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.~~ ~~Dwelling units and sleeping units.~~

    3. Lighting that is required to have specific application control in accordance with Section C405.2.4.

4. Sidelight daylight zones on the first floor above grade in Group A-2 and Group M occupancies.

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. Display and accent light shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
2. Lighting in cases used for display case purposes shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
3. ~~Hotel and motel sleeping units and guest suites~~ *Sleeping units* shall have a master control device that is capable of automatically switching off all permanently installed luminaires and switched receptacles within 20 minutes after all occupants ~~leave~~ have left the ~~room~~ unit.

    Exceptions:

    ~~**Exception:**~~1. Lighting and switched receptacles controlled by captive key systems.

    2. Spaces where patient care is directly provided.
4. Permanently installed luminaires within *dwelling units* shall be provided with controls complying with either Section C405.2.2.2 or C405.2.1.1.
5. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided that the control device is readily accessible.
6. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
7. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

C405.4.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-9.

$TCLP = [\,SL + LV + LTPB + \text{Other}\,]$ **(Equation 4-9)**

where:

TCLP	=	Total connected lighting power (watts).
SL	=	Labeled wattage of luminaires for screw-in lamps.
LV	=	Wattage of the transformer supplying low-voltage lighting.
LTPB	=	Wattage of line-voltage lighting tracks and plugin busways as the specified wattage of the luminaires, but at least 30 W/lin. ft. (100 W/lin m), or the wattage limit of the system's circuit breaker, or the wattage limit of other permanent current-limiting devices on 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.

Exceptions:

1. The connected power associated with the following lighting equipment is not included in calculating total connected lighting power.
    1.1. Professional sports arena playing field lighting.
    ~~1.2. Lighting in sleeping units, provided that the lighting complies with Section R404.1.~~

1.3. Emergency lighting automatically off during normal building operation.

1.4. 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.

1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark.

1.6. Casino gaming areas.

1.7. Mirror lighting in dressing rooms.

2. Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device:

   2.1. Task lighting for medical and dental purposes.

   2.2. Display lighting for exhibits in galleries, museums and monuments.

3. Lighting for theatrical purposes, including performance, stage, film production and video production.
4. Lighting for photographic processes.
5. Lighting integral to equipment or instrumentation and installed by the manufacturer.
6. Task lighting for plant growth or maintenance.
7. Advertising signage or directional signage.
8. In restaurant buildings and areas, lighting for food warming or integral to food preparation equipment.
9. Lighting equipment that is for sale.
10. Lighting demonstration equipment in lighting education facilities.
11. Lighting *approved* because of safety or emergency considerations, inclusive of exit lights.
12. Lighting integral to both open and glass-enclosed refrigerator and freezer cases.
13. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.
14. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
15. Exit signs.

Reason: There is probably no part of the 2015 IECC lighting requirements that is more confusing than the treatment of sleeping unit and dwelling unit lighting.
In the 2015 IECC, sleeping units have the option of either complying with the lighting power density requirements in Tables C405.4.2(1) and C405.4.2(2) or complying with Section R404.1. Sleeping units must always comply with the controls requirements in the code, so that they must be provided with occupant sensors in all spaces 300 sf or less, and light reduction controls in all other spaces. Please keep in mind that hospital patient rooms are considered sleeping units. The proposed re-write in C405.2.4 eliminates the requirement for automatic controls in hospital patient rooms, and also allows captive key systems to be used in other types of sleeping units in lieu of occupant sensors.

Dwelling units also have the choice of either complying with the lighting power density requirements in Tables C405.4.2(1) and C405.4.2(2) or complying with Section R404.1. However, dwelling units which choose to comply with the lighting power density requirements in the code are also required to have automatic shutoff in every room, using either occupant sensors or time-switch controls. One important effect of this proposal would be to replace the controls requriements for dwelling units following the "lighting power density" compliance path with a requirement that all lights within the units either be connected to "light reduction controls" complying with C405.2.2.2 or occupanct sensors complying with C405.2.1.1. Please keep in mind that this is a reduction in stringency compared to the current code, which requires automatic shutoff in all spaces.

An important clarification is also provided for dwelling units in multifamily buildings. There is no category for individual apartment "living" units in multifamily buildings in Table C405.4.2(2), and the lighting within apartment "living" units was not included in the PNNL models when the "multifamily" category was derived in Table C405.4.2(1). Therefore, dwelling units should always be excluded from lighting power density calculations in multifamily buildings, and R404.1 should be followed instead. Very few people understand this, and it is almost impossible to decipher by reading the code.

Finally, the structure of the code is quite confusing in how it deals with sleeping units and dwelling units, with numerous exceptions and qualifications hidden in different locations. These requirements do not appear to conflict with each other, but you could spend a great deal of time with the code book before you uncovered them all. Rather than sending users of the code through the entirety of C405.2, and including exceptions in every section for dwelling and sleeping units, it makes more sense to provide an overview of these requirements in one location, by providing guidance in C405.1.

Cost Impact: Will not increase the cost of construction

By eliminating some controls requirements in sleeping and dwelling units the overall cost of construction would be reduced.

CE179-16 : C405.1-BAILEY12806

CE180-16

IECC: C405.1.

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

2015 International Energy Conservation Code

Revise as follows:

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

> **Exception:** Dwelling units within commercial buildings shall not be required to comply with Sections C405.2 through C405.5, provided that they comply with Section R404.1.

~~Walk-in~~ Lighting installed in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with the lighting requirements of Section C403.2.15 or C403.2.16.

Reason: This proposal clarifies the language in Section C405.1 that pertains to the lighting that is installed in walk-in coolers, freezers, and other refrigeration equipment. The vast majority of requirements shown in Sections C403.2.15 and C403.2.16 are not related to lighting efficiency or controls.
It should be noted that as the federal law for this equipment changes from design specifications to overall energy performance specifications, this language will not be necessary in future versions of the IECC.

Cost Impact: Will not increase the cost of construction
This is a clarification of the language and does not change or add any requirements to the code.

CE180-16 : C405.1-ROSENSTOCK11860

CE182-16

IECC: C405.2, C405.2.4.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C405.2 Lighting controls (Mandatory). Lighting systems shall be provided with controls as specified in Sections C405.2.1~~, C405.2.2, C405.2.3, C405.2.4 and~~ through C405.2.5.

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.

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. ~~Display and accent light~~ The following lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a ~~dedicated~~ time-switch control ~~that is independent of~~ complying with Section C405.2.2.1. In addition, a manual control shall be provided to control such lighting separately from the ~~controls for other~~ general lighting ~~within~~ in the ~~room or~~ 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. ~~2. Lighting in cases used for display case purposes shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.~~
2. Hotel and motel sleeping units and guest suites shall have a master control device that is capable of automatically switching off all installed luminaires and switched receptacles within 20 minutes after all occupants leave the room.

   Exception: Lighting and switched receptacles controlled by captive key systems.
3. ~~3. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided that the control device is readily accessible.~~
3. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a ~~dedicated~~ time switch control complying with Section C405.2.2.1 that is independent of the controls for other lighting within the room or space.
4. ~~4. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.~~

Reason: This proposal is an editorial simplification of this list of requirements. It also clarifies, in item 1, that the automatic controls requirements in Sections C405.2.1 and C405.2.2 are also applicable to lighting in items 1.1 through 1.4. Some users of the code have understood lighting in items 1.1 through 1.4 to be exempt from the requirements of C405.2.1 and C405.2.2, but a careful reading of the code shows that this is not the case and that these lights must also be connected to occupant sensor or time switch controls, in addition to having separate manual control. This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The proposal is editorial and should have no impact on the cost of construction.

CE182-16 : C405.2-COLLINS11594

CE183-16

IECC: C202 (New), C405.2.

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 International Energy Conservation Code

Add new text as follows:

SECTION C202 DEFINITIONS

LUMINAIRE LIGHT LEVEL CONTROLS. A lighting system consisting of one or more luminaires with embedded lighting control logic, occupancy and ambient light sensors, wireless networking capabilities, and local override switching capability, where required.

Revise as follows:

C405.2 Lighting controls (Mandatory). Lighting systems shall be provided with controls ~~as specified in Sections C405.2.1, C405.2.2, C405.2.3, C405.2.4~~ that comply with one of the following:

1. Lighting controls as specified in Sections C405.2.1, C405.2.2, C405.2.3, C405.2.4, and C405.2.5.
2. Luminaire light level controls (LLLC) and lighting controls as specified in Sections C405.2.4, and C405.2.5. The LLLC luminaire shall be independently capable of:

   1. Monitoring occupant activity to brighten or dim its lighting when occupied or unoccupied respectively.
   2. Monitoring ambient light, both electric light and ~~C405.2.5~~ daylight, and brighten or dim artificial light to maintain desired light level
   3. Configuration and re-configuration of performance parameters including; bright and dim set-points, time-outs, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configurations, for each control strategy.

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.

Reason: The purpose of this code change proposal is to acknow ledge lighting control technology that meets the intent of the provisions of the IECC if the control requirements have specific capabilities. Luminaire level lighting control (LLLC) refers to a controls solution w here each luminaire in a space has independence from every other and can therefore maximize incremental control w ithin very small areas. For example, a LLLC luminaire serves 80-120 square feet (sf) of open office space versus the standard approach of 'zoned' lighting controls w ith luminaires grouped to serve much larger interior areas. Each LLLC is not only 'w irelessly addressable', it can locally process information from integrated sensors to implement lighting control logic as w ell as can be programmed, overseen and modified through a computer user interface. An LLLC system w ill meet the intent of the lighting control requirements as specified in Section C405.2.1, C405.2.2, C405.2.3. The minimum LLLC capabilities that w ill meet the IECC lighting control requirements include:

1. Single or multi-type sensors (occupancy and photocell)
2. Embedded luminaire control processor
3. Continuous dimming ballast/drivers

4. Wireless networking radio.

LLLC Benefits include:
• Granularity allowing control at the smallest increment
• System persistence via independent nodes
• Flexibility to modify luminaire output: Limitless grouping, zone control with pre-set auto- response. Tuning the light level (and resulting energy use) to match occupant needs at each fixture. Adjusting to new employee/user/older occupant with individualized adjustment. In response to space reuse (all or part). For temporary demand responsiveness
• Standardization

The LLLC technology, as specified in this proposal, will save approximately 50% over the current lighting control requirements in open office areas. Plan review verification time will be less than that for plan review for compliance with the current lighting control requirements. Plan reviewers only need to determine of the LLLC is specified for all of the lights in the building instead of reviewing lighting control specifications for each space. Building inspection can spot check to verify that the technology is installed verses looking at each room.

Cost Impact: Will not increase the cost of construction
None. The LLLC is listed as an option in meeting the lighting control requirements and is not a required lighting control system.

CE183-16 : C405.2-MAKELA12502

CE184-16

IECC: C405.2.1.

Proponent : Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2015 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~~ Lounge/breakrooms.
5. ~~Employee lunch and break rooms~~ Enclosed offices.
~~6.~~ ~~Private offices.~~
6. Restrooms.
7. Storage rooms.
~~8.~~ ~~Janitorial closets.~~
8. Locker rooms.
9. Other spaces 300 square feet (28 m^2) or less that are enclosed by floor-to-ceiling height partitions.
~~10.~~ ~~Warehouses.~~
10. Warehouse storage areas.

Reason: This proposal revises this section for clarity, and for consistency with other parts of the code, with no change in stringency.

1. Conforms the space types names in this list with the space type names in the Lighting Power Allowance Table C405.5.2(2).

2. "Janitorial closets" are not a space type listed in Table C405.5.2(2) but any room referred to as a "closet" should be assumed to be less than 300 square feet, and hence would already be required to have occupant sensor controls and does not need to be listed separately.

Cost Impact: Will not increase the cost of construction
The proposal is a clarification of the intent of the current code requirements.

CE184-16 : C405.2.1-HEINMILLER12078

CE185-16

IECC: C405.2.1, C405.2.1.1, C405.2.1.3 (New).

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 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.
5. Employee lunch and break rooms.
6. Private offices.
7. <u>Open plan office areas.</u>
8. Restrooms.
9. Storage rooms.
10. Janitorial closets.
11. Locker rooms.
12. Other spaces 300 square feet (28 m^2) or less that are enclosed by floor-to-ceiling height partitions.
13. Warehouses.

C405.2.1.1 Occupant sensor control function. Occupant sensor controls in spaces other than warehouses<u> and open plan office areas, as</u> specified in Section C405.2.1 shall comply with the following:

1. Automatically turn off lights within 30 minutes of all occupants leaving the space.
2. Be manual on or controlled to automatically turn the lighting on 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. Shall incorporate a *manual control* to allow occupants to turn lights off.

Add new text as follows:

<u>**C405.2.1.3 Occupant sensor control function in open plan office areas.** Occupant sensor controls in open plan office spaces less than 250 square feet (23 m^2) 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:</u>

1. <u>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 m^2) within the open plan office space.</u>

2. <u>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.</u>
3. <u>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.</u>
4. <u>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.</u>

Reason: This proposal adds occupant sensor control to open plan office areas. These areas were not previously included in occupant sensor control requirements because there were not readily available controls to switch off small groups of work stations while maintaining a minimum background illumination in the overall area. Multiple manufacturers now have those controls available, so they can be included in code requirements. There are significant savings, especially during after-hours use and custodial service, as lighting only the workstation areas in actual use rather than the entire open office space saves significant energy. The control function for these areas is written so it can be accomplished either with dimming or switching systems and "manual on" is intentionally excluded from this control function, because that is not easily workable in an open office plan area with multiple occupants. The provision does not apply to areas smaller than 250 square feet, as the control function in Section C405.2.1.1 is more appropriate for smaller areas with multiple workstations. For open office areas between 250 and 600 square feet, the control function in either Sections C405.2.1.1 or C405.2.1.3 can be applied, as the control function of C405.2.1.1 meets the requirements of C405.2.1.3, as switching lights off is "<u>no more than 20%</u>."

Energy Savings: An analysis of energy impact shows that net savings from the expanding occupancy sensors to open office areas as proposed is about $34 annually per 400 square feet of floor area in offices in Climate Zone 8. A 400 square foot example is selected as an area that would cover 4 typical workstations and is within the 250 to 600 square foot range of the requirement. Other climate zones will have greater total savings, as there will be less increase in heating resulting from the lower internal loads. More details are found in the cost-effectiveness analysis referenced in the cost impact section.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

Bibliography:

1. Hart, R., and Liu, B. (2015). Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes. Pacific Northwest National Laboratories for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-23923 Rev1. https://www.energycodes.gov/development/commercial/methodology.
2. Hart, R. and R. Athalye. September 2015. "Cost-effectiveness Analysis of Expanding use of Occupancy Sensors." https://www.energycodes.gov/development/2018IECC.

Cost Impact: Will increase the cost of construction

The cost for additional lighting controls in open office areas is expected to be about $250 per 400 square foot workstation area for simple controls, or $0.95 per square foot for advanced wireless control systems; however, there are significant savings associated with these applications.

Cost-effectiveness: PNNL performed a cost-effectiveness analysis using the established DOE methodology.[1] Results of the cost-effectiveness analysis showed that the average savings-to-investment ratio (SIR) is 2.2 to 1.4 in typical offices, depending on the sophistication of the system installed. A proposal 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 complete cost-effectiveness analysis is available at:

https://www.energycodes.gov/development/2018IECC.[2]

CE186-16

IECC: C405.2.1, C405.2.1.1, C405.2.1.2.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

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.
5. Employee lunch and break rooms.
6. Private offices.
7. Restrooms.
8. Storage rooms.
9. Janitorial closets.
10. Locker rooms.
11. Other spaces 300 square feet (28 m^2) or less that are enclosed by floor-to-ceiling height partitions.
12. Warehouses.

Revise as follows:

C405.2.1.1 Occupant sensor control function. Occupant sensor controls in ~~spaces~~ warehouses shall comply with Section C405.2.1.2. Occupant sensor controls for other ~~than warehouses~~ spaces specified in Section C405.2.1 shall comply with the following:

1. ~~Automatically~~ They shall automatically turn off lights within 30 minutes of all occupants leaving the space.
2. ~~Be~~ They shall be manual on or controlled to automatically turn the lighting on 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. ~~Shall~~ They shall incorporate a *manual control* to allow occupants to turn lights off.

C405.2.1.2 Occupant sensor control function in warehouses. 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: Section C405.2.1 tells the code user which spaces must be provided with occupant sensor controls. Section C405.2.1.2 tells the user how the occupant sensor controls must operate in warehouses. Section C405.2.1.1 tells the user how the occupant sensor controls must operate in all the other uses on the C405.2.1 list. The text of C405.2.1.1 is slightly confusing. It doesn't clearly say that the section applies to all of the spaces listed in C405.2.1 **EXCEPT** warehouses. The proposed change solves the issue by providing two sentences with distinct direction for the code user. In case the cdpACCESS system doesn't show the 2 sections not being amended, we have shown all of them for context of the change.

C405.2.1 Occupant sensor controls. Occupant sensor controls shall be installed to control lights in the follow ing space types:

1. Classrooms/lecture/training rooms.
2. Conference/meeting/multipurpose rooms.
3. Copy/print rooms.
4. Lounges.
5. Employee lunch and break rooms.
6. Private offices.
7. Restrooms.
8. Storage rooms.
9. Janitorial closets.
10. Locker rooms.
11. Other spaces 300 square feet (28 m^2) or less that are enclosed by floor-to-ceiling height partitions.
12. Warehouses.

C405.2.1.1 Occupant sensor control function. Occupant sensor controls in spaces other than w arehouses specified in Section C405.2.1 shall comply w ith the follow ing:

1. Automatically turn off lights w ithin 30 minutes of all occupants leaving the space.
2. Be manual on or controlled to automatically turn the lighting on to not more than 50 percent pow er.

   Exception: Full automatic-on controls shall be permitted to control lighting in public corridors, stairw ays, restrooms, primary building entrance areas and lobbies, and areas w here manual-on operation w ould endanger the safety or security of the room or building occupants.

3. Shall incorporate a *manual control* to allow occupants to turn lights off.

C405.2.1.2 Occupant sensor control function in warehouses. In w arehouses, the lighting in aislew ays and open areas shall be controlled w ith occupant sensors that automatically reduce lighting pow er by not less than 50 percent w hen the areas are unoccupied. The occupant sensors shall control lighting in each aislew ay independently and shall not control lighting beyond the aislew ay being controlled by the sensor.

This proposal w as submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC w as established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes w ith 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 2015, the SEHPCAC has held three tw o- or three-day open meetings and 25 w orkgroup calls, w hich included members of the SEHPCAC as w ell as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC w ebsite at: http://w w w .iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
This is editorial clarification and should have no impact on construction cost.

CE186-16 : C405.2.1.1-COLLINS11459

CE187-16

IECC: C405.2.1.1.

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

C405.2.1.1 Occupant sensor control function. Occupant sensor controls in spaces other than warehouses specified in Section C405.2.1 shall comply with the following:

1. Automatically turn off lights within ~~30~~ 20 minutes of all occupants leaving the space.
2. Be manual on or controlled to automatically turn the lighting on 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. Shall incorporate a *manual control* to allow occupants to turn lights off.

Reason: Reducing the shutoff time for occupancy sensors will result in lights turning off sooner after occupants leave a room and increase savings. There has been enough experience with occupancy sensor selection and placement in the design community so that acceptable performance can be achieved with a 20 minute maximum timeout setting.

Energy Savings: A field study of the energy impact of occupancy sensor settings[1] shows a significant difference in savings for 20 minute vs. 5 minute shutoff settings. The range is 6% to 13% difference, depending on space type. It is expected that about half that difference in savings would result from a 30 to 20 minute setting change, or about 5% of total baseline lighting energy use. For a typical installation in Climate Zone 8, where the heating penalty for lighting savings is greatest, the shift in time-off setting from 30 to 20 minutes can result in annual increased savings of around $15 to $20 per thousand square feet of occupancy sensor controlled area.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

Bibliography:

1. Lighting Controls Council. "Demand Reduction and Energy Savings Using Occupancy Sensors." National Electric Manufacturers Association (NEMA), April 2006. https://www.nema.org/Policy/Energy/Efficiency/Documents/demandreduction.pdf.

Cost Impact: Will not increase the cost of construction

There is no added cost, as this simply requires changing a simple setting on the occupancy sensor during installation.

Cost-effectiveness: This change is cost-effective in that it provides significant savings with no anticipated cost increase.

CE187-16 : C405.2.1.1-WILLIAMS12242

CE188-16

IECC: C405.2.2, C405.2.2.1.

Proponent : Jack Bailey, One Lux Studio, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2015 International Energy Conservation Code

Revise as follows:

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 C405.2.2.1.

> **Exception:** Where a *manual control* provides light reduction in accordance with Section C405.2.2.2, ~~automatic controls~~*time-switch controls* shall not be required for the following:
> 1. *Sleeping units*.
> 2. Spaces where patient care is directly provided.
> 3. Spaces where an automatic shutoff would endanger occupant safety or security.
> 4. Lighting intended for continuous operation.
> 5. Shop and laboratory classrooms.

C405.2.2.1 Time-switch control function. Each space provided with *time-switch controls* shall also 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 at least 24 hours and then resumes normally scheduled operations.
4. Have program backup capabilities, which prevent the loss of program and time settings for at least 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 m^2).

    Exceptions:

    1. Within ~~malls, arcades~~ mall concourses, auditoriums, ~~single-tenant retail spaces~~ sales areas, ~~industrial~~ manufacturing facilities and sports arenas:
        - 1.1. The time limit shall be permitted to be greater than 2 hours, provided that the override switch is a captive key device.
        - 1.2. The area controlled by the override switch is permitted to be greater than 5,000 square feet (465 m^2), but shall not be greater than 20,000 square feet (1860 m^2).
        - 1.3. Where provided with *manual control*, the following areas are not required to have light reduction control:
            - 5.7.1. Spaces that have only one luminaire with

a rated power of less than 100 watts.

5.7.2. Spaces that use less than 0.6 watts per square foot (6.5 W/m^2).

5.7.3. Corridors, ~~equipment rooms, public~~ lobbies, electrical ~~or~~ rooms and mechanical rooms.

Reason: The proposal is editorial in nature.
In Section C405.2.2.2 the use of the term "automatic control" is confusing, as occupant sensor controls, time switch controls, and daylight responsive controls are all "automatic" by definition, and this exception is clearly intended to apply to time switch controls only.

The list of space types in the exception to C405.2.2.1 is modified to match the space types listed in Table C405.2.2(2). It is important that we use the same terminology to describe space types throughout the lighting section.

Cost Impact: Will not increase the cost of construction
The proposal clarifies code requirements only. No new requirements are added, and no existing requirements are eliminated.

Analysis: Please note that the format of Section C405.2.2.1 is not correctly reflective of current IECC. Please consult page C72 of the 2015 IECC to see the proper numbering and indentation for this Section.

CE188-16 : C405.2.2.1-BAILEY12052

CE189-16

IECC: C405.2.2.1, C405.2.2.2, C408.3.1.2.

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2015 International Energy Conservation Code

Revise as follows:

C405.2.2.1 Time-switch control function. Each space provided with *time-switch controls* shall also be provided with ~~a *manual control* for light reduction~~ dimming controls 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 at least 24 hours and then resumes normally scheduled operations.
4. Have program backup capabilities, which prevent the loss of program and time settings for at least 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 m^2).

    Exceptions:

    1. Within malls, arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas:
        - 1.1. The time limit shall be permitted to be greater than 2 hours, provided that the override switch is a captive key device.
        - 1.2. The area controlled by the override switch is permitted to be greater than 5,000 square feet (465 m^2), but shall not be greater than 20,000 square feet (1860 m^2).
        - 1.3. Where provided with *manual control*, the following ~~areas~~ spaces are not required to have ~~light-reduction control~~ dimming controls:
            - 5.7.1. Spaces ~~that have only one luminaire~~ with ~~a rated power of~~ less than ~~100~~ 60 watts of installed lighting power.
            - 5.7.2. ~~Spaces that use less than 0.6 watts per square foot (6.5 W/m^2)~~ Corridors, electrical rooms, mechanical rooms, parking areas, and stairwells.
            - ~~5.7.3. Corridors, equipment rooms, public lobbies, electrical or mechanical rooms.~~

C405.2.2.2 ~~Light-reduction~~ Dimming controls. ~~Spaces~~ Luminaires in spaces required to have ~~light-reduction~~ dimming controls shall ~~have a *manual*~~

~~*control* that allows the occupant~~ dim continuously from full output to ~~reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50~~ 15 percent~~. Lighting reduction~~ of full output or lower, and 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.~~

connected to dimming controls that incorporate a preset light level. Where located in courtrooms, dining areas and offices, dimming controls shall be manual, and readily accessible to occupants.

C408.3.1.2 Time-switch controls. Where time-switch controls are provided, the following procedures shall be performed:

1. Confirm that the time-switch control is programmed with accurate weekday, weekend and holiday schedules.
2. Provide documentation to the owner of time- switch controls programming including weekday, weekend, holiday schedules, and set-up and preference program settings.
3. Verify the correct time and date in the time switch.
4. Verify that any battery back-up is installed and energized.
5. Verify that the override time limit is set to not more than 2 hours.
6. Simulate occupied condition. Verify and document the following:
   - 6.1. All lights can be turned on and off by their respective area control switch.
   - 6.2. The switch only operates lighting in the enclosed space in which the switch is located.
7. Simulate unoccupied condition. Verify and document the following:
   - 7.1. Nonexempt lighting turns off.
   - 7.2. Manual override switch allows only the lights in the enclosed space where the override switch is located to turn on or remain on until the next scheduled shutoff occurs.
8. Establish preset light levels for dimming controls that satisfy the functional needs for each space.
9. Additional testing as specified by the *registered design professional*.

Reason: To save energy.
This proposal would replace the "light reduction" switching requirements that have been in the code since 2003 with a new dimming requirement. There are several ways that this will enhance energy savings:

1. Dimming lights reduces their energy consumption, and allowing lights to be set at a uniform dimmed level makes it more likely that lights will be operated at a reduced level than with the current switching requirements.
2. This additional requirement in the time-switch controls section will encourage the more widespread use of occupant sensor controls amongst users of the code who do not want to install dimming controls, and occupant sensor controls are assumed to save more energy in most applications.
3. Dimming will encourage the more widespread use of LED luminaires. LED luminaires are more efficient than conventional light sources, and they are also much more easily dimmed (usually at no additional cost).
4. As proposed here, this section will encourage "task tuning" lighting control strategies. Lighting design is as much an art as a science, and spaces often end up with light levels that are higher than desired for a variety of reasons, including equipment sizing break points, inaccuracies in photometric calculations, and user preferences. "Task tuning" refers to the practice of "presetting" lights permanently to a level less than

100%. Because this reduces power consumption over the life of the lighting installation it is an incredibly effective tool for saving energy.

California Building Energy Efficiency Standards of 2013 require dimmable lights in almost most spaces over 100 square feet, so this is not a new concept. Dimming controls are widely available, and can be as simple as a preset wallbox dimmer switch wired between the time-switch system and the load.

Cost Impact: Will increase the cost of construction
Most LED luminaires are dimmable to 15% at no additional cost. LED technology will be in even more widespread use by the time this code is adopted.
Preset wallbox dimmer switches are available at price points ranging from $13 to $60 each from Home Depot, depending on the style, manufacturer, and size of the load. Assuming 500W per dimmer switch, and 1.0 watts / square foot, this would be one dimmer switch per 500 square feet. Assuming an average installed cost of $50 per dimmer switch, this would result in an increased construction cost of $0.10 per square foot for areas required to comply with this requirement.

The wiring costs are assumed to be the same. The existing "light reduction" switching requirements in the code require one neutral and two switched legs (3 wires total) to a switch box with two switches in it. Depending on the type of dimmer selected, two, three, or four wires may be required to be pulled to the switchbox, but only one device will need to be installed.

Analysis: Please note that the format of Section C405.2.2.1 is not correctly reflective of current IECC. Please consult page C72 of the 2015 IECC to see the proper numbering and indentation for this Section.

CE189-16 : C405.2.2.1-BAILEY12053

CE190-16

IECC: C202 (New), C405.2.2.1, C405.2.4.

Proponent : Hope Medina, Cherry Hills Village, representing Colorado Chapter of ICC (hmedina@coloradocode.net)

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

CAPTIVE KEY OVERRIDE A lighting control that will not release the key that activates the override when the lighting is on.

Revise as follows:

C405.2.2.1 Time-switch control function. Each space provided with *time-switch controls* shall also 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 at least 24 hours and then resumes normally scheduled operations.
4. Have program backup capabilities, which prevent the loss of program and time settings for at least 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 m^2).

    Exceptions:

    1. Within malls, arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas:
        - 1.1. The time limit shall be permitted to be greater than 2 hours, provided that th~~e override~~ switch is a captive key device.
        - 1.2. The area controlled by the override switch~~ is permitted to~~ shall not be ~~greater than~~ limited to 5,000 square feet (465 m^2)~~, but shall not be greater~~ provided that such area is less than 20,000 square feet (1860 m^2).
        - 1.3. Where provided with *manual control*, the following areas are not required to have light reduction control:
            - 5.7.1. Spaces that have only one luminaire with a rated power of less than 100 watts.
            - 5.7.2. Spaces that use less than 0.6 watts per square foot (6.5 W/m^2).
            - 5.7.3. Corridors, equipment rooms, public lobbies, electrical or mechanical rooms.

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. Display and accent light shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
2. Lighting in cases used for display case purposes shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
3. Hotel and motel sleeping units and guest suites shall have a master control device that is capable of automatically switching off all installed luminaires and switched receptacles within 20 minutes after all occupants leave the room.

    Exception: Lighting and switched receptacles controlled by captive key <u>override</u> systems.
4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided that the control device is readily accessible.
5. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
6. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

Reason: Currently there is no definition in the code for a captive key device, and w hen researching the definition it brings up a device for fire services. We corrected the verbiage to reference the correct device for w hat is being required in these sections of the IECC. The definition added is the definition used w ith California's Title 24. This is a definition that is currently being used and recognized, so it makes sense to use something that is already recognizable and usable.
Our Theme: A Code for the End User

Is the code section completely understandable to the end user?

Is the code section or requirement easy to find?

Is the code requirement even doable in the real w orld?

Will the code requirement really save energy or only on paper?

Cost Impact: Will not increase the cost of construction
This is using the correct terminology, so it w ill not increase cost.

Analysis: Please note that the format of Section C405.2.2.1 is not correctly reflective of current IECC. Please consult page C72 of the 2015 IECC to see the proper numbering and indentation for this Section.

CE190-16 : C405.2.2.1-MEDINA12945

CE191-16

IECC: C405.2.2.3.

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2015 International Energy Conservation Code

Revise as follows:

~~C405.2.2.3~~ C405.2.5 Manual controls. Where required by this code, ~~*Manual*~~ *manual controls* for lights shall comply with the following:

1. ~~Shall~~ They shall be readily accessible to occupants.
2. ~~Shall~~ They shall be located where the controlled lights are visible, or shall identify the area served by the lights and indicate their status.

Reason: Sections C405.2.1 and C405.2.2 both require manual controls, and yet this section is currently located w ithin C405.2.2. In order for the provisions to be clearly applicable to C405.2.1 it is proposed that this be re-numbered C405.2.5.
It is common for people to install "above code" lighting controls, for example a manual override sw itch w hich is provided for convenience, not to meet a code requriement. When this is done, the code should not be telling people w here their "above code" control device must be located.

Cost Impact: Will not increase the cost of construction
No additional requirements are being added to the code.

CE191-16 : C405.2.2.3-BAILEY12064

CE192-16

IECC: C405.2.3, C405.4.

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 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 sidelight *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 toplight *daylight zones* complying with Section C405.2.3.3.

~~**Exceptions**~~ **Exception:** ~~Daylight responsive controls~~*Daylight responsive controls* are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Dwelling units and sleeping units.
3. Lighting that is required to have specific application control in accordance with Section C405.2.4.
4. Sidelight ~~daylight zones~~*daylight zones* on the first floor above grade in Group A-2 and Group M occupancies.

5. Buildings where the total connected lighting power calculated under Section C405.4.1 is not greater than the adjusted interior lighting power allowance (*LPAadj*) calculated in accordance with Equation 4-9:

$$LPAadj = [LPAnorm \cdot (1.0 - 0.4 \cdot UDZFA / TBFA)] \quad \textbf{(Equation 4-9)}$$

where:

LPAadj = Adjusted building interior Lighting Power Allowance in Watts

LPAnorm = Normal building Lighting Power Allowance in Watts calculated in accordance with Section C405.4.2 and reduced in accordance with Section C406.3 where option 2 is used to comply with the requirements of Section C406.

UDZFA = Uncontrolled *daylight zone* floor area is the sum of all sidelight and toplight *daylight 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 C405.4.2.

C405.4 Interior lighting power requirements (Prescriptive). A building complies with this section where its total connected lighting power calculated under Section C405.4.1 is not greater than the interior lighting power allowance calculated under Section C405.4.2.

Reason: The IECC currently requires daylight responsive controls in daylight areas except in specific spaces where such controls are not practical or would compromise the use of the space. This proposal allows the option for lighting power density (LPD) to be reduced by 40% in daylight areas in exchange for an exception to daylight responsive controls in daylit areas. That 40% reduction is proportional to daylight areas and can be made in any area of the building to meet the average reduced interior lighting power allowance. In a number of cases, faced with the cost of daylighting controls and the challenges associated with commissioning them, lighting designers have found it more cost-effective to use more efficient lamps and luminaires. This allows a reduction in LPD with no reduction in illumination levels in the affected spaces. However, the daylight-responsive control requirements do not currently allow this tradeoff, as daylight-responsive controls are mandatory. This proposal is **not** a mandate that the LPD be reduced and such controls not be installed – it is only an option should the lighting designer choose to apply it.

The proposal is not intended to allow the LPD reduction exception when daylight controls are used to allow the 40% window-to-wall ratio, as that requirement directly references section C405.2.3.1 without referring to section C405.2.3 where the exception will be added.

In addition to the option for LPD reduction, the word "allowance" was added to section C405.4 as a point of clarification, as the reference is to the lighting power allowance, not the lighting power.

Energy Savings: This change is expected to have slight savings or be savings neutral, but result in more efficient base lighting systems that do not require correct control operation to provide savings. While there is not expected to be a theoretical savings for this tradeoff, two causes may contribute a marginal savings:

- Realization rates (actual delivered savings) for base lighting power density changes are generally expected to be higher for fixed efficiency items like lighting fixture efficacy when compared with savings that rely on controls.
- The proposed exception requires a higher reduction (40% instead of 28.9%) than a theoretical analysis shows is needed, although this may be partially offset by the actual average LPDs in new buildings being below the allowed LPD.

PNNL analyzed the impact of both LPD reductions and daylighting for the small office prototype. The simulation results were reviewed for climate zone 4A which has a typical daylighting impact. It was found that the energy cost savings from 100% daylight responsive building controls could be matched with a 28.9% reduction in LPD for both a furnace and air conditioner systems and an air-source heat pump system. These values were rounded up to 40% to establish a tradeoff value of LPD reduction to daylight area controlled. The increase in savings tradeoff is included for four reasons:

1. To account for the fact that many new buildings have a lower actual LPD than the allowance.
2. The fact that the LPD reduction can be spread over the non-daylight areas, making it highly achievable.
3. If daylight responsive controls were eligible for a performance tradeoff in Section 407, that path requires energy use to be 85% of the standard reference design building.
4. There is interest in encouraging the continued implementation of daylight controls to improve field implementation and acceptance, so the tradeoff should require using the highest efficiency lighting for LPD reduction.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

Bibliography:

1. Richman, E., S. Loper, J. Zhang and R. Hart. December 2015. "Cost-effectiveness Analysis of Reducing Interior Lighting Allowances." https://www.energycodes.gov/development/2018IECC.

Cost Impact: Will not increase the cost of construction

The LPD reduction option as an alternative to daylight responsive controls is an option that can be exercised at the discretion of the designer, so there is no change in actual code requirements. Should the option be taken, the higher efficiency lighting necessary to achieve the reduced LPD is expected to be less expensive than the cost of daylighting controls. A similar analysis was made for LPD reduction where it was found that LED lighting is a cost-effective way to reduce LPDs. That analysis can be reviewed in the documentation for proposal C-8 at: https://www.energycodes.gov/development/2018IECC.[1]

Cost-effectiveness: This change is cost-effective in that it either provides some savings or neutral energy impact, combined with an increase in savings reliability, at no anticipated cost increase. In addition, there is no change in requirements, as this code change proposal simply provides an optional alternative to daylight responsive controls.

CE192-16 : C405.2.3-WILLIAMS12280

CE193-16

IECC: C405.2.3.2, C405.2.3.3.

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2015 International Energy Conservation Code

Revise as follows:

C405.2.3.2 Sidelight daylight zone. The sidelight *daylight zone* is the floor area adjacent to vertical *fenestration* which complies with all of the following:

1. Where the fenestration is located in a wall, the 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(1).
2. Where the *fenestration* is located in a rooftop monitor, the *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(2) and C405.2.3.2(3).
3. The area of the *fenestration* is not less than 24 square feet (2.23 m^2).
4. The distance from the *fenestration* to any building or geological formation which 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. ~~Where located in existing buildings, the~~ <u>The</u>*visible transmittance* of the *fenestration* is not less than 0.20.

C405.2.3.3 Toplight daylight zone. The toplight daylight zone is the floor area underneath a roof fenestration assembly which complies with all of the following:

1. The 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.
2. No building or geological formation blocks direct sunlight from hitting the roof *fenestration* assembly at the peak solar angle on the summer solstice.
3. ~~Where located in existing buildings, the~~ <u>The</u> 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 *daylight zone* is not less than 0.008.

Reason: The term *fenestration* includes opaque doors in w alls, and opaque rooftop access hatches. As currently w ritten, the code w ould establish a *daylight zone* adjacent to these elements w hen they are installed in new buildings. By deleting the phrase "w here located in existing buildings" w e resolve this problem, so that only fenestration elements that admit daylight w ould be considered to establish a *daylight zone*.

Cost Impact: Will not increase the cost of construction
By reducing the scope of daylight responsive controls requirements this proposal w ould reduce the cost of construction.

CE194-16

IECC: C405.2.4.

Proponent : Marilyn Williams, NEMA, representing National Electrical Manufacturers Association (mar_williams@nema.org)

2015 International Energy Conservation Code

Revise as follows:

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. Display and accent light shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
2. Lighting in cases used for display case purposes shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
3. Hotel and motel sleeping units and guest suites shall have a master control device <u>or system</u> that is capable of automatically switching off all installed luminaires and switched receptacles within 20 minutes after all occupants leave the room.

    Exception: Lighting and switched receptacles controlled by captive key systems.
4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided that the control device is readily accessible.
5. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
6. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

Reason: Revision in Section (3) to make it clear that a system also complies w ith the requirement as a system is most likely w hat is utilized.

Cost Impact: Will not increase the cost of construction
This is just an editorial revision to clarify that systems are allow ed to comply w ith the requirement.

CE194-16 : C405.2.4 (NEW)-WILLIAMS11608

CE195-16

IECC: C405.2.4.

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2015 International Energy Conservation Code

Revise as follows:

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. Display and accent light shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
2. Lighting in cases used for display case purposes shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
3. Hotel and motel sleeping units and guest suites shall have ~~a master~~ control ~~device~~ devices or systems that ~~is capable of~~ automatically ~~switching~~ switch off all permanently installed luminaires and switched receptacles within 20 minutes after all occupants leave the room.

   Exception: Lighting and switched receptacles controlled by a captive key ~~systems~~ override switch.
4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided that the control device is readily accessible.
5. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
6. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

Reason: Editorial.
The existing language is permissive, i.e. "capable" rather than "shall". Also, there is no need to require a "master" device when the goal of switching off lights in unoccupied guest suites can be achieved by stand-alone occupant sensors in each room which are not networked together.

The word "permanently" is added to modify "installed luminaires". Hotel and motel guest rooms are unlike many other types of spaces in that they are often lighted primarily with plug-in luminaires.

Finally, the term "captive key system" is proposed to be replaced with "captive key override switch". First, in practice this is usually a device, not a system. Second, a quick review of manufacturer literature shows that these devices are usually referred to as either a "card key switch" or a "key card switch". Third, CA Title 24 uses the term "captive-key override".

Cost Impact: Will not increase the cost of construction
The proposal is mainly editorial, but by eliminating the "master" control and "system" phrases it is possible that some users will be able to install less expensive devices rather than more complicated networked systems, which would decrease the cost of construction without reducing the efficiency.

CE195-16 : C405.2.4-BAILEY12812

CE196-16

IECC: C405.2.5, C405.2.5.1 (New), C405.2.5.2 (New), C405.2.5.3 (New), C405.2.5.4 (New).

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2015 International Energy Conservation Code

Revise as follows:

C405.2.5 Exterior lighting controls. Exterior lighting systems shall be provided with controls that comply with Sections C405.2.5.1 through C405.2.5.4.

Exceptions:

1. Lighting for ~~exterior applications other than emergency lighting that is intended to be automatically off during building operation, lighting specifically~~ covered vehicle entrances and exits from buildings and parking structures where required ~~to meet health and life safety requirements or decorative~~ for eye adaptation.

2. Decorative gas lighting systems ~~shall:~~

   1. ~~Be provided with a control that automatically turns off the lighting as a function of available daylight.~~
   2. ~~Where lighting the building façade or landscape, the lighting shall have controls that automatically shut off the lighting as a function of dawn/dusk and a set opening and closing time.~~
   3. ~~Where not covered in Item 2, the lighting shall have controls configured to automatically reduce the connected lighting power by not less than 30 percent from not later than midnight to 6 a.m., from one hour after business closing to one hour before business opening or during any period when activity has not been detected for a time of longer than 15 minutes.~~

~~All time switches shall be able to retain programming and the time setting during loss of power for a period of at least 10 hours~~.

~~**Exception:** Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security or eye adaptation.~~

3. Lighting controlled from within dwelling units.

Add new text as follows:

C405.2.5.1 Daylight shutoff. Lights shall be automatically turned off when daylight is present and satifies the lighting needs.

C405.2.5.2 Decorative lighting shutoff. Building facade and landscape lighting shall automatically shut off from not later than one hour after business closing to not earlier than one hour before business opening, or longer.

C405.2.5.3 Lighting setback. Lighting that is not controlled in accordance with Section C405.2.5.2 shall be controlled so that the total wattage of such lighting is automatically reduced by not less than 30 percent by selectively switching off or dimming luminaires at one of the following times:

1. From not later than midnight to not earlier than 6 a.m.

2. From not later than one hour after business closing to not earlier than one hour before business opening.
3. During any time where activity has not been detected for 15 minutes or more.

C405.2.5.4 Exterior time-switch control function. Time-switch controls for exterior lighting shall comply with the following:
1. They shall have a clock that is not less than 7 day.
2. They shall be capable of being set for seven different day types per week.
3. They shall incorporate an automatic holiday setback feature.
4. They shall have program backup capabilities that prevent the loss of program and time settings for not less than 10 hours, if power is interrupted.

Reason: Section C405.2.5 w as added to the 2015 IECC, and the langage does not conform to ICC code w riting standards.
First, tw o of the exceptions in the first paragraph, w hich are not explicitly identified as such, are redundant and unecessary. "Emergency lighting that is intended to be automacically off during building operation" is already exempted in C405.2 (exception 3). And "Lighting specifically required to meet health and life safety requirements" is also exempted in C405.2 (exception 1).

Second, the overall structure of this section is unlike anything else in the code book.

This proposal addresses both of these issues. It also tightens the standards for timesw itch systems. When exterior lighting operations are based on business operating hours, it makes sense that a more robust time sw itch system is required, w hich has a seven day operating schedule and holiday setback. The language in C405.2.5.4 is copied directly from C405.2.2.1 so that the same time sw itch system could be used to control both interior and exterior lights.

The proposal also adds one new exception, for "lighting controlled from w ithin dw elling units". This occurs quite frequently on private roof terraces on high-rise residential buildings. People tend to take responsibility for shutting off the lighting that is connected to their ow n electrical meter, and it is not reasonable to require that a digital astronomic timeclock be required to control the light on your private terrace.

Cost Impact: Will not increase the cost of construction
Many people interpret the current provisions of the code to require that exterior lighting be dimmable by at least 30%. While technologically achievable, the additional w iring and controls are expensive, and in many instances the 30% reducion can be achieved by sw itching off lights w hich are not critical to safety and security. The existing code language is not clear on this point.
On the other hand, by placing more stringent requirements on timesw itch systems for exterior lighting this proposal may require a more expensive control system to be used on some projects. But in reality, the big break point in time sw itch system pricing is from a mechanical device to a digital device, and the requirements in the 2015 IECC w ill already require you to use the more expensive digital device in almost all instances.

Putting these tw o considerations together it appears that there w ill be a net reduction in construction costs, though this w ill vary from project to project.

CE196-16 : C405.2.5-BAILEY12061

CE197-16

IECC: C405.2.5.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

C405.2.5 Exterior lighting controls. Lighting for exterior applications other than emergency lighting that is intended to be automatically off during building operation, lighting specifically required to meet health and life safety requirements or decorative gas lighting systems shall:

1. Be provided with a control that automatically turns off the lighting as a function of available daylight.
2. Where lighting the building façade or landscape, the lighting shall have controls that automatically shut off the lighting as a function of dawn/dusk and a set opening and closing time.
3. Where not covered in Item 2, the lighting shall have controls configured to automatically reduce the connected lighting power by not less than 30 percent from not later than midnight to 6 a.m., from one hour after business closing to one hour before business opening or during any period when activity has not been detected for a time of longer than 15 minutes.
4. Luminaires serving outdoor parking areas and having a rated input wattage of greater than 78 Watts and a mounting height of 24 feet (7.3 m) or less above the ground, shall be controlled to automatically reduce the power of each luminaire by not less than 50% when activity has not been detected in the area illuminated by the controlled luminaires for a time period not longer than 15 minutes. Not more than 1,500 watts of lighting power shall be controlled together.

All time switches shall be able to retain programming and the time setting during loss of power for a period of at least 10 hours.

Exception: Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security or eye adaptation.

Reason: This proposed change adds specific occupancy based control to specific exterior lighting w here it is know n to be effective and w ill save the maximum possible energy compared to the current scheduled shutoff requirement. Occupancy based control w ill eliminate lighting energy use w hen the area is unoccupied w hich can be significant in parking areas at night

Cost Impact: Will increase the cost of construction
This w ill increase cost of construction because new controls are being required in some exterior spaces. Occupancy based exterior control has been found to be cost effective based on a recent California study.: http://w w w .energy.ca.gov/title24/2013standards/prerulemaking/documents/current/Reports/Nonresidential/Lighting_Cc

CE197-16 : C405.2.5-FERGUSON12891

CE198-16

IECC: C405.3.

Proponent : Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2015 International Energy Conservation Code

Delete without substitution:

~~**C405.3 Exit signs (Mandatory).** Internally illuminated exit signs shall not be more than 5 watts per side.~~

Reason:
This requirement is already mandated by U.S. Federal regulation and is commonly complied w ith. It is no longer needed in this code.

Exit signs manufactured and distributed in commerce since January 1, 2006 are required by U.S. Federal regulations to consume no more than 5 w atts per side.
See: http://w w w 1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/59

Cost Impact: Will not increase the cost of construction
Exit signs that meet the deleted requirement are already the type of exit signs that are commonly installed, and are required by Federal regulations. Deleting this requirement from this code w ill have no impact on the cost of exit signs that must be installed.

CE198-16 : C405.3-HEINMILLER12076

CE199-16

IECC: C405.3.

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

2015 International Energy Conservation Code

Revise as follows:

C405.3 Exit signs (Mandatory). Internally illuminated exit signs shall not ~~be~~ consume more than 5 watts per side.

Reason: This is an editorial change to clarify the requirement.

Cost Impact: Will not increase the cost of construction
This proposal only clarifies the requirement, and does not add any new requirements or change the existing requirement.

CE199-16 : C405.3-ROSENSTOCK11774

CE200-16

IECC: C405.2.4, C405.4 (New).

Proponent : jim edelson (jim@newbuildings.org)

2015 International Energy Conservation Code

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. Display and accent light shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
2. Lighting in cases used for display case purposes shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
3. Hotel and motel sleeping units and guest suites shall have a master control device that is capable of automatically switching off all installed luminaires and switched receptacles within 20 minutes after all occupants leave the room.

   Exception: Lighting and switched receptacles controlled by captive key systems.
4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided that the control device is readily accessible.
5. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space. Each control zone shall be not greater than the area served by a single luminaire or 4,000 square feet, whichever is larger.
6. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

Add new text as follows:

C405.4 Task lighting for plant growth and maintenance (Mandatory)
Not less than 95 percent of the permanently installed lighting fixtures used for plant growth and maintenance shall be fitted for, and contain only, lamps having an efficacy of not less than 90 lumens per Watt, or the lighting fixtures shall have a total luminaire efficacy of not less than 80 lumens-per-watt.

Reason:
The lighting control requirements for spaces where plant growing is the primary use lack any specificity on what constitutes a zone. This provision to be published in the 2016 Washington Energy Code set a maximum control zone size based on negotiations with lighting designers.

In addition, the exemption from the LPD requirements for plant growth applications lacks any efficacy requirement, thus providing a gap in achieving energy savings from this specific application which also may be exempt from control requirements and be running continuously for extended periods of time. A version of this minimum efficacy provision, which still permits a wide range of lamp sources, will also appear in the new Washington code, where artificial lighting for plant growth is one of the fastest growing energy end uses in the state..

Bibliography:

Cost Impact: Will not increase the cost of construction

There are a wide range of design conditions in agricultural applications that make it difficult to predict the cost impact of this proposal.

The proposal will ensure more effective design for lighting controls for plant growing, thus maximizing the value of the controls that are already required by the energy code. There should be no additional design cost, and only if fewer controls would have been installed per the current code, would there be additional equipment and installation costs.

The higher-efficacy lamps may, or may not, incur additional equipment costs. The per lamp cost will be higher for the next several years, but depending on the design of the lighting system, there may be reduced numbers of luminaires and lamps. In an article entitled "Energy-Efficient Agricultural Lighting" by Scott Sanford,Scott, published in2004 by University of Wisconsin- Extension, the author states "The number of fixtures will depend on the lighting level required, the type of fixture used, the reflectance values of the surfaces to be illuminated, height of the work plane, and the amount of variation in light levels that can be tolerated."

Sample costs include $50-150 per additional control if additional controls are required. Each lighting system designed to this proposal may provide additional costs or cost savings depending on the number of lamps, number of luminaires, costs of lamps, costs of controls, and impacts on the sizing of the HVAC system.

The prices for LED lamps are predicted to reach parity within the 2019-2022 primary adoption period for this code, and the benefits for operators of these facilities would include reduced energy costs. The difference in first cost between T-8 and LED four foot luminaires is projected to decrease to $3.30 per 1000 lumens by 2020, and continue decreasing beyond 2020. According to the "Energy Savings Forecast of Solid-State Lighting in General Illumination Applications" prepared for the U.S. Department of Energy in August 2014, the measured and projected prices for 4 foot linear applications (in constant 2013 dollars) are:

2013 T-8 (fixture+ballast+lamp)	$67.40 per 1000 lumens
2015 LEDs (fixture+lamp)	$118.00 per 1000 lumens
2020 LEDs (fixture+lamp)	$70.70 per 1000 lumens

In addition, there will be labor cost savings due to less frequent relamping.

CE200-16 : C405.4 (NEW)-EDELSON13059

CE201-16

IECC: C405.4, C405.4.1, C405.4.2, C406.1, C406.3.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C405.4 Interior lighting power requirements (Prescriptive). A building complies with this section where its total connected interior lighting power calculated under Section C405.4.1 is not greater than the interior lighting power allowance calculated under Section C405.4.2.

C405.4.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-9.

TCLP = [*SL* + *LV* + *LTPB* + Other] **(Equation 4-9)**

where:

TCLP	=	Total connected lighting power (watts).
SL	=	Labeled wattage of luminaires for screw-in lamps.
LV	=	Wattage of the transformer supplying low-voltage lighting.
LTPB	=	Wattage of line-voltage lighting tracks and plugin busways as the specified wattage of the luminaires, but at least 30 W/lin. ft. (100 W/lin m), or the wattage limit of the system's circuit breaker, or the wattage limit of other permanent current-limiting devices on 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.

Exceptions:

1. The connected power associated with the following lighting equipment is not included in calculating total connected lighting power.
    1.1. Professional sports arena playing field lighting.
    1.2. Lighting in sleeping units, provided that the lighting complies with Section R404.1.
    1.3. Emergency lighting automatically off during normal building operation.
    1.4. 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.
    1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark.
    1.6. Casino gaming areas.
    1.7. Mirror lighting in dressing rooms.
2. Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device:
    2.1. Task lighting for medical and dental purposes.
    2.2. Display lighting for exhibits in galleries, museums and monuments.
3. Lighting for theatrical purposes, including performance, stage, film production and video production.
4. Lighting for photographic processes.
5. Lighting integral to equipment or instrumentation and installed by the

manufacturer.

6. Task lighting for plant growth or maintenance.
7. Advertising signage or directional signage.
8. In restaurant buildings and areas, lighting for food warming or integral to food preparation equipment.
9. Lighting equipment that is for sale.
10. Lighting demonstration equipment in lighting education facilities.
11. Lighting *approved* because of safety or emergency considerations, inclusive of exit lights.
12. Lighting integral to both open and glass-enclosed refrigerator and freezer cases.
13. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.
14. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
15. Exit signs.

C405.4.2 Interior lighting power~~.~~ allowance *No change to text.*

C406.1 Requirements. Buildings shall comply with at least one of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power ~~density system~~ 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.

C406.3 Reduced lighting power ~~density~~. The total connected interior lighting power ~~(watts) of the building~~ calculated in accordance with Section C405.4.1 shall be ~~determined by using~~ less than 90 percent of the ~~lighting power values specified in Table C405.4.2(1) times the floor area for the building types, or by using 90 percent of the interior~~ total lighting power allowance calculated ~~by the Space-by-Space Method~~ in accordance with Section C405.4.2.

Reason: The proposal seeks to improve the language in C405 and C406 regarding lighting power budget. The intent is editorial - providing consistent terms throughout the section.
This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The proposal is editorial and presents no technical change. There should be no impact on the cost of construction.

CE201-16 : C405.4-COLLINS11590

CE202-16

IECC: C202, C405.4.1.

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2015 International Energy Conservation Code

Delete without substitution:

SECTION 202 DEFINITIONS

~~**LOW-VOLTAGE LIGHTING.** Lighting equipment powered through a transformer such as a cable conductor, a rail conductor and track lighting.~~

Revise as follows:

C405.4.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-9.

TCLP = [~~*SL*~~ *LVL*~~+ *LV* + *LTPB*~~ **+ BLL + LED + TRK** + Other] **(Equation 4-9)**

where:

TCLP	=	Total connected lighting power (watts).
~~*SL*~~	~~=~~	~~Labeled wattage of luminaires for screw-in lamps.~~
~~*LV*~~ *LVL*	=	~~Wattage~~ For luminaires with lamps connected directly to building power, such as line voltage lamps , the rated wattage of the ~~transformer supplying low-voltage lighting~~ 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.
~~*LTPB*~~ *TRK*	=	~~Wattage~~ For lighting track, cable conductor, rail conductor, and plug-in busway systems that allow the addition and relocation of ~~line-voltage lighting tracks and plugin busways as~~ luminaires without rewiring, the wattage shall be one of the following: 1. The specified wattage of the luminaires, but ~~at least~~ not less than 30 W/lin. ft. (100 W/lin m)~~, or the~~ . 2. The wattage limit of the ~~system's circuit breaker, or~~ permanent current-limiting devices protecting the system. 3. The wattage limit of ~~other permanent current-limiting devices on~~ 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.

Exceptions:

1. The connected power associated with the following lighting equipment is not included in calculating total connected lighting power.
    1.1. Professional sports arena playing field lighting.
    1.2. Lighting in sleeping units, provided that the lighting complies with Section R404.1.
    1.3. Emergency lighting automatically off during normal building operation.
    1.4. 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.
    1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark.
    1.6. Casino gaming areas.
    1.7. Mirror lighting in dressing rooms.
2. Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device:
    2.1. Task lighting for medical and dental purposes.

    2.2. Display lighting for exhibits in galleries, museums and monuments.

3. Lighting for theatrical purposes, including performance, stage, film production and video production.
4. Lighting for photographic processes.
5. Lighting integral to equipment or instrumentation and installed by the manufacturer.
6. Task lighting for plant growth or maintenance.
7. Advertising signage or directional signage.
8. In restaurant buildings and areas, lighting for food warming or integral to food preparation equipment.
9. Lighting equipment that is for sale.
10. Lighting demonstration equipment in lighting education facilities.
11. Lighting *approved* because of safety or emergency considerations, inclusive of exit lights.
12. Lighting integral to both open and glass-enclosed refrigerator and freezer cases.
13. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.
14. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
15. Exit signs.

Reason: Equation 4-9 was added in the 2015 IECC. While this was a worthwhile addition to the code, when it was added it re-used language from previous versions of the code which have not kept pace with technological developments in the lighting industry. This outdated language creates several problems:
First, "screw base lamps" are not synonymous with incandescent lamps. Incandescent lamps are available in over a dozen different base types, of which only three or four could be described as "screw base". At the same time, many metal halide and high pressure sodium lamps, which operate from ballasts, also have screw bases. This proposal eliminates the term "screw base lamps" and refers instead to "lamps connected directly to building power".

Second, it is not clear what voltages are considered to be "low". When this definition was first added to the code, if was probably assumed to refer to 12V and 24V applications, but UL Class 2 would allow up to 60 volts DC (and LED luminaires with remote drivers in this voltage range are becoming much more common). Furthermore, this code tells us that a "low voltage transformer" has an input voltage of less than 600 volts. So presumably a 277V circuit would be considered "low voltage" to a power engineer, and lights that operates at 277V would also be considered "low voltage". This proposal eliminates the term entirely. The code really doesn't care about voltage - it should only be concerned with wattage. The term "low voltage lighting" was previously used in three different locations within the code, but the other two locations were eliminated in the 2015 version, so this is the only remaining reference in the commercial section of the code.

Third, there is no reference in the code to lighting emitting diode (LED) technology. LED luminaires have neither lamps nor ballasts. This proposal would simply require that the watts going into LED luminaires be counted.

And finally, the introduction of microprocessors into ballasts has resulted in a dramatic reduction in ballast SKU's, as ballasts can now sense what lamp is connected to them and adjust their output accordingly. This proposal requires that the wattage consumed by the ballast when operating the actual installed lamp is all that matters.

Overall this proposal will modernize terminology in the code to much more closely match lighting terminology which is currently in use.

Cost Impact: Will not increase the cost of construction
The intent of this proposal is to clarify the language to result in a more consistent interpretation of the code. However, there may be a minor cost savings. When specifying a luminaire utilizing screw-base lamps in a commercial building, it has become common to require that a "wattage reduction label" be provided on the fixture. This label states that the maximum lamp wattage that can be installed is limited to some smaller amount - typically

12W or 15W per socket - based on the LED retrofit lamp that is actually going to be used in the fixture, rather than the 60W - 150W that the incandescent socket is rated for. This has no impact on the lamps that are used (no commercial building owner will accept incandescent lamps anymore - they all want LED), but it does add a minor fee of typically $5-$15 per fixture for the lavel. The updated language above would end this practice, and result in some minor savings on the re-labelling fee.

CE202-16 : C405.4.1-BAILEY12056

CE203-16

IECC: C405.4.1.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C405.4.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-9.

$TCLP = [SL + LV + LTPB + \text{Other}]$ **(Equation 4-9)**

where:

TCLP	=	Total connected lighting power (watts).
SL	=	Labeled wattage of luminaires for screw-in lamps.
LV	=	Wattage of the transformer supplying low-voltage lighting.
LTPB	=	Wattage of line-voltage lighting tracks and plugin busways as the specified wattage of the luminaires, but at least 30 W/lin. ft. (100 W/lin m), or the wattage limit of the system's circuit breaker, or the wattage limit of other permanent current-limiting devices on 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.

~~**Exceptions 1.**~~ The connected power associated with the following lighting equipment <u>and applications</u> is not included in calculating total connected lighting power.
~~1.1~~ <u>1. Television broadcast lighting for playing areas in sports arenas.</u> Professional sports arena playing field lighting.
~~1.2~~<u>2.</u> Lighting in sleeping units, provided the lighting complies with Section R404.1.
~~1.3~~<u>. 3.</u> Emergency lighting automatically off during normal business hours.
~~1.4~~<u>. 4.</u> 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.
~~1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark~~.
~~1.6~~. <u>5</u>. Casino gaming areas.
~~1.7~~. <u>6</u>. Mirror lighting in dressing rooms.
~~2. Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device.~~
~~2.1~~. <u>7.</u> Task lighting for medical and dental purposes <u>that is in addition to general lighting and controlled by an independent control device.</u>
~~2.2~~. <u>8.</u> Display lighting for exhibits in galleries, museums and monuments <u>that is in addition to general lighting and controlled by an independent control device.</u>

~~3.~~ <u>9</u>. Lighting for theatrical purposes, including performance, state, film production and video production.
~~4~~. <u>10.</u> Lighting for photographic processes.
~~5~~<u>11</u>. Lighting integral to equipment or instrumentation and installed by the manufacturer.
~~6~~. <u>12.</u> Task lighting for plant growth or maintenance.
~~7,~~<u>13</u>. Advertising signage or directional signage.
~~8.~~ <u>14</u>. ~~In restaurant buildings and areas~~, Lighting for food warming ~~or integral to food preparation equipment~~
~~9.~~<u>15</u>. Lighting equipment that is for sale.

~~10~~. 16. Lighting demonstration equipment in lighting education facilities.
~~11~~. 17. Lighting approved because of safety ~~or emergency~~ considerations, ~~inclusive of exit lights~~.
~~12. Lighting integral to both open and glass enclosed refrigerator and freezer cases.~~
~~13~~. 18. Lighting in retail display windows, provided the display area is enclosed by ceiling height partitions.
~~14.~~19. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
~~15.~~ 20. Exit signs.

Reason: This is mostly an editorial reorganization that organizes all exceptions into one list. Unfortunately that seems to have resulted in an excessive amout of underline and strikethrough, but only four revisions are also proposed:

1. Television broadcast lighting for playing areas in sports arenas. ~~Professional sports arena playing field lighting.~~

   Lighting requirements for high definition television are identical for professional and amateur sports arenas and there should be no distinction made based on the professional or amateur status of the athletes. The exception is limited to "television broadcast lighting" because ample lighting w attage is already available for functional lighting for the players (see Table C405.4.2(2) w here 3.68 w /sf is allow ed). This change also makes the IECC consistent w ith the exemption in ASHRAE 90.1.

~~1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark.~~

   This seems to be in conflict w ith C501.6.

~~8. In restaurant buildings and areas,~~ Lighting for food w arming ~~or integral to food preparation equipment~~.

   See exception ~~5.~~11. for lighting that is integral to equipment.

   Food w arming lights should be exempt regardless of w hether they are used in a restaurant or in some other type of food preparation and sales area (e.g. a high school cafeteria).

11. Lighting *approved* because of safety ~~or emergency~~ considerations~~, inclusive of exit lights~~.

   See exception ~~1.3.~~3. for emergency lighting exception.

   See exception ~~15.~~20. for exit sign exception.

~~12 Lighting integral to both open and glass enclosed refrigerator and freezer cases.~~

See exception 5. for lighting that is integral to equipment.

This proposal w as submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC w as established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes w ith 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 2015, the SEHPCAC has held three tw o- or three-day open meetings and 25 w orkgroup calls, w hich included members of the SEHPCAC as w ell as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC w ebsite at: http://w w w .iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
This is really an editorial modernizing and simplifying of this list of exceptions. The only change that might be construed as substantive changing is the playing field lighting w hich is simultaneouslty broadened (i.e. it is no longer limited to professional sports venues) and narrow ed (it is limited to broadcast lighting only).

CE203-16 : C405.4.1-COLLINS11592

CE204-16

IECC: C405.4.1.

Proponent : Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2015 International Energy Conservation Code

Revise as follows:

C405.4.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-9.

TCLP = [*SL* + *LV* + *LTPB* + Other] **(Equation 4-9)**

where:

TCLP	=	Total connected lighting power (watts).
SL	=	Labeled wattage of luminaires for screw-in lamps.
LV	=	Wattage of the transformer supplying low-voltage lighting.
LTPB	=	Wattage of line-voltage lighting tracks and plugin busways as the specified wattage of the luminaires, but at least ~~30~~ 8 W/lin. ft. (~~100~~ 25 W/lin m), or the wattage limit of the system's circuit breaker, or the wattage limit of other permanent current-limiting devices on 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.

Exceptions:

1. The connected power associated with the following lighting equipment is not included in calculating total connected lighting power.
   1.1. Professional sports arena playing field lighting.
   1.2. Lighting in sleeping units, provided that the lighting complies with Section R404.1.
   1.3. Emergency lighting automatically off during normal building operation.
   1.4. 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.
   1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark.
   1.6. Casino gaming areas.
   1.7. Mirror lighting in dressing rooms.
2. Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device:
   2.1. Task lighting for medical and dental purposes.
   2.2. Display lighting for exhibits in galleries, museums and monuments.
3. Lighting for theatrical purposes, including performance, stage, film production and video production.
4. Lighting for photographic processes.
5. Lighting integral to equipment or instrumentation and installed by the manufacturer.
6. Task lighting for plant growth or maintenance.
7. Advertising signage or directional signage.
8. In restaurant buildings and areas, lighting for food warming or integral to food

preparation equipment.

9. Lighting equipment that is for sale.
10. Lighting demonstration equipment in lighting education facilities.
11. Lighting *approved* because of safety or emergency considerations, inclusive of exit lights.
12. Lighting integral to both open and glass-enclosed refrigerator and freezer cases.
13. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.
14. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
15. Exit signs.

Reason: The code requires that at least 30 W/ft be accounted to track lighting because track lighting does not have a fixed power consumption. The power consumption of track can change if fixtures are added or deleted. The 30 watts/ft assumes the use of incandescent track fixtures, for example one 90W incandescent halogen PAR38 fixture every three feet. But if you have a design that uses long lengths of track with few fixtures, you are required to account for much more power than you are actually using, which can very quickly eat up your power allowance. The code allows you to count the wattage of the current limiting device, instead of 30 watts/ft. But this then requires the installation of special current limiters, which is additional hassle, complexity, and cost. These current limiters have no practical purpose. They prevent someone from theoretically loading up the track with many high-wattage halogen fixtures, but realistically this isn't going to happen. So these current limiters just sit there doing nothing.

The world is rapidly shifting from halogen to LED for track lighting fixtures. LED track fixtures are already the default for new installations in the US. By the time IECC-2018 goes into effect it is very unlikely that anyone will be installing halogen track fixtures. LED track fixtures are approximately four times more efficacious than halogen (LED PAR about 80 lumens/watt, Halogen PAR about 20 lumens/watt), using about 25% of the energy of a halogen fixture with equivalent output. Therefore, this proposal reduces the required minimum power allocation for track to 8 watts/ft (25% of 30 watts). This will mean that it will be much less likely that useless current limiters will need to be specified and installed.

Cost Impact: Will not increase the cost of construction
Overall this proposal will reduce the cost of construction because useless current limiters will no longer need to be installed to comply with the code.

CE204-16 : C405.4.1-HEINMILLER13025

CE205-16

IECC: C405.4.2.

Proponent : Jack Bailey, One Lux Studio, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE C405.4.2 (1)
INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (w/ft^2)
Automotive facility	0.80
Convention center	1.01
Courthouse	1.01
Dining: bar lounge/leisure	1.01
Dining: cafeteria/fast food	0.9
Dining: family	0.95
Dormitory (a,b)	0.57
Exercise center	0.84
Fire station (a)	0.67
Gymnasium	0.94
Health care clinic	0.90
Hospital (a)	1.05
Hotel/Motel (a,b)	0.87
Library	1.19

Manufacturing facility	1.17
Motion picture theater	0.76
Multifamily (c)	0.51
Museum	1.02
Office	0.82
Parking garage	0.21
Penitentiary	0.81
Performing arts theater	1.39
Police station	0.87
Post office	0.87
Religious building	1.0
Retail	1.26
School/university	0.87
Sports arena	0.91
Town hall	0.89
Transportation	0.70
Warehouse	0.66
Workshop	1.19

a. Where *sleeping units* are excluded from lighting power calculations by application of R404.1, 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 R404.1, 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 C405.4.2 (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	2.43
In a religious building	1.53
In a sports arena	0.43
Otherwise	0.43
Banking activity area	1.01
Breakroom (See Lounge/Breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	1.34
Otherwise	1.24
Conference/meeting/multipurpose room	1.23

Copy/print room	0.72
Corridor	
In a facility for the visually impaired (and not used primarily by the staff)[b]	0.92
In a hospital	0.79
In a manufacturing facility	0.41
Otherwise	0.66
Courtroom	1.72
Computer room	1.71
Dining area	
In a penitentiary	0.96
In a facility for the visually impaired (and not used primarily by the staff)[b]	1.9
In bar/lounge or leisure dining	1.07
In cafeteria or fast food dining	0.65
In family dining	0.89
Otherwise	0.65
Electrical/mechanical room	0.95
Emergency vehicle garage	0.56

COMMON SPACE TYPES[a]	LPD (watts/sq.ft)
Food preparation area	1.21
Guest room (c,d)	0.47

Laboratory	
In or as a classroom	1.43
Otherwise	1.81
Laundry/washing area	0.6
Loading dock, interior	0.47
Lobby	
In a facility for the visually impaired (and not used primarily by the staff)[b]	1.8
For an elevator	0.64
In a hotel	1.06
In a motion picture theater	0.59
In a performing arts theater	2.0
Otherwise	0.9
Locker room	0.75
Lounge/breakroom	
In a healthcare facility	0.92
Otherwise	0.73
Office	
Enclosed	1.11
Open plan	0.98
Parking area, interior	0.19

Pharmacy area	1.68
Restroom	
In a facility for the visually impaired (and not used primarily by the staff[b]	1.21
Otherwise	0.98
Sales area	1.59
Seating area, general	0.54
Stairway (See space containing stairway)	
Stairwell	0.69
Storage room	0.63
Vehicular maintenance area	0.67
Workshop	1.59
BUILDING TYPE SPECIFIC SPACE TYPES[a]	**LPD (watts/sq.ft)**
Facility for the visually impaired[b]	
In a chapel (and not used primarily by the staff)	2.21
In a recreation room (and not used primarily by the staff)	2.41
Automotive (See Vehicular Maintenance Area above)	
Convention Center—exhibit space	1.45
Dormitory—living quarters [(c,d)]	0.38
Fire Station—sleeping quarters [(c)]	0.22
Gymnasium/fitness center	

In an exercise area	0.72
In a playing area	1.2

BUILDING TYPE SPECIFIC SPACE TYPES[a]	LPD (watts/sq.ft)
healthcare facility	
In an exam/treatment room	1.66
In an imaging room	1.51
In a medical supply room	0.74
In a nursery	0.88
In a nurse's station	0.71
In an operating room	2.48
In a patient room (c)	0.62
In a physical therapy room	0.91
In a recovery room	1.15
Library	
In a reading area	1.06
In the stacks	1.71
Manufacturing facility	
In a detailed manufacturing area	1.29
In an equipment room	0.74
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)	1.23
In a low bay area (less than 25'' floor-to- ceiling height)	1.19
Museum	
In a general exhibition area	1.05
In a restoration room	1.02
Performing arts theater—dressing room	0.61
Post Office—Sorting Area	0.94
Religious buildings	
In a fellowship hall	0.64
In a worship/pulpit/choir area	1.53
Retail facilities	
In a dressing/fitting room	0.71
In a mall concourse	1.1
Sports arena—playing area	
For a Class I facility	3.68
For a Class II facility	2.4
For a Class III facility	1.8
For a Class IV facility	1.2
Transportation facility	
In a baggage/carousel area	0.53
In an airport concourse	0.36

At a terminal ticket counter	0.8
Warehouse—storage area	
For medium to bulky, palletized items	0.58
For smaller, hand-carried items	0.95

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 day care, senior support or people with special visual needs.

c. Where *sleeping units* are excluded from lighting power calculations by application of R404.1, 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 R404.1, neither the area of the *dwelling units* nor the wattage of lighting in the *dwelling units* is counted.

Reason: The treatment of dwelling and sleeping units is one of the most commonly misunderstood parts of C405. To begin with, users have the option of either including dwelling and sleeping unit lighting within their lighting power calculations, or following the "high efficacy lighting" compliance path in R404.1. This choice is not clearly spelled out, as these options are incorporated in very different parts of the code, and a casual user could easily miss them.

Another problem is that many users of the code believe that they are supposed to include the area of sleeping and dwelling units when determining their lighting power allowance for the building, but that they should exclude the wattage of lighting in those units when calculating their connected lighting power. This creates a huge loophole, and is not the intent of the code, although it is also not clearly prohibited anywhere.

The last problem is that dwelling units are always excluded from the scope of Standard 90.1, and when PNNL derives the LPD values for 90.1 they do not include the lighting within dwelling units in building types which have dwelling units. This is not such a big problem for hotels, motels, and dormitories, but it is a significant issue for multifamily buildings, where 90% or more of the floor area may be located within dwelling units.

This proposal would add clarifying footnotes to the LPD Tables to result in a more consistent use and application of the code.

Cost Impact: Will not increase the cost of construction
This proposal is a clarification which does not add any new requirements to the code or delete any existing requirements.

CE205-16 : TABLE C405.4.2-BAILEY12048

CE206-16

IECC: C405.4.2.

Proponent : Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE C405.4.2 (1)
INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (w/ft^2)
Automotive facility	~~0.80~~ 0.71
Convention center	~~1.01~~ 0.76
Courthouse	~~1.01~~0.90
Dining: bar lounge/leisure	~~1.01~~0.90
Dining: cafeteria/fast food	~~0.9~~0.79
Dining: family	~~0.95~~0.78
Dormitory	~~0.57~~0.61
Exercise center	~~0.84~~0.65
Fire station	~~0.67~~0.53
Gymnasium	~~0.94~~0.68
Health care clinic	~~0.90~~0.82
Hospital	1.05
Hotel/Motel	~~0.87~~0.75
Library	~~1.19~~0.78
Manufacturing facility	~~1.17~~0.90

Motion picture theater	~~0.76~~0.83
Multifamily	~~0.51~~0.68
Museum	~~1.02~~1.06
Office	~~0.82~~0.79
Parking garage	~~0.21~~0.15
Penitentiary	~~0.81~~0.75
Performing arts theater	~~1.39~~1.18
Police station	~~0.87~~0.80
Post office	~~0.87~~0.67
Religious building	~~1.00~~0.94
Retail	~~1.26~~1.06
School/university	~~0.87~~0.81
Sports arena	~~0.91~~0.87
Town hall	~~0.89~~0.80
Transportation	~~0.70~~0.61
Warehouse	~~0.66~~0.48
Workshop	~~1.19~~0.90

TABLE C405.4.2 (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	~~2.43~~2.03
In a religious building	1.53
In a sports arena	0.43
Otherwise	0.43
Banking activity area	~~1.01~~ 0.86
Breakroom (See Lounge/Breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	1.34
Otherwise	~~1.24~~0.96
Conference/meeting/multipurpose room	~~1.23~~1.07
Copy/print room	~~0.72~~0.56
Corridor	

In a facility for the visually impaired (and not used primarily by the staff)[b]	0.92
In a hospital	~~0.79~~0.92
In a manufacturing facility	~~0.41~~0.29
Otherwise	0.66
Courtroom	~~1.72~~1.39
Computer room	~~1.71~~1.33
Dining area	
In a penitentiary	0.96
In a facility for the visually impaired (and not used primarily by the staff)[b]	~~1.9~~2.00
In bar/lounge or leisure dining	~~1.07~~0.93
In cafeteria or fast food dining	~~0.65~~0.63
In family dining	~~0.89~~0.71
Otherwise	~~0.65~~0.63
Electrical/mechanical room	~~0.95~~0.43
Emergency vehicle garage	~~0.56~~0.41

COMMON SPACE TYPES[a]	LPD (watts/sq.ft)
Food preparation area	~~1.21~~ 1.06
Guest room	~~0.47~~0.77
Laboratory	
In or as a classroom	~~1.43~~1.20

Otherwise	~~1.81~~1.45
Laundry/washing area	~~0.6~~0.43
Loading dock, interior	~~0.47~~0.58
Lobby	
In a facility for the visually impaired (and not used primarily by the staff)[b]	~~1.8~~2.03
For an elevator	~~0.64~~0.68
In a hotel	1.06
In a motion picture theater	~~0.59~~0.45
In a performing arts theater	~~2.0~~1.70
Otherwise	~~0.9~~1.0
Locker room	~~0.75~~0.48
Lounge/breakroom	
In a healthcare facility	~~0.92~~0.78
Otherwise	~~0.73~~0.62
Office	
Enclosed	~~1.11~~0.93
Open plan	~~0.98~~0.81
Parking area, interior	~~0.19~~0.14
Pharmacy area	~~1.68~~1.34
Restroom	
In a facility for the visually impaired (and not used primarily by the staff[b]	~~1.21~~0.96

Otherwise	~~0.98~~0.85
Sales area	~~1.59~~1.22
Seating area, general	~~0.54~~0.42
Stairway (See space containing stairway)	
Stairwell	~~0.69~~0.58
Storage room	~~0.63~~0.46
Vehicular maintenance area	~~0.67~~0.56
Workshop	~~1.59~~1.14
BUILDING TYPE SPECIFIC SPACE TYPES[a]	**LPD (watts/sq.ft)**
Facility for the visually impaired[b]	
In a chapel (and not used primarily by the staff)	~~2.21~~1.06
In a recreation room (and not used primarily by the staff)	~~2.41~~1.80
Automotive (See Vehicular Maintenance Area above)	
Convention Center—exhibit space	~~1.45~~0.88
Dormitory—living quarters	~~0.38~~0.54
Fire Station—sleeping quarters	~~0.22~~0.20
Gymnasium/fitness center	
In an exercise area	~~0.72~~0.50
In a playing area	~~1.2~~0.82

BUILDING TYPE SPECIFIC SPACE TYPES[a]	LPD (watts/sq.ft)
healthcare facility	
In an exam/treatment room	~~1.66~~1.68
In an imaging room	~~1.51~~1.06
In a medical supply room	~~0.74~~0.54
In a nursery	~~0.88~~1.00
In a nurse's station	~~0.71~~0.81
In an operating room	~~2.48~~2.17
In a patient room	0.62
In a physical therapy room	~~0.91~~0.84
In a recovery room	~~1.15~~1.03
Library	
In a reading area	~~1.06~~0.82
In the stacks	~~1.71~~1.20
Manufacturing facility	
In a detailed manufacturing area	~~1.29~~0.93
In an equipment room	~~0.74~~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)	~~1.23~~0.75
In a low bay area (less than 25'' floor-to- ceiling height)	~~1.19~~0.96
Museum	

In a general exhibition area	1.05
In a restoration room	~~1.02~~0.85
Performing arts theater—dressing room	~~0.61~~0.36
Post Office—Sorting Area	~~0.94~~0.68
Religious buildings	
In a fellowship hall	~~0.64~~0.55
In a worship/pulpit/choir area	1.53
Retail facilities	
In a dressing/fitting room	~~0.71~~0.50
In a mall concourse	~~1.1~~0.90
Sports arena—playing area	
For a Class I facility	~~3.68~~2.47
For a Class II facility	~~2.4~~1.96
For a Class III facility	~~1.8~~1.70
For a Class IV facility	~~1.2~~ 1.13
Transportation facility	
In a baggage/carousel area	~~0.53~~0.45
In an airport concourse	~~0.36~~0.31
At a terminal ticket counter	~~0.8~~0.62
Warehouse—storage area	

For medium to bulky, palletized items	~~0.58~~0.35
For smaller, hand-carried items	~~0.95~~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 day care, senior support or people with special visual needs.

Reason: This proposal revises the Lighting Power Density (LPD) allowances to be appropriate for currently available lighting technology. The values in this proposal are identical to those in Addendum ch to ASHRAE/IES Standard 90.1 after the second public review draft. These values were developed by PNNL/DOE and approved by the ASHRAE/IES 90.1 Lighting Subcommittee for inclusion in Standard 90.1 - 2016 and are derived from the PNN/DOE lighting models that have been used for the development of the LPDs in previous versions of Standard 90.1. LED technology was used in the models for the first time and this is the main reason for the significant reduction in the allowances.
The IALD has supported, and continues to support, the PNNL/DOE LPD modeling process as the best available method for developing appropriate lighting power allowances for energy codes. We participated in the development of these new values through our representation on the 90.1 lighting subcommittee and through the ANSI/ASHRAE/IES public review commenting process. We believe that these values will reduce the energy use of our buildings while still allowing high-quality interior lighting to be provided.

Cost Impact: Will increase the cost of construction
Currently, LED fixtures cost more than fluorescent fixtures. So as of today, this proposal would increase the cost of construction because it will require the use of more LED fixtures. But the effect on cost of construction when IECC-2018 goes into effect will be much less because we expect the cost of LED fixtures to continue to decline. Even though the initial cost of construction may be higher, the use of LED fixtures will be cost effective due to the lower energy use and reduced maintenance costs of LEDs. This is already the case today according to DOE analysis. It will only improve as LED costs come down.

CE206-16 : TABLE C405.4.2-HEINMILLER12068

CE207-16

IECC: C405.4.2.

Proponent : Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE C405.4.2 (2)
INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

BUILDING TYPE SPECIFIC SPACE TYPES[a]	LPD (watts/sq.ft)
healthcare facility	
In an exam/treatment room	1.66
In an imaging room	1.51
In a medical supply room	0.74
In a nursery	0.88
In a nurse's station	0.71
In an operating room	2.48
In a patient room	0.62
In a physical therapy room	0.91
In a recovery room	1.15
Library	
In a reading area	1.06
In the stacks	1.71
Manufacturing facility	
In a detailed manufacturing area	1.29

In an equipment room	0.74
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)	1.23
In a low bay area (less than 25'' floor-to- ceiling height)	1.19
Museum	
In a general exhibition area	1.05
In a restoration room	1.02
Performing arts theater—dressing room	0.61
Post Office—Sorting Area	0.94
Religious buildings	
In a fellowship hall	0.64
In a worship/pulpit/choir area	1.53
Retail facilities	
In a dressing/fitting room	0.71
In a mall concourse	1.1
Sports arena—playing area	
For a Class I facility (c)	3.68
For a Class II facility (d)	2.4
For a Class III facility (e)	1.8
For a Class IV facility (f)	1.2

Transportation facility	
In a baggage/carousel area	0.53
In an airport concourse	0.36
At a terminal ticket counter	0.8
Warehouse—storage area	
For medium to bulky, palletized items	0.58
For smaller, hand-carried items	0.95

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 day care, senior support or people with special visual needs.

c. Class I facilities consist of Professional faciities; and Semi-professional, Collegiate, or Club facilities with seating for 5,000 or more spectators.
d. Class II facilities consist of Collegiate and Semi-professional facilities with seating for fewer than 5,000 spectators; Club facilites with seating for between 2,000 and 5,000 spectators; and Amatuer League and High School facilites with seating for more than 2,000 spectators.
e. Class III facilties consist of Club, Amatuer League, and High School facilites with seating for 2,000 or fewer spectators.
f. Class IV facilities consist of Elementary School and Recreational facilities, and Amatuer League and High School facilties without provision for spectators.

Reason: The Classes of Facility for Sports Arena playing area Lighting Power Allowances are not defined in this code and need to be defined. Otherwise, users of this code and code officials have no idea what they mean. These space types in the interior lighting power allowance LPD table come from ASHRAE/IES Standard 90.1. Class of facility is not defined in Standard 90.1 either, but is known to come from the Illuminating Engineering Society (IES) *Recommended Practice for Sports and Recreational Area Lighting*, IES RP-6-15. The definitions used in the proposed footnotes to the table are derived from IES RP-6-15.

Cost Impact: Will not increase the cost of construction
The proposal is a clarification of the intent of the current code requirements.

CE207-16 : TABLE C405.4.2-HEINMILLER12075

CE208-16

IECC: C405.4.2.

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

TABLE ~~C405.4.2~~ C405.4.2(1) (1)
INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (~~w~~W/ft^2)
Automotive facility	~~0.80~~ 0.71
Convention center	~~1.01~~ 0.76
Courthouse	~~1.01~~ 0.90
Dining: bar lounge/leisure	~~1.01~~ 0.90
Dining: cafeteria/fast food	~~0.9~~ 0.79
Dining: family	~~0.95~~ 0.78
Dormitory	~~0.57~~ 0.61
Exercise center	~~0.84~~ 0.65
Fire station	~~0.67~~ 0.53
Gymnasium	~~0.94~~ 0.68
Health care clinic	~~0.90~~ 0.82
Hospital	1.05
Hotel/Motel	~~0.87~~ 0.75
Library	~~1.19~~ 0.78
Manufacturing facility	~~1.17~~ 0.90

Motion picture theater	~~0.76~~ 0.83
Multifamily	~~0.51~~ 0.68
Museum	~~1.02~~ 1.06
Office	~~0.82~~ 0.79
Parking garage	~~0.21~~ 0.15
Penitentiary	~~0.81~~ 0.75
Performing arts theater	~~1.39~~ 1.18
Police station	~~0.87~~ 0.80
Post office	~~0.87~~ 0.67
Religious building	~~1.0~~ 0.94
Retail	~~1.26~~ 1.06
School/university	~~0.87~~ 0.81
Sports arena	~~0.91~~ 0.87
Town hall	~~0.89~~ 0.80
Transportation	~~0.70~~ 0.61
Warehouse	~~0.66~~ 0.48
Workshop	~~1.19~~ 0.90

For SI units: $W/m^2 = 10.76 \cdot W/ft^2$.
W = watts.

TABLE ~~C405.4.2~~ C405.4.2(2) (2)
INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE TYPES[a]	LPD ~~(watts/sq.ft)~~ (W/ft^2)

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	~~2.43~~ 2.03
In a religious building	1.53
In a sports arena	0.43
Otherwise	0.43
Banking activity area	~~1.01~~ 0.86
Breakroom (See Lounge/Breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	1.34
Otherwise	~~1.24~~ 0.96
Conference/meeting/multipurpose room	~~1.23~~ 1.07
Copy/print room	~~0.72~~ 0.56
Corridor	

In a facility for the visually impaired (and not used primarily by the staff)[b]	0.92
In a hospital	~~0.79~~ 0.92
In a manufacturing facility	~~0.41~~ 0.29
Otherwise	0.66
Courtroom	~~1.72~~ 1.39
Computer room	~~1.71~~ 1.33
Dining area	
In a penitentiary	0.96
In a facility for the visually impaired (and not used primarily by the staff)[b]	~~1.9~~ 2.00
In bar/lounge or leisure dining	~~1.07~~ 0.93
In cafeteria or fast food dining	~~0.65~~ 0.63
In family dining	~~0.89~~ 0.71
Otherwise	~~0.65~~ 0.63
Electrical/mechanical room	~~0.95~~ 0.43
Emergency vehicle garage	~~0.56~~ 0.41

COMMON SPACE TYPES[a]	LPD ~~(watts/sq.ft)~~ (W/ft^2)
Food preparation area	~~1.21~~ 1.06
Guest room	~~0.47~~ 0.77
Laboratory	
In or as a classroom	~~1.43~~ 1.20

Otherwise	~~1.81~~ 1.45
Laundry/washing area	~~0.6~~ 0.43
Loading dock, interior	~~0.47~~ 0.58
Lobby	
In a facility for the visually impaired (and not used primarily by the staff)[b]	~~1.8~~ 2.03
For an elevator	~~0.64~~ 0.68
In a hotel	1.06
In a motion picture theater	~~0.59~~ 0.45
In a performing arts theater	~~2.0~~ 1.70
Otherwise	~~0.9~~ 1.00
Locker room	~~0.75~~ 0.48
Lounge/breakroom	
In a healthcare facility	~~0.92~~ 0.78
Otherwise	~~0.73~~ 0.62
Office	
Enclosed	~~1.11~~ 0.93
Open plan	~~0.98~~ 0.81
Parking area, interior	~~0.19~~ 0.14
Pharmacy area	~~1.68~~ 1.34
Restroom	

In a facility for the visually impaired (and not used primarily by the staff)[b]	~~1.21~~ 0.96
Otherwise	~~0.98~~ 0.85
Sales area	~~1.59~~ 1.22
Seating area, general	~~0.54~~ 0.42
Stairway (See space containing stairway)	
Stairwell	~~0.69~~ 0.58
Storage room	~~0.63~~ 0.46
Vehicular maintenance area	~~0.67~~ 0.56
Workshop	~~1.59~~ 1.14
BUILDING TYPE SPECIFIC SPACE TYPES[a]	**LPD ~~(watts/sq.ft)~~ (W/ft^2)**
Facility for the visually impaired[b]	
In a chapel (and not used primarily by the staff)	~~2.21~~ 1.06
In a recreation room (and not used primarily by the staff)	~~2.41~~ 1.80
Automotive (See Vehicular Maintenance Area above)	
Convention Center—exhibit space	~~1.45~~ 0.88
Dormitory—living quarters	~~0.38~~ 0.54
Fire Station—sleeping quarters	~~0.22~~ 0.20
Gymnasium/fitness center	
In an exercise area	~~0.72~~ 0.50
In a playing area	~~1.2~~ 0.82

BUILDING TYPE SPECIFIC SPACE TYPES[a]	LPD ~~(watts/sq.ft)~~ (W/ft^2)
healthcare facility	
In an exam/treatment room	~~1.66~~ 1.68
In an imaging room	~~1.51~~ 1.06
In a medical supply room	~~0.74~~ 0.54
In a nursery	~~0.88~~ 1.00
In a nurse's station	~~0.71~~ 0.81
In an operating room	~~2.48~~ 2.17
In a patient room	0.62
In a physical therapy room	~~0.91~~ 0.84
In a recovery room	~~1.15~~ 1.03
Library	
In a reading area	~~1.06~~ 0.82
In the stacks	~~1.71~~ 1.20
Manufacturing facility	
In a detailed manufacturing area	~~1.29~~ 0.93
In an equipment room	~~0.74~~ 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)	~~1.23~~ 0.75
In a low bay area (less than 25'' floor-to- ceiling height)	~~1.19~~ 0.96
Museum	

In a general exhibition area	~~1.05~~ 1.05
In a restoration room	~~1.02~~ 0.85
Performing arts theater—dressing room	~~0.61~~ 0.36
Post Office—Sorting Area	~~0.94~~ 0.68
Religious buildings	
In a fellowship hall	~~0.64~~ 0.55
In a worship/pulpit/choir area	1.53
Retail facilities	
In a dressing/fitting room	~~0.71~~ 0.50
In a mall concourse	~~1.1~~ 0.90
Sports arena—playing area[c]	
For a Class I facility	~~3.68~~ 2.47
For a Class II facility	~~2.4~~ 1.96
For a Class III facility	~~1.8~~ 1.70
For a Class IV facility	~~1.2~~ 1.13
Transportation facility	
In a baggage/carousel area	~~0.53~~ 0.45
In an airport concourse	~~0.36~~ 0.31
At a terminal ticket counter	~~0.8~~ 0.62
Warehouse—storage area	

For medium to bulky, palletized items	~~0.58~~ 0.35
For smaller, hand-carried items	~~0.95~~ 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 day care, senior support or people with special visual needs.

c. Class of play as defined in IES RP-6.

For SI units: $W/m^2 = 10.76 \cdot W/ft^2$. W/m in height = 3.281 • W/foot in height.

W = watts.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:
Add to Chapter 6 under IES:
IES RP-6 (2015) Recommended Practice for Sports and Recreational Area Lighting . . . . . Table C405.4.2(2)

Reason: This proposed change modifies the interior lighting power allowance for both space-by-space and building area methods by using Light Emitting Diode (LED) as the base technology in the lighting systems modeling analysis. PNNL reviewed current product availability, efficacy, distribution capability, and cost. In cases where LED fixtures were available and capable of replacing a current technology product, their efficacy was included in the space models. Not all fixtures in the models are replaced with LED technology as in some cases there were not sufficient LED products or the LED technology was not specifically suited for the expected task. The proposal matches the second public review of addendum CH to ASHRAE standard 90.1. Overall the weighted average of lighting power densities (LPD) was reduced. In the process of developing the addendum and responding to comments on the first addendum, the lighting subcommittee of the ASHRAE 90.1 Standing Standards Project Committee revised lighting power densities based on reasonably conservative inclusion of more efficient lighting technology in their standard space models. Where appropriate, the space models LPD is revised as shown in Table C405.4.2(2). Then the building LPD tables are revised based on the space changes. In this process, four building types had small increases compared with the prior 90.1-2013 LPDs:

- The museum and motion picture theatre building type LPDs increased primarily because of the changes in the electric/mechanical room and elevator lobby space types. None of the other space types that make up the majority of the space in a museum (primarily exhibition space) and motion picture theatre (audience seating) had any significant reductions to offset the increases in these two space types. The electric/mechanical room and elevator lobby space type changes were a result of subcommittee discussions and analysis of comment responses that resulted in changes to the lighting models to more fairly represent the lighting power needed for the functions in these spaces.
- The multi-family building type LPD also went up slightly because of the changes in the electric/ mechanical room and elevator lobby space types. The multi-family building type includes only the common spaces since private dwelling spaces are exempt. Therefore, the electric/mechanical room and elevator lobby spaces take up a more significant portion of the building areas.
- The dormitory building type LPD also went up because of the changes in the dormitory room space type. The dormitory building type is dominated by the dormitory room space type and therefore, the whole building value went up. The dorm room space type increased based on subcommittee changes to the model to better represent realistic current design practice which caused an increase in the power needed to effectively light that space type.

With the exception of the noted building LPDs, all other building LPDs were reduced or remained the same.

In addition to LPD revisions, SI conversion factors are added to footnotes, and table headings are made consistent as "W/ft^2." A IES reference for the different sporting facility classes is added, as these are not defined in the standard.

Energy Savings: An analysis of energy impact shows that annual savings from interior lighting power allowance reduction in the proposal ranges from $10 to $126 per thousand square feet of floor area in offices and stand alone retail buildings respectively in Climate Zone 8. Other climate zones will have greater savings, as there will be less heating impact. More details are found in the cost-effectiveness analysis referenced in the cost impact section.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

Bibliography:

1. U.S. Department of Veteran Affairs. May 2014. "LED & Convetnional Lighting Systems Comparison Study." http://www.cfm.va.gov/til/studies/LEDStudy.pdf.
2. Hart, R., and Liu, B. (2015). Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes. Pacific Northwest National Laboratories for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-23923 Rev1. https://www.energycodes.gov/development/commercial/methodology.
3. Richman, E., S. Loper, J. Zhang and R. Hart. December 2015. "Cost-effectiveness Analysis of Reducing Interior Lighting Allowances." https://www.energycodes.gov/development/2018IECC.

Cost Impact: Will increase the cost of construction

The LED fixtures for use in interior light fixtures provide more lighting at a lower energy use. LEDs have a higher cost per lamp, but their expected life is longer, so their overall cost is lower. A study[1] completed in 2014 by the U.S. Department of Veterans Affairs found that LED fixtures were cost-effective in most facility applications. LED prices are expected to continue to decrease, making this technology increasingly cost-effective.

Cost-effectiveness: PNNL performed a cost-effectiveness analysis using The established DOE methodology.[2] Results of the cost-effectiveness analysis showed that the savings-to-investment ratio (SIR) was infinite for typical retail establishments, as the present value of costs was negative due to a reduction in lamp replacement costs. A proposal 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 complete cost-effectiveness analysis is available at: https://www.energycodes.gov/development/2018IECC.[3]

Analysis: A review of the standard(s) proposed for inclusion in the code, IES RP-6, 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 1, 2015.

CE208-16 : TABLE C405.4.2-WILLIAMS12244

CE209-16

IECC: C405.4.2.2.1.

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

C405.4.2.2.1 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. 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, power shall be determined in accordance with Equation 4-10.

   ~~Additional interior lighting power allowance = 500 watts + (Retail Area 1 • 0.6 W/ft^2) + (Retail Area 2 • 0.6 W/ft^2) + (Retai W/ft^2) + (Retail Area 4 • 2.5 W/ft^2)~~

   Additional interior lighting power allowance = 300 W + (*Retail Area 1* • 0.36 W/ft^2) + (*Retail Area 2* • 0.36 W/ft^2) + (*R Area 4* • 1.87 W/ft^2)
   For SI units:

   Additional interior lighting power allowance = 300 W + (*Retail Area 1* • 3.87 W/m^2) + (*Retail Area 2* • 3.87 W/m^2) + (*Retail A 4* • 20.1 W/m^2)

   (Equation 4-10)

   where:

~~Retail Area 1~~*Retail Area 1*	=	The floor area for all products not listed in Retail Area 2, 3 or 4.
~~Retail Area 2~~*Retail Area 2*	=	The floor area used for the sale of vehicles, sporting goods and small electronics.
~~Retail Area 3~~*Retail Area 3*	=	The floor area used for the sale of furniture, clothing, cosmetics and artwork.
~~Retail Area 4~~*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 A that justification documenting the need for additional lighting power based on visua 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 f appearance or for highlighting art or exhibits, provided that the additional lighting power sh W/ft^2 ~~(~~ (10.7 ~~w~~ W/m^2) of such spaces.

Reason: The code allows additional lighting wattage for display lighting in retail areas to acknowledge the need for bright merchandise lighting. This proposal reduces that allowance based on providing equivalent lighting levels with newer light emitting diode (LED) lamp technology. A large portion of retail display lighting that is eligible for the additional allowances typically uses Halogen MR-16 lamps. The LED market has been working steadily to enter this area. In 2012, there were many effective products but they were not robust enough to replace the higher wattage (50W) MR-16 products. As of 2014 and beyond, this has changed. There are now many products covering the spread of the capabilities of the 20W to 50W Halogen MR-16s. LED offerings are effective direct replacements for retail display Halogen. Information from recent reports[1] shows that LED could provide similar light at approximately 30% of the existing Halogen wattage or a 70% reduction. A more conservative approach is taken in this proposal, with a 50% reduction in the general display allowance and a 25% reduction in retail area 4.

This proposal does not include any changes to the decorative lighting allowance in item 2, although the lower case w/ft^2 have been changed to upper case W/ft^2.

Energy Savings: While there is a high variation in how different retail establishments apply display lighting, an analysis of the DOE strip mall prototype[2] for the impact of the proposed savings shows annual energy cost savings of 2.7% per year or around $850 for a 22,500 square foot establishment. This electric cost savings is in addition to the lamp replacement cost savings from using longer life LEDs.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

Bibliography:

1. http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/snapshot2014_mr16.pdf & http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/caliper_22_summary.pdf.
2. The DOE prototypes represent typical U.S. building stock and the building energy use is simulated in EnergyPlus. See more information about the prototypes at: https://www.energycodes.gov/commercial-prototype-building-models.

Cost Impact: Will increase the cost of construction

The LED fixtures for use in display light fixtures provide more lighting output at a lower energy use. LEDs have a higher cost per lamp, but their expected life is longer, so their overall cost is lower. A survey of typical lamps in the 200 to 800 lumen output range is shown in the following table, based on a review of online lamp prices from a national maintenance product supplier.

MR-16 lamp	Lumen Output	Cost per lamp	Life, hours MTTF*	Lamp cost, $/3000 hours	$/500 lumens /3000 hours	$/500 lumens /3000 hours Limited to 5 year use
Halogen	200	$3.33	3,000	$3.33	$8.33	$8.33
Halogen	400	$3.08	1,971	$4.69	$5.86	$5.86
Halogen	500	$15.31	3,000	$15.31	$15.31	$15.31
Halogen	790	$6.47	3,000	$6.47	$4.09	$4.09
Average Halogen		**$7.05**		**$7.45**	**$8.40**	**$8.40**
LED	450	$16.25	25,000	$1.95	$2.17	$3.61
LED	370	$37.00	25,000	$4.44	$6.00	$10.00
LED	650	$35.00	30,000	$3.50	$2.69	$5.38
Average LED		**$23.82**		**$3.30**	**$3.62**	**$6.33**
Ratio of LED to Halogen lamp cost				44%	43%	75%

*MTTF is mean time to failure, a statistically calculated lamp life.

LED prices are expected to continue to decrease, and will be lower by the time this code is adopted. Lamp costs are normalized to 500 lumens of output and 3000 hours of operation a year or about 10 hours per day for 6 days a week. The last column in the table is the lamp cost per 500 lumens per 3000 hours, but limits the LEDs to 5 years of use at 3000 hours per year. In both the full life and conservative 5-year case, the average lamp cost for LEDs is less once lamp life is considered. The costs shown do not include additional lamp replacement labor savings or any reduction in electrical distribution costs due to lower wattage lamps. From several points of view, the use of LED fixtures for display lighting represents a reduction in life cycle lamp costs to building owners.

Cost-effectiveness: This change is cost-effective in that it provides significant savings with no anticipated life-cycle cost increase.

CE209-16 : C405.4.2.2.1-WILLIAMS12362

CE210-16

IECC: C405.4.2.2.1.

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

C405.4.2.2.1 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. 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 4-10.

~~Additional interior lighting power allowance = 500 watts + (Retail Area 1 • 0.6 W/ft ^{2}) + (Retail Area 2 • 0.6 W/ft ^{2}) + (Retail Area 3 • 1.4 W/ft ^{2}) + (Retail Area 4 • 2.5 W/ft ^{2})~~ **~~(Equation 4-10)~~**

Additional interior lighting power allowance = 500 watts + (Retail Area 1 • 0.6 W/ft ^{2}) + (Retail Area 2 • 0.6 W/ft ^{2}) + (Retail Area 3 • 1.4 W/ft ^{2}) + (Retail Area 4 • 2.5 W/ft ^{2})

(Equation 4-10)

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 ~~1.0 w~~ 0.9 W/ft ^{2} ~~(10.7 w~~ (9.7 W/m ^{2}) in lobbies or museum exhibition areas and not more than 0.75 W/ft ^{2} (8.1 W/m ^{2}) ~~of such~~ in other spaces.

Reason: The code allows additional lighting wattage for decorative lighting to acknowledge the need for highlighting art or architectural features. This proposal reduces that allowance based on providing equivalent or brighter lighting levels with newer light emitting diode (LED) lamp technology. A large portion of decorative lighting that is eligible for the additional allowances is typically Halogen MR-16 product. The LED market has been working steadily to enter this area. In 2012, there were many effective products but they were not robust enough to replace the higher wattage (50W) MR-16 products. As of 2014 and beyond, this has changed. There are now many products covering the spread of the capabilities of the 20W to 50W Halogen MR-16s. LED offerings are effective direct replacements for Halogen used to spotlight art or architectural features. Information from recent reports[1] shows that LED could provide similar light at approximately 30% of the existing Halogen wattage or a 70% reduction. A more conservative approach is taken in this proposal, to allow for use of fluorescent wall washers and other luminaires with a 25% reduction in the general decorative allowance and a 10% reduction in spaces with a high need for decorative lighting: lobbies and museum exhibition spaces.

Energy Savings: While there is a high variation in how different buildings apply decorative lighting, a reduction in the maximum allowed decorative lighting allowance will result in potential energy savings. This electric cost savings is in addition to the lamp replacement cost savings from using longer life LEDs.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

Bibliography:

1. http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/snapshot2014_mr16.pdf & http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/caliper_22_summary.pdf

Cost Impact: Will increase the cost of construction

The LED fixtures for use in many decorative light fixtures provide more lighting output at a lower energy use. LEDs have a higher cost per lamp, but their expected life is longer, so their overall cost is lower. A survey of typical lamps in the 200 to 800 lumen output range is shown in the following table, based on a review of online lamp prices from a national maintenance product supplier.

MR-16 lamp	Lumen Output	Cost per lamp	Life, hours MTTF*	Lamp cost, $/3000 hours	$/500 lumens /3000 hours	$/500 lumens /3000 hours Limited to 5 year use
Halogen	200	$3.33	3,000	$3.33	$8.33	$8.33
Halogen	400	$3.08	1,971	$4.69	$5.86	$5.86
Halogen	500	$15.31	3,000	$15.31	$15.31	$15.31
Halogen	790	$6.47	3,000	$6.47	$4.09	$4.09
Average Halogen		**$7.05**		**$7.45**	**$8.40**	**$8.40**
LED	450	$16.25	25,000	$1.95	$2.17	$3.61
LED	370	$37.00	25,000	$4.44	$6.00	$10.00
LED	650	$35.00	30,000	$3.50	$2.69	$5.38
Average LED		**$23.82**		**$3.30**	**$3.62**	**$6.33**
Ratio of LED to Halogen lamp cost				44%	43%	75%

*MTTF is mean time to failure, a statistically calculated lamp life.

LED prices are expected to continue to decrease, and will be lower by the time this code is adopted. Lamp costs are normalized to 500 lumens of output and 3000 hours of operation a year or about 10 hours per day for 6 days a week. The last column in the table is the lamp cost per 500 lumens per 3000 hours, but limits the LEDs to 5 years of use at 3000 hours per year. In both the full life and conservative 5-year case, the average lamp cost for LEDs is less once lamp life is considered. The costs shown do not include additional lamp replacement labor savings or any reduction in electrical distribution costs due to lower wattage lamps. From several points of view, the use of LED fixtures for decorative lighting represents a reduction in life cycle lamp costs to building owners.

Cost-effectiveness: This change is cost-effective in that it provides savings with no anticipated life-cycle cost increase.

CE210-16 : C405.4.2.2.1-WILLIAMS12367

CE211-16

IECC: C405.5, C405.5.1, C405.5.2 (New), C405.5.2(3) (New), C405.5.2.1 (New).

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C405.5 Exterior lighting power requirements (Mandatory). ~~Where the power for~~ A building complies with this section where its total connected exterior lighting power calculated under Section C405.5.1 is ~~supplied through~~ not greater than th~~e energy service to the building, all~~ exterior lighting ~~shall comply with~~ power allowance calculated under Section ~~C405.5.1~~ C405.5.2.

> ~~**Exception:** Where *approved* because of historical, safety, signage or emergency considerations.~~

C405.5.1 ~~Exterior~~ Total connected building lighting power. The total exterior connected lighting power ~~allowance for~~ shall be the total maximum rated wattage of all ~~exterior building applications~~ lighting that is ~~the sum of~~ powered through the ~~base site allowance plus the individual allowances for areas that are~~ energy service to ~~be illuminated and are permitted in Table C405.5.1(2) for the applicable lighting zone. Trade-offs are allowed only among exterior lighting applications listed in Table C405.5.1(2), in the Tradable Surfaces section. The lighting zone for~~ the building ~~exterior is determined from Table C405.5.1(1) unless otherwise specified by the local jurisdiction~~.

> **Exception:** Lighting used for the following ~~exterior~~ applications ~~is exempt where equipped with a control device independent of the control of the nonexempt lighting:~~ 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 is 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 public monuments and registered historic landmark structures or buildings.~~
> 13. Used to highlight features of public monuments.

Add new text as follows:

C405.5.2 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 to the building. Lighting power allowances are as specified in Table C405.5.2(2). The lighting zone for the building exterior is determined in accordance with Table C405.5.2(1) unless otherwise specified by the authority having jurisdiction.

TABLE ~~C405.5.1~~ C405.5.2(2) (2)
~~INDIVIDUAL~~ LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

		LIGHTING ZONES			
		Zone 1	**Zone 2**	**Zone 3**	**Zone 4**
~~Base Site Allowance (Base allowance is usable in tradable or nontradable surfaces.)~~	Base site Allowance	500 W	600 W	750 W	1300 W
	Uncovered Parking Areas				
	Parking areas and drives	0.04 W/ft^2	0.06 W/ft^2	0.10 W/ft^2	0.13 W/ft^2
	Building Grounds				
	Walkways less than 10 feet wide	0.7 W/linear foot	0.7 W/linear foot	0.8 W/linear foot	1.0 W/linear foot
	Walkways 10 feet wide or greater, plaza areas special feature areas	0.14 W/ft^2	0.14 W/ft^2	0.16 W/ft^2	0.2 W/ft^2
	Stairways	0.75 W/ft^2	1.0 W/ft^2	1.0 W/ft^2	1.0 W/ft^2
~~Tradable Surfaces (Lighting power densities for uncovered parking areas, building~~	Pedestrian tunnels	0.15 W/ft^2	0.15 W/ft^2	0.2 W/ft^2	0.3 W/ft^2
	Building Entrances and Exits				

~~grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)~~	Main entries	20 W/linear foot of door width	20 W/linear foot of door width	30 W/linear foot of door width	30 W/linear foot of door width
	Other doors	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width
	Entry canopies	0.25 W/ft^2	0.25 W/ft^2	0.4 W/ft^2	0.4 W/ft^2
	Sales Canopies				
	Free-standing and attached	0.6 W/ft^2	0.6 W/ft^2	0.8 W/ft^2	1.0 W/ft^2
	Outdoor Sales				
	Open areas (including vehicle sales lots)	0.25 W/ft^2	0.25 W/ft^2	0.5 W/ft^2	0.7 W/ft^2
	Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	10 W/linear foot	10 W/linear foot	30 W/linear foot
~~Nontradable Surfaces (Lighting power density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The~~	~~Building facades~~	~~No allowance~~	~~0.075 W/ft2 of gross above grade wall area~~	~~0.113 W/ft^2 of gross above grade wall area~~	~~0.15 W/ft^2 of gross above grade wall area~~
	~~Automated teller machines (ATM) and night depositories~~	~~270 W per location plus 90 W per additional ATM per location~~	~~270 W per location plus 90 W per additional ATM per location~~	~~270 W per location plus 90 W per additional ATM per location~~	~~270 W per location plus 90 W per additional ATM per location~~
	E~~ntrances and gatehouse inspection stations at guarded facilities~~	~~0.75 W/ft^2 of covered and uncovered area~~	~~0.75 W/ft^2 of covered and uncovered area~~	~~0.75 W/ft^2 of covered and uncovered area~~	~~0.75 W/ft^2 of covered and uncovered area~~

~~following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.~~)	~~Loading areas for law enforcement, fire, ambulance and other emergency service vehicles~~	~~0.5 W/ft² of covered and uncovered area~~	~~0.5 W/ft² of covered and uncovered area~~	~~0.5 W/ft² of covered and uncovered area~~	~~0.5 W/ft² of covered and uncovered area~~
	~~Drive-up windows/doors~~	~~400 W per drive-through~~	~~400 W per drive-through~~	~~400 W per drive-through~~	~~400 W per drive-through~~
	~~Parking near 24-hour retail entrances~~	~~800 W per main entry~~	~~800 W per main entry~~	~~800 W per main entry~~	~~800 W per main entry~~

For SI: 1 foot = 304.8 mm, 1 watt per square foot = 0.0929 W/~~0.0929~~ m ^{2} .

W = watts.

TABLE C405.5.2(3)

	LIGHTING ZONES		
	Zone 1	**Zone 2**	**Zone 3**
Building facades	No allowance	0.075 W/ft^2 of gross above-grade wall area	0.113 W/ft^2 of gross above-grade wall area
Automated teller machines (ATM) and night depositoris	270 W per location plus 90 W per additional ATM per location		
Entrances and gatehouse inspection stations at guarded facilities	0.75 W/ft^2 of covered and uncovered area.		
Loading areas for law enforcement, fire, ambulance and other	0.5 W/ft^2 of covered and uncovered area		

emergency service vehicles	
Drive-up windows and doors	400 W per drive through
Parking near 24-hour retail entrances.	800 W per main entry

C405.5.2.1 Additional exterior lighting power Any increase in the exterior lighting power allowance is limited to the specific lighting applications indicated in Table C405.5.2(3). The additional power shall be used only for the luminaires that are serving these applications and shall not be used for any other purpose.

Reason: This proposal is intended as an editorial re-write to make the exterior lighting power section read like the interior lighting power section. This would be of great benefit to the code in the long run. Some specific notes about the changes:

> **The code does not currently state that the connected exterior lighting power must be less than or equal to the exterior lighting power allowance. This seems like a significant omission. The language above, and the proposed restructuring of this section, is meant to replicate the interior lighting power requirements in C405.4 as closely as possible. This has obvious advantages in education, application of the code, and enforcement.**
>
> **Regarding the existing exception in Section C405.5: First, all exceptions should be listed under C405.5.1. Second, all "historical" exceptions should be eliminated from the body of the code, as these are addressed in Section C501.6. Third, signage is already exempt (see C405.5.1 exceptions 1 and 2). The "safety and emergency" exemptions are added to the list in Section C405.5.1.**
>
> **It is not clear why the interior lighting power section uses the concept of "additional power allowances" whereas the exterior lighting power section uses the concept of "tradable and nontradable allowances". It is much cleared to users if both sections approach this in the same way and with the same terminology.**

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The intent of the proposal is editorial. While a substantial modernization of the text, there is no intent at substantive change.

CE211-16 : C405.5-COLLINS11622

CE212-16

IECC: C405.5.1.

Proponent : Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2015 International Energy Conservation Code

Revise as follows:

C405.5.1 Exterior building lighting power. The total exterior lighting power allowance for all exterior building applications is the sum of the base site allowance plus the individual allowances for areas that are to be illuminated and are permitted in Table C405.5.1(2) for the applicable lighting zone. Trade-offs are allowed only among exterior lighting applications listed in Table C405.5.1(2), in the Tradable Surfaces section. The lighting zone for the building exterior is determined from Table C405.5.1(1) unless otherwise specified by the local jurisdiction.

> **Exception:**Lighting used for the following exterior applications is exempt where equipped with a control device independent of the control of the nonexempt lighting:
>
> 1. Specialized signal, directional and marker lighting associated with transportation.
> 2. Advertising signage or directional signage.
> 3. Integral to equipment or instrumentation and is installed by its manufacturer.
> 4. Theatrical purposes, including performance, stage, film production and video production.
> 5. Athletic playing areas.
> 6. Temporary lighting.
> 7. Industrial production, material handling, transportation sites and associated storage areas.
> 8. Theme elements in theme/amusement parks.
> 9. Used to highlight features of art, public monuments, and ~~registered historic landmark structures or buildings~~ the National flag.
> 10. Lighting for water features and swimming pools.
> 11. Lighting that is controlled from within dwelling units, where the lighting complies with Section R404.1.

Reason: This proposal adds some minor types of lighting to be exempted from the exterior lighting power limits.
1. The exemption for art would make the IECC 2018 consistent with ANSI/ASHRAE/IES Standard 90.1 - 2016.

2. The exemptions for swimming pools and water features should be have been added to previous versions of this code. They were added in the 2010 version of ASHRAE/IES Standard 90.1.

3. All "historical" exceptions should be eliminated from the body of the code, as these are addressed in Section C501.6.

4. Federal law stipulates many aspects of flag etiquette. The section of law dealing with American Flag etiquette is generally referred to as the Flag Code. The flag code stipulates that the flag should be lighted at all times, either by sunlight or by an appropriate light source. However, there is no allowance in TABLE C405.5.2(2) for flag lighting, so a project which consisted of (a) erecting a flag pole, and (b) lighting it, would be in trouble.

Cost Impact: Will not increase the cost of construction
This proposal exempts some additional types of lighting from the exterior lighting power requirements of this code.

CE212-16 : C405.5.1-HEINMILLER12085

CE213-16

IECC: C405.5.2 (New).

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

2015 International Energy Conservation Code

Add new text as follows:

C405.5.2 Lighting equipment (Mandatory) Gas-fired lighting appliances shall not be equipped with continuously burning pilot ignition systems.

Reason: This provision will make the lighting section of commercial code consistent with the lighting section of the residential code section R404.1.1. It will also be consistent with other provisions of the code, such as Section C404.9.1 for commercial pool heaters ("Gas-fired heaters shall not be equipped with continuously burning pilot lights"), Table 403.2.3(4) for warm air furnaces, footnotes f and g, ("Units shall also include an IID" - IID is an intermittent ignition device), federal energy efficiency requirements for residential gas ovens, federal energy efficiency requirements for residential gas hot water boilers, and federal efficiency requirements for residential gas steam boilers.
The energy usage of gas lighting with contiuously burning pilot lights is very significant. A gas light using 2,500 Btu/hour will give off about the same amount of light as a 60-Watt (205 Btu) incandescent light bulb (about 800-850 lumens). In other words, a gas light will use over 12 times more energy than an incandescent light bulb. When compared to a 10-Watt LED light bulb, the gas light uses over 72 times more energy.

With a continuously burning pilot light, the 2,500 Btu/hour gas light will use 21.9 Million Btu's (or about 215 therms or 215 ccf) of gas per year. In other words, one light will use more than a typical residential gas water heater.

Many manufacturers produce gas lamps that do not have continuously burning pilot lights, as shown below:

http://www.gaslights.com/electronicignitionlightstorches.aspx, https://www.vulcanlighting.com/catalog/, http://americangaslamp.com/product-support/lamp-installation/, http://www.flambeauxlighting.com/faqs.aspx

The savings will be significant. Usage will be reduced by at least 50%, and for a 2,500 Btu/hour gas lamp, that translate to a savings of 109.5 Million Btu's per year (or about 107.5 therms per year). At a commercial rate of $0.90 per therm, the savings are $96.75 per year. This will mean that the simple payback will be less than 1-2 years.

Cost Impact: Will increase the cost of construction
The cost to install a gas light without continuously burning pilot lights is slightly higher (approximately $50-100), depending on the installation and wiring needs.

CE213-16 : C405.5.1-ROSENSTOCK11856

CE214-16

IECC: C405.5.1.

Proponent : Michael Hamilton, representing Arlington County Government (VA) (mhamilton@arlingtonva.us)

2015 International Energy Conservation Code

TABLE C405.5.1 (2)
INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

		LIGHTING ZONES			
		Zone 1	**Zone 2**	**Zone 3**	**Zone 4**
Base Site Allowance[a] (Base allowance is usable in tradable or nontradable surfaces.)		500 W	600 W	750 W	1300 W
Tradable Surfaces (Lighting power densities for	**Uncovered Parking Areas**				
	Parking areas and drives	0.04 W/ft^2	0.06 W/ft^2	0.10 W/ft^2	0.13 W/ft^2
	Building Grounds				
	Walkways less than 10 feet wide	0.7 W/linear foot	0.7 W/linear foot	0.8 W/linear foot	1.0 W/linear foot
	Walkways 10 feet wide or greater, plaza areas special feature areas	0.14 W/ft^2	0.14 W/ft^2	0.16 W/ft^2	0.2 W/ft^2
	Stairways	0.75 W/ft^2	1.0 W/ft^2	1.0 W/ft^2	1.0 W/ft^2
	Pedestrian tunnels	0.15 W/ft^2	0.15 W/ft^2	0.2 W/ft^2	0.3 W/ft^2

uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	**Building Entrances and Exits**				
	Main entries	20 W/linear foot of door width	20 W/linear foot of door width	30 W/linear foot of door width	30 W/linear foot of door width
	Other doors	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width
	Entry canopies	0.25 W/ft^2	0.25 W/ft^2	0.4 W/ft^2	0.4 W/ft^2
	Sales Canopies				
	Free-standing and attached	0.6 W/ft^2	0.6 W/ft^2	0.8 W/ft^2	1.0 W/ft^2
	Outdoor Sales				
	Open areas (including vehicle sales lots)	0.25 W/ft^2	0.25 W/ft^2	0.5 W/ft^2	0.7 W/ft^2
	Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	10 W/linear foot	10 W/linear foot	30 W/linear foot
Nontradable Surfaces (Lighting power density calculations for the following applications can be used only for the specific application and cannot be traded	Building facades	No allowance	0.075 W/ft2 of gross above-grade wall area	0.113 W/ft^2 of gross above-grade wall area	0.15 W/ft^2 of gross above-grade wall area
	Automated teller machines (ATM) and night depositories	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location
	Entrances and gatehouse inspection stations	0.75 W/ft^2 of covered	0.75 W/ft^2 of covered	0.75 W/ft^2 of covered	0.75 W/ft^2 of covered and

between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	at guarded facilities	and uncovered area	and uncovered area	and uncovered area	uncovered area
	Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.5 W/ft^2 of covered and uncovered area	0.5 W/ft^2 of covered and uncovered area	0.5 W/ft^2 of covered and uncovered area	0.5 W/ft^2 of covered and uncovered area
	Drive-up windows/doors	400 W per drive-through	400 W per drive-through	400 W per drive-through	400 W per drive-through
	Parking near 24-hour retail entrances	800 W per main entry	800 W per main entry	800 W per main entry	800 W per main entry

~~For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m^2.~~

~~W = watts.~~

a. For additions to an existing building, the Base Site Allowance for the additions shall be zero Watts.

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m^2.

W = watts.

Reason: Under the current code language, an addition to an existing building can utilize a "Base Site Allowance" to calculate the total allowable exterior lighting power of the addition. The base site allowance is a one-time whole-building allowance regardless of the size or type of building. Therefore, any building that is being expanded upon with an addition would have already utilized the Base Site Allowance to calculate the total allowable exterior lighting power of the existing building. The current code language allows for an existing building that has been designed and built to just below the maximum allowable exterior lighting power allowance to be expanded with an addition that together greatly increase the allowable exterior lighting power. The code-compliant building with code-compliant additions will result in a greater exterior lighting power allowance than if the entire building and addition were designed and constructed at the same time as one building with one "Base Site Allowance." This proposed code change aligns the total allowable exterior lighting power of an existing building and addition with the total allowable exterior lighting power of a building of comparable design built all at once.

Cost Impact: Will not increase the cost of construction
This code change proposal does not increase the cost of construction. Substantiation: The elimination of the "Base Site Allowance" for additions will result a lower exterior lighting power allowance for an addition. A lower exterior lighting power allowance means less exterior lighting. This will not require new equipment or more costly equipment to be purchased and installed. This code change does not require an investment in more efficient equipment in order to achieve energy savings, but rather requires the installation of less equipment in order to achieve energy savings.

CE214-16 : TABLE C405.5.1-HAMILTON13127

CE215-16

IECC: C405.5.1.

Proponent : Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE C405.5.1 (2)
INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

		LIGHTING ZONES			
		Zone 1	**Zone 2**	**Zone 3**	**Zone 4**
Base Site Allowance (Base allowance is usable in tradable or nontradable surfaces.)		~~500~~350 W	~~600~~400 W	~~750~~500 W	~~1300~~900 W
	Uncovered Parking Areas				
	Parking areas and drives	~~0.04~~0.03 W/ft^2	~~0.06~~0.04 W/ft^2	~~0.10~~0.06 W/ft^2	~~0.13~~0.08 W/ft^2
	Building Grounds				
	Walkways and Ramps less than 10 feet wide	~~0.7~~0.5 W/linear foot	~~0.7~~0.5 W/linear foot	~~0.8~~0.6 W/linear foot	~~1.0~~0.7 W/linear foot
	Walkways and Ramps 10 feet wide or greater, plaza areas, special feature areas	~~0.14~~0.10 W/ft^2	~~0.14~~0.10 W/ft^2	~~0.16~~0.11 W/ft^2	~~0.2~~0.14 W/ft^2
	Dining Areas	0.65 W/ft^2	0.65 W/ft^2	0.75 W/ft^2	0.95 W/ft^2

Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	Stairways	~~0.75~~0.6 W/ft^2	~~1.0~~0.7 W/ft^2	~~1.0~~0.7 W/ft^2	~~1.0~~0.7 W/ft^2
	Pedestrian tunnels	~~0.15~~0.12 W/ft^2	~~0.15~~0.12 W/ft^2	~~0.2~~0.14 W/ft^2	~~0.3~~0.21 W/ft^2
	Landscaping	0.03 W/ft^2	0.04 W/ft^2	0.04 W/ft^2	0.04 W/ft^2
	Building Entrances and Exits				
	Pedestrian and vehicular entrances and exits~~Main entries~~	~~20~~14 W/linear foot of opening~~door width~~	~~20~~14 W/linear foot of opening~~door width~~	~~30~~21 W/linear foot of opening~~door width~~	~~30~~21 W/linear foot of opening~~door width~~
	~~Other doors~~	~~20 W/linear foot of door width~~	~~20 W/linear foot of door width~~	~~20 W/linear foot of door width~~	~~20 W/linear foot of door width~~
	Entry canopies	~~0.25~~0.2 W/ft^2	0.25 W/ft^2	0.4 W/ft^2	0.4 W/ft^2
	Loading docks	0.35 W/ft^2	0.35 W/ft^2	0.35 W/ft^2	0.35 W/ft^2
	Sales Canopies				
	Free-standing and attached	~~0.6~~0.4 W/ft^2	~~0.6~~0.4 W/ft^2	~~0.8~~0.6 W/ft^2	~~1.0~~0.7 W/ft^2
	Outdoor Sales				
	Open areas (including vehicle sales lots)	~~0.25~~0.2 W/ft^2	~~0.25~~0.2 W/ft^2	~~0.5~~0.35 W/ft^2	~~0.7~~0.5 W/ft^2
	Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	~~10~~7 W/linear foot	~~10~~7 W/linear foot	~~30~~21 W/linear foot
Nontradable Surfaces (Lighting power	Building facades	No allowance	0.075 W/ft2 of gross above-grade wall area	0.113 W/ft^2 of gross above-grade wall area	0.15 W/ft^2 of gross above-grade wall area

density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	Automated teller machines (ATM) and night depositories	~~270~~135 W per location plus ~~90~~45 W per additional ATM per location	~~270~~135 W per location plus ~~90~~45 W per additional ATM per location	~~270~~135 W per location plus ~~90~~45 W per additional ATM per location	~~270~~135 W per location plus ~~90~~45 W per additional ATM per location
	Uncovered e~~E~~ntrances and gatehouse inspection stations at guarded facilities	~~0.75~~0.5 W/ft^2 of covered and uncovered area	~~0.75~~0.5 W/ft^2 of covered and uncovered area	~~0.75~~0.5 W/ft^2 of covered and uncovered area	~~0.75~~0.5 W/ft^2 of covered and uncovered area
	Uncovered l~~L~~oading areas for law enforcement, fire, ambulance and other emergency service vehicles	~~0.5~~0.35 W/ft^2 ~~of covered and uncovered area~~	~~0.5~~0.35 W/ft^2 ~~of covered and uncovered area~~	~~0.5~~0.35 W/ft^2 ~~of covered and uncovered area~~	~~0.5~~0.35 W/ft^2 ~~of covered and uncovered area~~
	Drive-up windows/doors	~~400~~200 W per drive-through	~~400~~200 W per drive-through	~~400~~200 W per drive-through	~~400~~200 W per drive-through
	Parking near 24-hour retail entrances	~~800~~400 W per main entry	~~800~~400 W per main entry	~~800~~400 W per main entry	~~800~~400 W per main entry

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m^2.

W = watts.

Reason: This proposal revises the Lighting Power Density (LPD) allowances to be appropriate for currently available lighting technology. The values in this proposal are from those in Addendum cg to ASHRAE/IES Standard 90.1. These values were developed by PNNL/DOE and approved by the ASHRAE/IES 90.1 Lighting Subcommittee for inclusion in Standard 90.1 - 2016 and are derived from the PNN/DOE lighting models that have been used for the development of the LPDs in previous versions of Standard 90.1. LED technology was used in the models for the first time and this is the main reason for the significant reduction in the allowances.
The IALD has supported, and continues to support, the PNNL/DOE LPD modeling process as the best available method for developing appropriate lighting power allowances for energy codes. We participated in the development of these new values through our representation on the 90.1 lighting subcommittee and through the ANSI/ASHRAE/IES public review commenting process. We believe that these values will reduce the energy use of our buildings while still allowing high-quality exterior lighting to be provided.

Cost Impact: Will not increase the cost of construction

These reduced power allowances will likely require the use of LED fixtures, which in some cases are more expensive than HID fixtures. But LED fixtures are already the type of fixture commonly installed for exterior lighting. So the code would not require the purchase of more expensive fixtures than are already being used.

CE215-16 : TABLE C405.5.1-HEINMILLER12088

CE216-16

IECC: C405.5.1.

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

TABLE ~~C405.5.1~~ C405.5.1(2) (2)
INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

		LIGHTING ZONES			
		Zone 1	**Zone 2**	**Zone 3**	**Zone 4**
Base Site Allowance (Base allowance is usable in tradable or nontradable surfaces.)		~~500~~ 350 W	~~600~~ 400 W	~~750~~ 500 W	~~1300~~ 900 W
Tradable Surfaces (Lighting power densities for uncovered	**Uncovered Parking Areas**				
	Parking areas and drives	~~0.04~~ 0.03 W/ft^2	~~0.06~~ 0.04 W/ft^2	~~0.10~~ 0.06 W/ft^2	~~0.13~~ 0.08 W/ft^2
	Building Grounds				
	Walkways/Ramps less than 10 feet wide	~~0.7~~ 0.5 W/linear foot	~~0.7~~ 0.5 W/linear foot	~~0.8~~ 0.6 W/linear foot	~~1.0~~ 0.7 W/linear foot
	Walkways/Ramps 10 feet wide or greater, plaza areas, special feature areas	~~0.14~~ 0.10 W/ft^2	~~0.14~~ 0.10 W/ft^2	~~0.16~~ 0 .11 W/ft^2	~~0.2~~ 0.14 W/ft^2
	Stairways	~~0.75~~ 0.6 W/ft^2	~~1.0~~ 0.7 W/ft^2	~~1.0~~ 0.7 W/ft^2	~~1.0~~ 0.7 W/ft^2
	Pedestrian tunnels	~~0.15~~ 0.12 W/ft^2	~~0.15~~ 0.12 W/ft^2	~~0.2~~ 0.14 W/ft^2	~~0.3~~ 0.21 W/ft^2
	Building Entrances and Exits				

parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	~~Main entries~~ Pedestrian and vehicular entrances and exits	~~20~~ 14 W/linear foot of ~~door width~~opening	~~20~~ 14 W/linear foot of ~~door width~~opening	~~30~~ 21 W/linear foot of ~~door width~~opening	~~30~~ 21 W/linear foot of ~~door width~~opening
	~~Other doors~~	~~20 W/linear foot of door width~~	~~20 W/linear foot of door width~~	~~20 W/linear foot of door width~~	~~20 W/linear foot of door width~~
	Entry canopies	~~0.25~~ 0.2 W/ft^2	0.25 W/ft^2	0.4 W/ft^2	0.4 W/ft^2
	Sales Canopies				
	Free-standing and attached	~~0.6~~ 0.4 W/ft^2	~~0.6~~ 0.4 W/ft^2	~~0.8~~ 0.6 W/ft^2	~~1.0~~ 0.7 W/ft^2
	Outdoor Sales				
	Open areas (including vehicle sales lots)	~~0.25~~ 0.2 W/ft^2	~~0.25~~ 0.2 W/ft^2	~~0.5~~ 0.35 W/ft^2	~~0.7~~ 0.5 W/ft^2
	Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	~~10~~ 7 W/linear foot	~~10~~ 7 W/linear foot	~~30~~ 21 W/linear foot
Nontradable Surfaces (Lighting power density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces	Building facades	No allowance	0.075 W/ft2 of gross above-grade wall area	0.113 W/ft^2 of gross above-grade wall area	0.15 W/ft^2 of gross above-grade wall area
	Automated teller machines (ATM) and night depositories	~~270~~ 135 W per location plus ~~90~~ 45 W per additional ATM per location	~~270~~ 135 W per location plus ~~90~~ 45 W per additional ATM per location	~~270~~ 135 W per location plus ~~90~~ 45 W per additional ATM per location	~~270~~ 135 W per location plus ~~90~~ 45 W per additional ATM per location
	Uncovered entrances and gatehouse inspection stations at guarded facilities	~~0.75~~ 0.5 W/ft^2~~of covered and uncovered area~~	~~0.75~~ 0.5 W/ft^2~~of covered and uncovered area~~	~~0.75~~ 0.5 W/ft^2~~of covered and uncovered area~~	~~0.75~~ 0.5 W/ft^2~~of covered and uncovered area~~

or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)					
	Uncovered loading areas for law enforcement, fire, ambulance and other emergency service vehicles	~~0.5~~ 0.35 W/ft^2 ~~of covered and uncovered area~~	~~0.5~~ 0.35 W/ft^2 ~~of covered and uncovered area~~	~~0.5~~ 0.35 W/ft^2 ~~of covered and uncovered area~~	~~0.5~~ 0.35 W/ft^2 ~~of covered and uncovered area~~
	Drive-up windows/doors	~~400~~ 200 W per drive-through	~~400~~ 200 W per drive-through	~~400~~ 200 W per drive-through	~~400~~ 200 W per drive-through
	Parking near 24-hour retail entrances	~~800~~ 400 W per main entry	~~800~~ 400 W per main entry	~~800~~ 400 W per main entry	~~800~~ 400 W per main entry

~~For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m^2.~~

For SI units: W/m^2 = 10.76 • W/ft^2. W/linear m = 3.281 • W/linear foot.

W = watts.

Reason: This proposal modifies the exterior Lighting Power Allowances (LPA) by changing the basis for determining an energy effective and achievable power density from typical high-intensity discharge (HID) or fluorescent lamps to Light Emitting Diode (LED) technology, where practical. The LED technology basis was developed by directly comparing the efficacy of appropriate replacement LED products with the efficacy of comparable HID or fluorescent products. Direct comparison of market available products showed that a change from metal halide HID to LED technology would achieve an average reduction in connected power of 48% to 61% which translates to a potential revised LPA of 39% to 52% of the existing values. To ensure appropriate design capability in all applications, the maximum reduction factors were revised to provide typically 60% or more of the current LPAs. The reduction factors thus determined were applied to the applicable area type lighting power allowances to produce this revised LED-based set of LPAs.

***Energy Savings*: An analysis of energy impact for the stand-alone retail prototype shows that annual savings from the exterior lighting reduction in the proposal averages $70 per parking area fixture, with a tight range (±0.3%) across all climate zones. More details are found in the cost-effectiveness analysis referenced in the cost impact section.**

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

Bibliography:

1. **John Jolly, and Theodore C. Moeller. "LED & Conventional Lighting Systems Comparison Study." GLHN Architects & Engineers, Inc. for the National Institute of Building Sciences and the Department of Veterans Affairs, May 2014. http://www.cfm.va.gov/til/studies/LEDStudy.pdf.**
2. **Hart, R., and Liu, B. (2015). Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes. Pacific Northwest National Laboratories for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-23923 Rev1. https://www.energycodes.gov/development/commercial/methodology.**
3. **Hart, R., J. Zhang, and E. Richman. September 2015. "Cost-effectiveness Analysis of Reduce Exterior Lighting Allowances." https://www.energycodes.gov/development/2018IECC.**

Cost Impact: Will increase the cost of construction

The LED lamps for use in exterior light fixtures provide more lighting at a lower energy use. The incremental cost for parking lot lighting fixtures was found to be $380; however, the LED lamp life is longer, avoiding multiple lamp replacement costs with the baseline HID fixtures. LED prices are expected to continue to decrease, making this technology increasingly cost-effective.

***Cost-effectiveness*: A study completed in 2014[1] for the U.S. Department of Veterans Affairs found that LED fixtures were cost-effective in all exterior applications. PNNL performed a cost-effectiveness analysis using the established DOE methodology.[2] Results of the cost-effectiveness analysis showed that the savings-to-investment ratio (SIR) was infinite for typical retail establishments, as the present value of costs was negative due to a reduction in lamp replacement costs. A proposal 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 complete cost-effectiveness analysis is available at: https://www.energycodes.gov/development/2018IECC.[3]**

CE216-16 : TABLE C405.5.1-WILLIAMS12368

CE217-16

IECC: C405.5.2 (New).

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 International Energy Conservation Code

Add new text as follows:

C405.5.2 Exterior building grounds lighting. Exterior building grounds luminaires that operate at greater than 100 watts shall contain lamps having an efficacy of not less than 90 lumens per watt except where such luminaires are controlled by a motion sensor or qualify for one of the exceptions in Section C405.5.1.

Reason: The commercial provisions of the 2012 IECC included a provision that required higher wattage exterior lighting sources to meet minimum efficacy requirements unless the light was controlled by a motion sensor (see 2012 IECC Section C405.6.1). This requirement was removed from the 2015 IECC. LED light source technology is advancing rapidly, and the raw lamp efficacy of LED light sources are rapidly improving beyond that of both Pulse Start Metal Halide (PSMH), the current baseline standard, and High Pressure Sodium (HPS) light sources. Further, the efficiency of LED luminaires is typically significantly higher than either PSMH or HPS luminaires. LED luminaires will exceed combined HID source luminaire efficacy sometime in late 2014 or 2015. (DOE 2013) Finally, LED luminaires can deliver light more uniformly to the target area, which will result in further savings opportunities. This code change proposal will result in an estimated savings 0.076 kwh per square foot of hardscape per year based on the Energy Savings Forecast of Solid State Lighting in General Illumination Applications –U.S. Department of Energy August 2014. The proposal will also reduce labor and maintenance costs due to reduced relamping. The energy savings estimates are sourced from the California Codes and Standards Enhancement, Dec 2014; "Nonresidential Outdoor Power Allowance" and were calculated before adjustment by the California Time Dependent Value (TDV) methodology.
In addition, LED light source technology has a variety of operational advantages over either PSMH or HPS, including:

- much longer life expectancy (in some cases beyond 100,000 hours)
- better lumen maintenance at a given age of operation
- very good dimming efficacy curves
- a large range of dimming capability (down to 10% in most cases)
- rapid level changes that accommodates sensor integration
- instant re-strike for On-Off-On switching capability
- preservation of source color characteristics over full dimming range

Cost Impact: Will increase the cost of construction
The additional first cost for installing a "small" LED light source over a similar size PSMH light source is approximately $210.00 (see table below). The cost is based on 2014 costs and are expected to decrease by the time that this code is published.

Size	PSMH Cost[1]	LED Cost[1]	Difference in Cost
Small	$846.00	$1,056.00	$210.00
Large	$1,079.00	1,663.00	$584.00

[1]Per luminaire Costs for Construction including installation, Based on Factory Representative Quotes

CE217-16 : C405.5.2 (NEW)-MAKELA12508

CE218-16

IECC: C405.6, C405.6.1 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

C405.6 ~~Electrical energy consumption~~ Energy metering and monitoring (Mandatory). Each dwelling unit located in a Group R-2 building shall have a separate electrical meter._

All other buildings and portions of Group R-2 buildings that are not dwelling units shall have devices to meter total electrical energy use and monitor the electrical energy use associated with HVAC systems, interior lighting, exterior lighting and circuits associated with electrical receptacles. Where involving more than one building tenant, energy use associated with all non-shared HVAC systems, interior lighting, exterior lighting and circuits associated with electrical receptacles shall be monitored separately for each tenant.

> Exception: Not more than 10 percent of the load for HVAC systems, interior lighting, exterior lighting and circuits associated with electrical receptacles shall be from other electrical loads.

Monitoring systems installed for HVAC systems, interior lighting, exterior lighting and circuits associated with electrical receptacles shall be capable of recording electrical energy usage every 15 minutes and report electrical energy usage hourly, daily, monthly, and annually. Monitoring systems shall be capable of maintaining all data collected for not less than 36 months.

Exceptions:

1. Buildings having a gross floor area of less than 25,000 square feet.
2. Individual tenant spaces having a gross floor area of less than 10,000 than square feet.
3. Common areas in Group R-2 buildings having a gross floor area less than 10,000 square feet.
4. Critical and equipment branches of Group I health care facilities covered by Article 517 of the NFPA 70.

Add new text as follows:

C405.6.1 Whole building energy monitoring Measurement devices shall be installed at the building site to monitor the energy use of each building. Measurement devices shall be installed to monitor the building use of the following types of energy supplied by a utility, energy provider, or plant that is not within the building:

1. Natural gas

2. Fuel oil
3. Propane
4. Steam
5. Chilled Water
6. Hot Water

The measurement devices shall have the capability to record electrical energy use every 60 minutes and report that use on an hourly, daily, monthly and annual basis and retain the recorded data for not less then 36 months.

Exceptions: The following are not required to have measurement devices with recording capabilities in accordance with this Section.

1. Buildings less than 25,000 square feet
2. Individual tenant spaces having a gross floor area of less than 10,000 square feet.
3. Dwelling Units
4. Common areas in Group R-2 buildings having a gross floor area less than 10,000 square feet.
5. Fuel use for on-site emergency equipment.

Reason: ASHRAE/IES Standard 90.1-2013, which is adopted by reference as an alternative to the IECC Commercial Provisions, has been updated with respect to energy metering. The change ensures continued consistency between the IECC and standard 90.1-2013. It retains the current provisions in the IECC for multi-family residential buildings and then includes electrical and fossil fuel metering provisions for other building types and occupancies.

Cost Impact: Will increase the cost of construction
There will be higher costs due to additional installation of metering infrastructure, but the information from the monitoring reports will assist facility energy managers to save energy on a continuous basis, which will lead to lower energy costs.

CE218-16 : C405.6-FERGUSON10598

CE219-16

IECC: C405.7 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Add new text as follows:

<u>**C405.7 Automatic receptacle controls Automatic controls shall be provided for not less than 50 percent of all 125 volt 15- and 20-Ampere receptacles in private offices, conference rooms, printing and copying rooms, break rooms, classrooms and individual workstations in Group B and E occupancies and for not less than 25 percent of branch circuits installed to supply electrical power to modular furniture in Group B and E occupancies. Such receptacles shall be uniformly distributed throughout each space and labeled in accordance with NFPA 70. Such automatic controls shall comply with one of the following:**</u>

1. <u>**Automatic controls shall be capable of operating on a scheduled basis using a time-of-day operated control device that will turn off receptacles at specific programmed times and provide for an independent program schedule.**</u>
2. <u>**Independent program schedules for automatic controls shall be configured to control receptacles in areas that are not greater than 5,000 square feet.**</u>
3. <u>**Independent program schedules for automatic controls shall be configured to control receptacles in areas on a single floor.**</u>
4. <u>**Automatic control shall be by means of an occupant sensor that is capable of turning off receptacles within 30 minutes after all occupants have left the *space* being *served***</u>
5. <u>**Automatic control shall be by means of an automated signal from another control or alarm system that is capable of turning off receptacles within 20 minutes after determining that the area served is unoccupied.**</u>

<u>**Exception: Automatic receptacle controls need not be provided in specific spaces where approved by the code official based on the need for continuous power to receptacles or for safety or security reasons associated with the space.**</u>

Reference standards type: This is an update to reference standard(s) already in the ICC Code Books
Add new standard(s) as follows:

NFPA 70: National Electrical Code®

Reason: Currently standby or "vampire loads" use a lot of energy. This proposal requires

- **At least 50% of all receptacles tobe controlled by an automatic control device:**
- **An occupancy sensor that will turn receptacles off within 30 minutes of all occupants leaving a space**
- **A scheduled basis using a time-of-day operated control device that turns receptacles off at specific programmed times**

It does not require the use of these receptacles, however, decreasing overall building energy use long term will require these loads to be turned off when the building is unoccupied and the non-essential equipment is not in use.

These provisions are consistent with the requirements of ASHRAE Standard 90.1-2013, and similar

controls are required in CA Title 24.

Cost Impact: Will increase the cost of construction
adding these devices will increase the cost of construction.

CE219-16 : C405.7 (NEW)-FERGUSON11784

CE220-16

IECC: C405.7.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C405.7 Electrical transformers (Mandatory). ~~Electric~~ Low-voltage dry-type distribution electric transformers shall meet the minimum efficiency requirements of Table C405.7 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 at least 20 percent more than the lowest tap.**
4. **Drive transformers.**
5. **Rectifier transformers.**
6. **Auto-transformers.**
7. **Uninterruptible power system transformers.**
8. **Impendance transformers.**
9. **Regulating transformers.**
10. **Sealed and nonventilating transformers.**
11. **Machine tool transformers.**
12. **Welding transformers.**
13. **Grounding transformers.**
14. **Testing transformers.**

TABLE C405.7
MINIMUM NOMINAL EFFICIENCY LEVELS FOR 10 CFR 431 LOW-VOLTAGE DRY-TYPE DISTRIBUTION TRANSFORMERS

SINGLE-PHASE TRANSFORMERS		THREE-PHASE TRANSFORMERS	
kVA[a]	Efficiency (%)[b]	kVA[a]	Efficiency (%)[b]
15	97.7	15	97.0
25	98.0	30	97.5

37.5	98.2	45	97.7
50	98.3	75	98.0
75	98.5	112.5	98.2
100	98.6	150	98.3
167	98.7	225	98.5
250	98.8	300	98.6
333	98.9	500	98.7
		750	98.8
		1000	98.9

a. kiloVolt-Amp rating.

b. Nominal efficiencies shall be established in accordance with the DOE 10 CFR 431 test procedure for low-voltage dry-type transformers.

Reason: This proposal is a simple editorial connection between Section C405.7 and Table C405.7. The transformers regulated by the section are only those listed in the table. The table is titled Low-voltage dry-type distribution transformers. The section's text implies coverage of all electric transformers. They should be consistent.
This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The change is editorial and changes no technical provisions.

CE220-16 : C405.7-COLLINS11464

CE221-16

IECC: C405.7.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE C405.7
MINIMUM NOMINAL EFFICIENCY LEVELS FOR 10 CFR 431 LOW-VOLTAGE DRY-TYPE DISTRIBUTION TRANSFORMERS

SINGLE-PHASE TRANSFORMERS		THREE-PHASE TRANSFORMERS	
kVA[a]	Efficiency (%)[b]	kVA[a]	Efficiency (%)[b]
15	97.70	15	~~97.0~~ 97.89
25	98.00	30	~~97.5~~98.23
37.5	98.20	45	~~97.7~~98.40
50	98.30	75	~~98.0~~98.60
75	98.50	112.5	~~98.2~~98.74
100	98.60	150	~~98.3~~98.83
167	98.70	225	~~98.5~~98.94
250	98.80	300	~~98.6~~99.02
333	98.90	500	~~98.7~~99.14
		750	~~98.8~~99.23
		1000	~~98.9~~99.28

a. kiloVolt-Amp rating.

b. Nominal efficiencies shall be established in accordance with the DOE 10 CFR 431 test procedure for low-voltage dry-type transformers.

Reason: New US federal energy efficiency standards go into effect for low voltage dry-type transformers go into effect on January 1, 2016. This proposal updates the minimum efficiency values

required for newly purchased low-voltage dry-type transformers, and ensures that the 2018 IECC is updated with the latest information.

Cost Impact: Will not increase the cost of construction
As these values represent the baseline minimum requirements for all new transformers, this proposal will not increase costs for new transformers that have to meet the required increase in energy efficiency.

CE221-16 : TABLE C405.7-FERGUSON10599

CE222-16

IECC: , C405.8 (New), C405.8.1 (New), C405.8.2 (New), C405.8.3 (New), C405.8.4 (New), C405.8.5 (New).

Proponent : Marilyn Williams, NEMA, representing National Electrical Manufacturers Association (mar_williams@nema.org)

2015 International Energy Conservation Code

Add new text as follows:

C405.8 Energy monitoring (Mandatory) Buildings with a gross conditioned floor area over 25,000 square feet shall comply with Sections C405.8.1 through C405.8.5. Buildings shall be equipped to measure, monitor, record and report energy consumption data for each end-use category required by Section C405.8.2.

Exception: Individual tenant spaces are not required to comply with this section provided that such spaces have their own utility services and meters and have less than 5,000 square feet of conditioned floor area.

C405.8.1 Electrical energy metering Meters or other measurement devices shall be provided to collect electrical energy consumption data for each end-use category required by Section C405.8.2. The electrical energy consumption data shall include all electrical energy supplied to the building and its assocated site, including enegy for site lighting, parking, recreational facilities, and other areas that serve the building and its occupants,

C405.8.2 End-use metering categories Meters or other approved measurement devices shall be provided to collect energy use data for each end-use category specified in Table 405.8.2. 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 specified in Table 405.8.2 shall be from a load not within that 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 tesing or an emergency.
3. End-use metering is not 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 C405.8.3 is provided.

TABLE C405.8.2
ENERGY USE CATEGORIES

Load Category	Description of energy use

Total HVAC system	Heating, cooling and ventilation including, 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 VAC,need not be included in the total HVAC system energy use.
Interior lightng	Lighting systems located within the *building.*
Exterior lighting	Lighting systems located on the *building site* but not withing the *building.*
Plug loads	Devices, appliances and equpment connected to convenience receptacle outlets
Process loads	Any single load that is not included in an HVAC, lighting, or plug load category and that exceeds 5 percent of the peak connected load of the whole building including, data centers, manufacturing equipment and commercial kitchens.
Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table including, vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas, and snow-melt systems.

C405.8.3 Meters Meters and other measurement devices required by this Section shall be confirgured to automatically communicate energy consumption data to the data acquisition system required by Section C405.8.4. Source meters shall be any digital-type meter. Lighting, HVAC and other building systems that can monitor their energy consumption shall not require meters. Current sensors are an alternative to meters, provded that they have a tested accuracy of +/-2 percent. Required metering systems and equipment shall have the capability to provide not less than hourly data that is fully integrated into the data acquisition system and graphical energy report in accordance with Sections C405.8.4 and C405.8.5.

C405.8.4 Data acquisition systems A data acquisition system shall have the capability to store the data from the required meters and other sensing devices for not less than 36 months. The data acquisition system shall have the capablity to store real-time energy consumption data and provide hourly, daily, monthly, and yearly logged data for each end-use category required by Section C405.8.2.

C405.8.5 Graphical energy report A permanent reporting mechanism shall be provided in the building that can be accessed 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 C405.8.2 for not less than every hour, day, month and year for the previous 36 months.

Reason: This proposal saves energy by providing actionable and timely 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). Estimates in available literature of the energy savings to be expected from metering and monitoring systems vary from 2% to 15%. The effectiveness of each system depends on owners and facility managers observing and acting upon

the data provide. Additionally, the 2013 version of ASHRAE sTD. 90.1 and several state energy codes requie energy monitoring.

Cost Impact: Will increase the cost of construction
The requirement will increase cost due to the energy monitoring equipment that will be added to the building. However, this added cost will be recovered in the reduction of energy cost from monitoring energy consumption levels of various energy consuming systems and compare them to previous levels. A Navigant Consulting recent study shows that by introducing sub-metering in the multi-residential sector, the average electricity use is reduced by 34% for non-electrically heated buildings, and by 27% for electrically heated buildings. There are few measures available today that can reduce electricity use to this degree without the associated costs of major infrastructure upgrades

CE222-16 : C405.8 (NEW)-WILLIAMS11605

CE223-16

IECC: , 0, C202 (New), C405.8.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org); Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org)

2015 International Energy Conservation Code

Delete without substitution:

SECTION C202 DEFINITIONS

~~**GENERAL PURPOSE ELECTRIC MOTOR (SUBTYPE II)**~~ **.** ~~**A motor incorporating the design elements of a general purpose electric motor (Subtype I) that is configured as one of the following:**~~

1. ~~**A U-frame motor.**~~
2. ~~**A Design C motor.**~~
3. ~~**A close-coupled pump motor.**~~
4. ~~**A footless motor.**~~
5. ~~**A vertical, solid-shaft, normal-thrust motor (as tested in a horizontal configuration).**~~
6. ~~**An 8-pole motor (900 rpm).**~~
7. ~~**A polyphase motor with voltage of not more than 600 volts (other than 230 or 460 volts).**~~

~~**GENERAL PURPOSE ELECTRIC MOTOR (SUBTYPE I).**~~ ~~**A motor that is designed in standard ratings with either of the following:**~~

1. ~~**Standard operating characteristics and standard mechanical construction for use under usual service conditions, such as those specified in NEMA MG1, paragraph 14.02, "Usual Service Conditions," and without restriction to a particular application or type of application.**~~
2. ~~**Standard operating characteristics or standard mechanical construction for use under unusual service conditions, such as those specified in NEMA MG1, paragraph 14.03, "Unusual Service Conditions," or for a particular type of application, and that can be used in most general purpose applications.**~~

~~**General purpose electric motors (Subtype I) are constructed in NEMA T-frame sizes or IEC metric equivalent, starting at 143T.**~~

Add new definition as follows:

IEC DESIGN H MOTOR **An electric motor that meets all of the following:**

1. **It is an induction motor designed for use with three-phase power.**
2. **It contains a cage rotor.**
3. **It is capable of direct-on-line starting.**
4. **It has 4, 6, or 8 poles.**
5. **It is rated from 0.4 kW to 1600 kW at a frequency of 60 Hz.**

IEC DESIGN N MOTOR **An electric motor that meets all of the following:**

1. It is an induction motor designed for use with three-phase power.

2. It contains a cage rotor.
3. It is capable of direct-on-line starting.
4. It has 2, 4, 6, or 8 poles.
5. It is rated from 0.4 kW to 1600 kW at a frequency of 60 Hz.

NEMA DESIGN A MOTOR A squirrel-cage motor that meets all of the following:

1. It is designed to withstand full-voltage starting and developing locked-rotor torque as shown in paragraph 12.38.1 of NEMA MG 1.
2. It has pull-up torque not less than the values shown in paragraph 12.40.1 of NEMA MG 1.
3. It has breakdown torque not less than the values shown in paragraph 12.39.1 of NEMA MG 1.
4. It has a locked-rotor current higher than the values shown in paragraph 12.355.1 of NEMA MG 1 for 60 hertz and paragraph 12.35.2 of NEMA MG 1 for 50 hertz.
5. It has a slip at rated load of less than 5 percent for motors with fewer than 10 poles.

NEMA DESIGN B MOTOR A squirrel-cage motor that meets all of the following:

1. It is designed to withstand full-voltage starting.
2. It develops locked-rotor, breakdown, and pull-up torques adequate for general application as specified in Sections 12.38, 12.39 and 12.40 of NEMA MG1.
3. It draws locked-rotor current not to exceed the values shown in Section 12.35.1 for 60 hertz and Section 12.35.2 for 50 hertz of NEMA MG1.
4. It has a slip at rated load of less than 5 percent for motors with fewer than 10 poles.

NEMA DESIGN C MOTOR A squirrel-cage motor that meets all of the following:

1. It is Designed to withstand full-voltage starting and developing locked-rotor torque for high-torque applications up to the values shown in paragraph 12.38.2 of NEMA MG1 (incorporated by reference, see §431.15).
2. It has pull-up torque not less than the values shown in paragraph 12.40.2 of NEMA MG1.
3. It has breakdown torque not less than the values shown in paragraph 12.39.2 of NEMA MG1.
4. It has a locked-rotor current not to exceed the values shown in paragraph 12.35.1 of NEMA MG1 for 60 hertz and paragraph 12.35.2 for 50 hertz.
5. It has a slip at rated load of less than 5 percent.

Add new text as follows:

C405.8 Electrical motors (Mandatory). Electric motors shall meet the minimum efficiency requirements of Tables C405.8(1) through C405.8(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.

Exceptions: 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

TABLE C405.8 (1)

MINIMUM NOMINAL FULL-LOAD EFFICIENCY FOR ~~60 HZ~~ NEMA DESIGN A, NEMA ~~GENERAL PURPOSE~~ DESIGN B, AND IEC DESIGN N MOTORS (EXCLUDING FIRE PUMP ELECTRIC MOTORS ~~(SUBTYPE I)~~ ~~RATED 600 VOLTS OR LESS (Random Wound)~~ AT 60 HZ~~[a]~~ [a,b]

~~MOTOR HORSEPOWER~~	~~NUMBER OF POLES~~	~~OPEN DRIP-PROOF MOTORS~~			~~TOTALLY ENCLOSED FAN-COOLED MOTORS~~		
		~~2~~	~~4~~	~~6~~	~~2~~	~~4~~	~~6~~
	~~Synchronous Speed (RPM)~~	~~3600~~	~~1800~~	~~1200~~	~~3600~~	~~1800~~	~~1200~~
~~1~~	–	~~77.0~~	~~85.5~~	~~82.5~~	~~77.0~~	~~85.5~~	~~82.5~~
~~1.5~~	–	~~84.0~~	~~86.5~~	~~86.5~~	~~84.0~~	~~86.5~~	~~87.5~~
~~2~~	–	~~85.5~~	~~86.5~~	~~87.5~~	~~85.5~~	~~86.5~~	~~88.5~~
~~3~~	–	~~85.5~~	~~89.5~~	~~88.5~~	~~86.5~~	~~89.5~~	~~89.5~~
~~5~~	–	~~86.5~~	~~89.5~~	~~89.5~~	~~88.5~~	~~89.5~~	~~89.5~~
~~7.5~~	–	~~88.5~~	~~91.0~~	~~90.2~~	~~89.5~~	~~91.7~~	~~91.0~~
~~10~~	–	~~89.5~~	~~91.7~~	~~91.7~~	~~90.2~~	~~91.7~~	~~91.0~~
~~15~~	–	~~90.2~~	~~93.0~~	~~91.7~~	~~91.0~~	~~92.4~~	~~91.7~~
~~20~~	–	~~91.0~~	~~93.0~~	~~92.4~~	~~91.0~~	~~93.0~~	~~91.7~~

~~25~~	–	~~91.7~~	~~93.6~~	~~93.0~~	~~91.7~~	~~93.6~~	~~93.0~~
~~30~~	–	~~91.7~~	~~94.1~~	~~93.6~~	~~91.7~~	~~93.6~~	~~93.0~~
~~40~~	–	~~92.4~~	~~94.1~~	~~94.1~~	~~92.4~~	~~94.1~~	~~94.1~~
~~50~~	–	~~93.0~~	~~94.5~~	~~94.1~~	~~93.0~~	~~94.5~~	~~94.1~~
~~60~~	–	~~93.6~~	~~95.0~~	~~94.5~~	~~93.6~~	~~95.0~~	~~94.5~~
~~75~~	–	~~93.6~~	~~95.0~~	~~94.5~~	~~93.6~~	~~95.4~~	~~94.5~~
~~100~~	–	~~93.6~~	~~95.4~~	~~95.0~~	~~94.1~~	~~95.4~~	~~95.0~~
~~125~~	–	~~94.1~~	~~95.4~~	~~95.0~~	~~95.0~~	~~95.4~~	~~95.0~~
~~150~~	–	~~94.1~~	~~95.8~~	~~95.4~~	~~95.0~~	~~95.8~~	~~95.8~~
~~200~~	–	~~95.0~~	~~95.8~~	~~95.4~~	~~95.4~~	~~96.2~~	~~95.8~~
~~250~~	–	~~95.0~~	~~95.8~~	~~95.4~~	~~95.8~~	~~96.2~~	~~95.8~~
~~300~~	–	~~95.4~~	~~95.8~~	~~95.4~~	~~95.8~~	~~96.2~~	~~95.8~~
~~350~~	–	~~95.4~~	~~95.8~~	~~95.4~~	~~95.8~~	~~96.2~~	~~95.8~~
~~400~~	–	~~95.8~~	~~95.8~~	~~95.8~~	~~95.8~~	~~96.2~~	~~95.8~~
~~450~~	–	~~95.8~~	~~96.2~~	~~96.2~~	~~95.8~~	~~96.2~~	~~95.8~~
~~500~~	–	~~95.8~~	~~96.2~~	~~96.2~~	~~95.8~~	~~96.2~~	~~95.8~~

Motor horsepower (standard kilowatt equivalent)	Nominal full-load efficiency (%) as of June 1, 2016							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open

1 (0.75)	77.0	77.0	85.5	85.5	82.5	82.5	75.5	75.5
1.5 (1.1)	84.0	84.0	86.5	86.5	87.5	86.5	78.5	77.0
2 (1.5)	85.5	85.5	86.5	86.5	88.5	87.5	84.0	86.5
3 (2.2)	86.5	85.5	89.5	89.5	89.5	88.5	85.5	87.5
5 (3.7)	88.5	86.5	89.5	89.5	89.5	89.5	86.5	88.5
7.5 (5.5)	89.5	88.5	91.7	91.0	91.0	90.2	86.5	89.5
10 (7.5)	90.2	89.5	91.7	91.7	91.0	91.7	89.5	90.2
15 (11)	91.0	90.2	92.4	93.0	91.7	91.7	89.5	90.2
20 (15)	91.0	91.0	93.0	93.0	91.7	92.4	90.2	91.0
25 (18.5)	91.7	91.7	93.6	93.6	93.0	93.0	90.2	91.0
30 (22)	91.7	91.7	93.6	94.1	93.0	93.6	91.7	91.7
40 (30)	92.4	92.4	94.1	94.1	94.1	94.1	91.7	91.7
50 (37)	93.0	93.0	94.5	94.5	94.1	94.1	92.4	92.4
60 (45)	93.6	93.6	95.0	95.0	94.5	94.5	92.4	93.0
75 (55)	93.6	93.6	95.4	95.0	94.5	94.5	93.6	94.1
100 (75)	94.1	93.6	95.4	95.4	95.0	95.0	93.6	94.1
125 (90)	95.0	94.1	95.4	95.4	95.0	95.0	94.1	94.1
150 (110)	95.0	94.1	95.8	95.8	95.8	95.4	94.1	94.1

200 (150)	95.4	95.0	96.2	95.8	95.8	95.4	94.5	94.1
250 (186)	95.8	95.0	96.2	95.8	95.8	95.8	95.0	95.0
300 (224)	95.8	95.4	96.2	95.8	95.8	95.8		
350 (261)	95.8	95.4	96.2	95.8	95.8	95.8		
400 (298)	95.8	95.8	96.2	95.8				
450 (336)	95.8	96.2	96.2	96.2				
500 (373)	95.8	96.2	96.2	96.2				

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.

b. For purposes of determining the required minimum nominal full-load efficiency of an electric motor that has a horsepower or kilowatt rating between two horsepower or two kilowatt ratings listed in this table, each such motor shall be deemed to have a listed horsepower or kilowatt rating, determined as follows:
(1) A horsepower at or above the midpoint between the two consecutive horsepowers shall be rounded up to the higher of the two horsepowers.

(2) A horsepower below the midpoint between the two consecutive horsepowers shall be rounded down to the lower of the two horsepowers.

(3) A kilowatt rating shall be directly converted from kilowatts to horsepower using the formula 1 kilowatt = (1/0.746) horsepower. The conversion should be calculated to three significant decimal places, and the resulting horsepower shall be rounded in accordance with paragraph (1) or (2), whichever applies.

TABLE C405.8 (2)
MINIMUM NOMINAL FULL-LOAD EFFICIENCY ~~OF GENERAL PURPOSE ELECTRIC~~ FOR NEMA DESIGN C AND IEC DESIGN H MOTORS ~~(SUBTYPE II) AND ALL DESIGN B MOTORS GREATER THAN 200 HORSEPOWER~~ AT 60 HZ~~[a]~~ [a,b]

~~MOTOR HORSEPOWER~~	~~NUMBER OF POLES~~	~~OPEN DRIP-PROOF MOTORS~~				~~TOTALLY ENCLOSED FAN-COOLED MOTORS~~			
		~~2~~	~~4~~	~~6~~	~~8~~	~~2~~	~~4~~	~~6~~	~~8~~

	~~Synchronous Speed (RPM)~~	~~3600~~	~~1800~~	~~1200~~	~~900~~	~~3600~~	~~1800~~	~~1200~~	~~900~~
~~1~~	–	~~NR~~	~~82.5~~	~~80.0~~	~~74.0~~	~~75.5~~	~~82.5~~	~~80.0~~	~~74.0~~
~~1.5~~	–	~~82.5~~	~~84.0~~	~~84.0~~	~~75.5~~	~~82.5~~	~~84.0~~	~~85.5~~	~~77.0~~
~~2~~	–	~~84.0~~	~~84.0~~	~~85.5~~	~~85.5~~	~~84.0~~	~~84.0~~	~~86.5~~	~~82.5~~
~~3~~	–	~~84.0~~	~~86.5~~	~~86.5~~	~~86.5~~	~~85.5~~	~~87.5~~	~~87.5~~	~~84.0~~
~~5~~	–	~~85.5~~	~~87.5~~	~~87.5~~	~~87.5~~	~~87.5~~	~~87.5~~	~~87.5~~	~~84.0~~
~~7.5~~	–	~~87.5~~	~~88.5~~	~~88.5~~	~~88.5~~	~~88.5~~	~~89.5~~	~~89.5~~	~~85.5~~
~~10~~	–	~~88.5~~	~~89.5~~	~~90.2~~	~~89.5~~	~~89.5~~	~~89.5~~	~~89.5~~	~~88.5~~
~~15~~	–	~~89.5~~	~~91.0~~	~~90.2~~	~~89.5~~	~~90.2~~	~~91.0~~	~~90.2~~	~~88.5~~
~~20~~	–	~~90.2~~	~~91.0~~	~~91.0~~	~~90.2~~	~~90.2~~	~~91.0~~	~~90.2~~	~~89.5~~
~~25~~	–	~~91.0~~	~~91.7~~	~~91.7~~	~~90.2~~	~~91.0~~	~~92.4~~	~~91.7~~	~~89.5~~
~~30~~	–	~~91.0~~	~~92.4~~	~~92.4~~	~~91.0~~	~~91.0~~	~~92.4~~	~~91.7~~	~~91.0~~
~~40~~	–	~~91.7~~	~~93.0~~	~~93.0~~	~~91.0~~	~~91.7~~	~~93.0~~	~~93.0~~	~~91.0~~
~~50~~	–	~~92.4~~	~~93.0~~	~~93.0~~	~~91.7~~	~~92.4~~	~~93.0~~	~~93.0~~	~~91.7~~
~~60~~	–	~~93.0~~	~~93.6~~	~~93.6~~	~~92.4~~	~~93.0~~	~~93.6~~	~~93.6~~	~~91.7~~
~~75~~	–	~~93.0~~	~~94.1~~	~~93.6~~	~~93.6~~	~~93.0~~	~~94.1~~	~~93.6~~	~~93.0~~
~~100~~	–	~~93.0~~	~~94.1~~	~~94.1~~	~~93.6~~	~~93.6~~	~~94.5~~	~~94.1~~	~~93.0~~
~~125~~	–	~~93.6~~	~~94.5~~	~~94.1~~	~~93.6~~	~~94.5~~	~~94.5~~	~~94.1~~	~~93.6~~
~~150~~	–	~~93.6~~	~~95.0~~	~~94.5~~	~~93.6~~	~~94.5~~	~~95.0~~	~~95.0~~	~~93.6~~
~~200~~	–	~~94.5~~	~~95.0~~	~~94.5~~	~~93.6~~	~~95.0~~	~~95.0~~	~~95.0~~	~~94.1~~

~~250~~	~~–~~	~~94.5~~	~~95.4~~	~~95.4~~	~~94.5~~	~~95.4~~	~~95.0~~	~~95.0~~	~~94.5~~
~~300~~	~~–~~	~~95.0~~	~~95.4~~	~~95.4~~	~~NR~~	~~95.4~~	~~95.4~~	~~95.0~~	~~NR~~
~~350~~	~~–~~	~~95.0~~	~~95.4~~	~~95.4~~	~~NR~~	~~95.4~~	~~95.4~~	~~95.0~~	~~NR~~
~~400~~	~~–~~	~~95.4~~	~~95.4~~	~~NR~~	~~NR~~	~~95.4~~	~~95.4~~	~~NR~~	~~NR~~
~~450~~	~~–~~	~~95.8~~	~~95.8~~	~~NR~~	~~NR~~	~~95.4~~	~~95.4~~	~~NR~~	~~NR~~
~~500~~	~~–~~	~~95.8~~	~~95.8~~	~~NR~~	~~NR~~	~~95.4~~	~~95.8~~	~~NR~~	~~NR~~

Motor horsepower (standard kilowatt equivalent)	**Nominal full-load efficiency (%) as of June 1, 2016**					
	4 Pole		**6 Pole**		**8 Pole**	
	Enclosed	**Open**	**Enclosed**	**Open**	**Enclosed**	**Open**
1 (0.75)	85.5	85.5	82.5	82.5	75.5	75.5
1.5 (1.1)	86.5	86.5	87.5	86.5	78.5	77.0
2 (1.5)	86.5	86.5	88.5	87.5	84.0	86.5
3 (2.2)	89.5	89.5	89.5	88.5	85.5	87.5
5 (3.7)	89.5	89.5	89.5	89.5	86.5	88.5
7.5 (5.5)	91.7	91.0	91.0	90.2	86.5	89.5
10 (7.5)	91.7	91.7	91.0	91.7	89.5	90.2
15 (11)	92.4	93.0	91.7	91.7	89.5	90.2
20 (15)	93.0	93.0	91.7	92.4	90.2	91.0

25 (18.5)	93.6	93.6	93.0	93.0	90.2	91.0
30 (22)	93.6	94.1	93.0	93.6	91.7	91.7
40 (30)	94.1	94.1	94.1	94.1	91.7	91.7
50 (37)	94.5	94.5	94.1	94.1	92.4	92.4
60 (45)	95.0	95.0	94.5	94.5	92.4	93.0
75 (55)	95.4	95.0	94.5	94.5	93.6	94.1
100 (75)	95.4	95.4	95.0	95.0	93.6	94.1
125 (90)	95.4	95.4	95.0	95.0	94.1	94.1
150 (110)	95.8	95.8	95.8	95.4	94.1	94.1
200 (150)	96.2	95.8	95.8	95.4	94.5	94.1

NR = No requirement.

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.

b. For purposes of determining the required minimum nominal full-load efficiency of an electric motor that has a horsepower or kilowatt rating between two horsepower or two kilowatt ratings listed in this table, each such motor shall be deemed to have a listed horsepower or kilowatt rating, determined as follows:
(1) A horsepower at or above the midpoint between the two consecutive horsepowers shall be rounded up to the higher of the two horsepowers.

(2) A horsepower below the midpoint between the two consecutive horsepowers shall be rounded down to the lower of the two horsepowers.

(3) A kilowatt rating shall be directly converted from kilowatts to horsepower using the formula 1 kilowatt = (1/0.746) horsepower. The conversion should be calculated to three significant decimal places, and the resulting horsepower shall be rounded in accordance with paragraph (1) or (2), whichever applies.

Reason: New federal energy efficiency standards for electric motors will go into effect on June 1, 2016. The new final rule was published in the *Federal Register* on May 29, 2014.
This proposal updates two motor efficiency tables to be consistent with the new federal standards. The scope of the federal standards has expanded, requiring an update to the table titles (and definitions) as well. In addition, new footnotes are added to be consistent with federal regulations. The new footnotes provide requirements for motors with horsepower (or kW) ratings that are in

between the values shown in the table (e.g., a 6.0 horsepower motor will be required to have the same efficiency as a 5.0 horsepower motor).

Bibliography: *Federal Register*, "Energy Conservation Program: Energy Conservation Standards for Commercial and Industrial Electric Motors", May 29, 2014, pages 30934-31014

Cost Impact: Will increase the cost of construction
The new standards for motors will increase the cost of motors, but will save energy costs compared to the previous federal standards. DOE estimated median payback periods on the order of 2.9 to 4.5 years, depending on the motor installed.

Analysis: A review of the standard(s) proposed for inclusion in the code, IEC 60034, 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 1, 2015.

CE223-16 : C405.8-FERGUSON12103

CE224-16

IECC: C405.9.2.

Proponent : Duane Jonlin, Seattle Dept of Construction and Inspections (duane.jonlin@seattle.gov)

2015 International Energy Conservation Code

Revise as follows:

C405.9.2 Escalators and moving walks. 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.
<u>**Exception:** A power factor controller that reduces operating voltage in response to light loading conditions is an alternative to the reduced speed function.</u>

Reason: The requirement for escalators to reduce their speed when unoccupied is most effective for installations that experience intermittent bursts of activity followed by longer periods of inactivity, such as at rail stations and performance venues. Escalators that experience more frequent light loading during the course of the day, such as office buildings or shopping malls, can benefit more from a "power factor controller," that maintains a consistent speed but requires less energy while lightly loaded. A power factor controller is generally less expensive than speed reduction capability, and this proposal allows a choice between the two technologies.

Cost Impact: Will not increase the cost of construction
Will in some cases decrease the cost of construction, as this exception permits an alternative that is generally less expensive.

CE224-16 : C405.9.2-JONLIN12133

CE225-16

IECC: , C405.10 (New).

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

2015 International Energy Conservation Code

Add new text as follows:

C405.10 Energy distribution design and load type isolation in buildings. Energy distribution systems within, on, or adjacent to and serving a *building* shall be designed such that each primary circuit, panel, feeder, piping system and supply mechanism supplies only one energy use category as defined in Table 405.10. The energy use type served by each distribution system shall be designated on the energy distribution system, and space shall be provided for installation of metering equipment or other data collection devices, temporary or permanent, to measure their energy use. The energy distribution system shall be designed to facilitate the collection of data for each of the energy use categories in Table 405.10. Where there are multiple buildings on a building site, each building shall comply separately with the provisions of Section 405.10.

Exceptions:

1. ***Buildings* designed and constructed such that the total usage of each of the energy use categories in Table 405.10 is measured through the use of installed meters or other equivalent methods as *approved*.**
2. ***Buildings* less than 25000 square feet in *total building floor area*.**
3. **Up to 5% of the load for each energy end use described in Table 405.10 shall be allowed to be from other energy use types.**
4. **Within Group I-2 occupancies, loads connected to critical life, safety and equipment branches shall be monitored independently or in the aggregate.**

TABLE C405.10
ENERGY USE CATEGORIES

Load category	Description of Energy Use
HVAC loads	All energy used to heat, cool, and provide ventilation to the *building* including fans, pumps, boiler energy, chiller energy and hot water used for space conditioning.
Lighting loads	All lighting energy used within the *building*.
Plug loads	All energy used by devices,

	appliances and equipment connected to convenience receptacle outlets.
Process loads	Any single load that is not included in the HVAC, lighting, or plug load category that exceeds 5 percent of the peak connected load of the whole building including data centers, manufacturing equipment and commercial kitchens.
Building operations and other miscellaneous loads	All energy used for building operations and other miscellaneous loads not included in HVAC, Lighting, Plug, and Process load categories including vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains and fireplaces, swimming pools, inground spas, snow-melt systems, and exterior lighting that is mounted on the building or used to illuminate building facades.

Reason: The commercial provisions of the 2015 IgCC and ASHRAE 90.1-2013 both include provisions that address separation of load types and submetering based on those load types. ASHRAE 90.1 sets a threshold of 25000 square feet for these requirements. The IgCC also sets a threshold of 25000 square feet for the submetering, but requires load segregation in the design of electrical systems to facilitate future monitoring of those loads in all buldings.

The success of the IECC in improving the performance of energy components has increased the importance of operations in achieving additional performance gains. Improving operations is dependent on good feedback about energy usage to operators and occupants. As building performance becomes more dependent on usage data, and the processing and use of this data becomes more widespread, it is important that in buildings designed for many decades to come the electrical systems be designed to provide actionable energy use data. Since neither load segregation nor submetering are required in the 2015 IECC, this proposal adds the language from the 2015 IgCC that requires buildings to at least have their electrical systems designed to accommodate future monitoring of load type energy use, while adding the 5% exception based on the 90.1 approach.

Cost Impact: Will increase the cost of construction

This proposal will result in a nominal increase in construction cost. It represents a change in practice only for building designs that do not already employ this or a similar distribution scheme. Most buildings in the size class subject to this requirement already have distribution systems that employ feeders and sub-panels. These buildings will need to have their distribution system designed differently so that the configuration of feeders and sub-panels follows the required load segregation scheme instead of a different distribution scheme. There may be minor increased cost from the need to install additional dedicated sub-panels or feeders. The 5% load mixing exemption should eliminate most instances of the need for long dedicated runs for isolated heterogeneous loads (eg, a light in a remote HVAC equipment room).

CE225-16 : C405.10 (NEW)-EDELSON12404

CE226-16

IECC: C202 (New), C405.10 (New).

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

VOLTAGE DROP. A decrease in voltage caused by losses in the wiring systems that connect the power source to the load.

Add new text as follows:

C405.10 Voltage drop in feeders and branch circuits. The total voltage drop across the combination of feeders and branch circuits shall not exceed 5 percent.

Reason: ***A limitation on the amount of allowed voltage drop will reduce the energy consumption of buildings and is currently in ASHRAE Standard 90.1-2016 due to addendum c to Standard 90.1-2013. When conductors are not sized to limit voltage drop, they will use additional energy in conductor resistance losses. This proposal will make the IECC consistent with 90.1-2016, which will be adopted by reference in the IECC and consistent with recommendations in the NEC.***

While footnotes to tables in the NEC suggests that conductor sizing be adjusted to limit voltage, these footnotes are not requirements, so providing a 5% limit to voltage drop in the energy code will have impact on those who do not follow the NEC table footnote suggestions.

Cost Impact: Will increase the cost of construction
While this proposed requirement has a theoretical impact on building cost, it is followed in most cases as standard practice; consequently there is not expected to be an overall cost increase.

CE226-16 : C405.10 (NEW)-FERGUSON11675

CE228-16

IECC: C405.10 (New).

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 International Energy Conservation Code

Add new text as follows:

C405.10 Controlled receptacles. (Mandatory) Not less than 50 percent of all 125 volt 15- and 20-ampere receptacles installed in private offices, open offices, conference rooms, rooms used primarily for printing andcopying functions, breakrooms, individual workstations, and classrooms, including those installed in modular partitions and modular office workstation systems, shall be controlled as specified in this section. In rooms larger than 200 square feet (19 m^2), a controlled receptacle shall be located within 72 inches (1.8 m) of each uncontrolled receptacle. 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 occupants have not been detected for a period not longer than 20 minutes.**
2. **A time-of-day operated control device that turns receptacle power off at specific programmed times and that 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 (2,323 m^2) and not to exceed one full floor. The device shall be capable of being overridden for periods of up to two hours by a timer taht can be accessed by the occupants. Any individual override switch shall control the controlled receptacles for a an area not to exceed 5,000 square feet (465 m^2). Override switches for controlled receptacles shall not be precluded from controlling the lighting within the same area.**

Exception: Receptacles designated for specific equipment requiring 24-hour operation, for building maintenance functions, or for specific safety or security equipment are not required to be controlled by an automatic control device and are not required to be located within 72 inches (1.8 m) of a controlled receptacle.

Reason: The code change proposal would require that 50% of receptacles installed in private offices, open offices, conference rooms, rooms used primarily for printing and/or copying functions, breakrooms, individual workstations, and classrooms, including those installed in modular partitions and modular office workstation systems be controlled either by an occupancy sensor or a time-of-day control device. 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 90.1-2010 and 2013, in the Washington State Nonresidential Energy Code and the Seattle Energy Code.

Bibliography:

http://www.energy.ca.gov/title24/2013standards/prerulemaking/documents/current/Reports/Nonresident

Cost Impact: Will increase the cost of construction
Costs were estimated to be $0.26/ft2 in small office and $0.19/ft2 in large office.

CE228-16 : C405.10 (NEW)-MAKELA12496

CE229-16

IECC: C406 (New), C406.1 (New).

Proponent : Craig Conner, representing self (craig.conner@mac.com)

2015 International Energy Conservation Code

Add new text as follows:

SECTION C406 ELECTRIC VEHICLE CHARGER READY

C406.1 Electric vehicle charger ready. For parking lots and parking garages having more than 100 vehicle parking spots, electrical conduit or other wiring method shall be installed for the future installation of not less than four Level 2 or 3 electric vehicle chargers for each increment of 100 parking spots.

Reason:
The goal of this proposal is to have new parking lots and garages be electric-vehicle (EV) charging-station ready. Trenching and other methods of installing the electrical connections to charging stations can be prohibitive after the construction of the parking is complete.

Cost Impact: Will increase the cost of construction

This will increase the cost of construction. One of the largest cost variables is the distance between the breaker box and the charging locations. Cost for the simplest option, conduit and electrical capacity sufficient for level 2 charing, could easily be $500 to $3000 per charging station location, which provides a significant incentive to locate the potential charging stations close to the breaker box. This cost estimate does not include the EV charging hardware.
Costs are estimated from Figure 2 of http://cleantechnica.com/2014/05/03/ev-charging-station-infrastructure-costs/

CE229-16 : C406 (NEW)-CONNER13653

CE230-16

IECC: C406, C406.1, C406.10 (New), C406.10.1 (New), C406.8 (New), C406.9 (New).

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 International Energy Conservation Code

Revise as follows:

SECTION C406 ~~ADDITIONAL~~ EFFICIENCY ~~PACKAGE OPTIONS~~ PACKAGES

C406.1 Requirements. Buildings shall comply with at least one of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power density system 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. Increased lamp efficacy in dwelling units in accordance with Section C406.10.

Add new text as follows:

C406.8 Enhanced envelope performance. The total UA of the building thermal envelope as designed shall be not less than 15 percent below the total UA of the building thermal envelope in accordance with Section C402.1.5.

C406.9 Reduced air infiltration. Air infiltration shall be verified by whole building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air leakage rate of the building envelope shall not exceed 0.25 cfm/ft^2 (2.0 L/s•m^2) under a pressure differential of 0.3 in. water (75 Pa), with the calculated surface area being the sum of the above and below grade building envelope. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner.

> Exception. For buildings having over 250,000 square feet (25,000 m^2) of conditioned floor area, air
> leakage testing need not be conducted on the whole building where testing is conducted on representative above- grade sections of the building. Tested areas shall total not less than 25 percent of the conditioned floor area and shall be tested in accordance with this section.

C406.10 Increased lamp efficiency in dwelling unit. To use the compliance method of Section C406.10.1, buildings shall be of the following types:

1. Group R-1: Boarding houses, hotels and motels.

2 Group R-2: Buildings with residential occupancies.

C406.10.1 Lamp fraction. Ninety-five percent of the lamps in permanently installed lighting fixtures in dwelling units shall be lamps with a minimum efficacy of:

1. 90 lumens per watt for lamps over 40 watts;
2. 60 lumens per watt for lamps over 15 watts to 40 watts;
3. 45 lumens per watt for lamps over 5 watts to 15 watts; and
4. 30 lumens per watt for lamps 5 watts and less.

Reason: The options packages have been published in both the 2012 IECC and the 2015 IECC. As energy savings in codes increase, and strategies to achieve them become more varied, many state codes and model codes use the "menu" approach to get an additional increment of savings. By providing options, each project can best assess what is the best strategy for its building to achieve this increment of savings. Between the 2012 IECC and the 2015 IECC, the number of options was increased from three to six. The number of options in this proposal is further increased to nine, providing an even greater number of options and increased flexibility for each project. Each option package was designed to provide approximately 3 % savings based on the loads regulated by the energy code, but actual savings will vary by building type, building size, climate, and other factors. This proposal strikes the word "additional" and "option" from the title of the to avoid confusion. Code users have viewed Section C406 as an option verses as a requirement so clarifying the title will lead to increased understanding of this section of the code.

This proposal adds three additional packages building off of code requirements included in the commercial provisions of the energy code.

Enhanced Envelope Performance.

To meet this option the code user would increase the efficiencies of the building envelope. Options might include using high performance glazing, increased roof/ceiling insulation or increased wall insulation, or a combination of increased envelope efficiencies to demonstrate that the building envelope is 15% more efficient than minimum code requirements. Increasing the efficiency of the building envelope will reduce the overall load on the building and can result in a smaller heating and cooling system for the building reducing the overall first cost.

Reduced Air Infiltration.

This option allows the code user to demonstrate that the building is tighter than the maximum air leakage rate of 0.4 cfm/sf. Reducing the infiltration rate on the building will result in an overall reduced heating and cooling load and increased occupant comfort.

Increased lamp efficacy in dwelling units.

Dwelling units are currently required to install high efficacy lighting in 75% of the connected fixtures. Compact fluorescents or LED lighting is typically used to meet this requirement. This option would require that an additional 15% of the fixtures include high efficacy lighting.

Cost Impact: Will not increase the cost of construction
None. This proposal may reduce the first cost in meeting the Additional Efficiency Package Options for certain occupancy types.

CE230-16 : C406-MAKELA12509

CE231-16

IECC: C406, C406.1.

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

2015 International Energy Conservation Code

Revise as follows:

SECTION C406 ADDITIONAL EFFICIENCY ~~PACKAGE~~ AND RENEWABLE ENERGY SUPPLY OPTIONS

C406.1 Requirements. Buildings shall comply with at least one of the following:

1. **More efficient HVAC performance in accordance with Section C406.2.**
2. **Reduced lighting power density system in accordance with Section C406.3.**
3. **Enhanced lighting controls in accordance with Section C406.4.**
4. **On-site ~~supply~~ production of renewable energy in accordance with Section C406.5, in addition to compliance with any other item listed in this section.**
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.**

Reason: This proposal clarifies the options availalbe in this section, and ensures that the building energy systems will be more efficient. At the current time, a building owner has a choice of increasing energy efficiency or producing renewable energy under C406. Under current federal and state policies, in many situations, it will cost less (on an after-tax basis) to produce renewable energy than to make the building more energy efficient.
Producing renewable energy is good, but it does not make any of the building energy consuming systems more energy efficient.

Under this proposal, if a building owner decides to produce energy on-site, it does not absolve them from making the building more energy efficient.

Cost Impact: Will increase the cost of construction
If a building owner chooses to produce renewable energy, then the costs will go up as the owner will be required to comply with at least one additional option that improves the energy efficiency of the building.

CE231-16 : C406-ROSENSTOCK11780

CE232-16

IECC: C406.1.

Proponent : jim edelson (jim@newbuildings.org)

2015 International Energy Conservation Code

Revise as follows:

C406.1 Requirements. Buildings shall comply with at least ~~one~~ <u>two</u> of the following:

1. **More efficient HVAC performance in accordance with Section C406.2.**
2. **Reduced lighting power density system 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.**

Reason: The flexibility of Section C406 has been steadily increasing since it was first included in the 2012 IECC. There were three Section C406 packages in the 2012 IECC and six packages in the 2015 IECC. There is a proposal to increase the number of packages in the 2018 IECC to nine. In order to ensure that jurisdictions are achieving sufficient energy savings from their new building stock to meet their policy goals, while at the same time providing projects with the flexibility of a "menu" of measures to achieve the additional energy savings, this proposal increases the requirement to two packages. The Washington 2016 energy code increased the requirement to two packages as one action to make progress towards the state's legislated energy policy goals.

Cost Impact: Will increase the cost of construction

A study was prepared by Skanska USA in September 2015 to analyze the cost of the additional package for Washington. The study is posted on the Washington State Building Code Council website.

The pricing included in the study is the direct cost of construction materials and labor including standard markups. The work is priced in 2015 dollars for work within the state of Washington. All work is assumed to be new construction and part of a larger scope of work for that trade. The six building prototypes chosen represent the typical sizes in each building typology along with the most common structure, skin and mechanical systems. Standard design parameters for zoning, tonnage and CFM determination were used to determine the premiums for mechanical system upgrades. Pricing assumes a competitive procurement method with at least 3 bidders.The analysis applied a subset of the nine packages to each of the six prototypes. A majority of the results ranged from $0 per square foot (reduced LPDs) to $1.76 per square foot (Dedicated Outdoor Air Supply). At least 2 packages under $1.00 per square foot were available for each of the six prototypes.

CE232-16 : C406.1-EDELSON12745

CE233-16

IECC: C202 (New), C406.1.

Proponent : Charles Foster, representing Steffes Corporation (cfoster20187@yahoo.com)

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

ENERGY STORAGE SYSTEM. Equipment that is designed for and capable of receiving, storing and discharging energy. Energy storage systems include chemical batteries, flywheels and thermal storage systems.

Revise as follows:

C406.1 Requirements. Buildings shall comply with at least one of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power density system 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. An energy storage system is provided. Where an energy storage system is used as a means to comply with item 7, the following information shall be submitted to the *code official* for review:

   7.1. A narrative describing the operation of the energy storage system that identifies the building end use loads being supplied by the energy storage system and the storage medium used.
   7.2. A list of energy storage system components.
   7.3. A calculation that indicates the maximum charge level in kilowatt-hours (kWh), maximum electric charge rate in kilowatts (kW) and electric or thermal discharge rate kilowatts (KW) of the system.
   7.4. The name of the utility, independent transmission operator (ISO), or regional transmission organization (RTO) that will control the energy storage system.
   7.5. Whether the energy storage system is to be dispatched by the serving grid operator, or micro-grid operator for frequency regulation, renewable integration, or grid stabilization purposes.

Reason: For many years, energy storage has played an important role in the develoment of safe, reliable electric grids in North
America. These traditional roles have included thermal energy space and water heater storage programs by electric utilities to
manage power supply and demand while providing affordable – and sometimes even negative – operating costs for consumers.
More recently, however, Energy storage has taken on an even more important role as buildings move toward netzero
energy. Without cost effective energy storage, the development of grid-scale renewable energy is limited. Additionally,

electric grid operators are struggling to balance the addition of renewable energy from wind and solar with their customer
demands -- often renewable energy production peaks when customer demand is low. Electric grid imbalances caused by the
addition of renewable energy during periods of low customer demand threaten grid stability.
For these reasons and others, the U.S. Department of Energy, Federal Energy Regulatory Commission, state public
service commissions, ISO's and RTO's and others are giving great attention to energy storage.
This proposal is a baby step towards merging building science with the growing need for energy storage. In effect, this
proposal simply states that, if a building is to be used as an energy storage facility, there are a few details that need to be
provided to the authority having jurisdiction. The requirements are minimal and are things that are well known in the energy
storage community.

It is anticipated that once this section is established it will be modified with more details in future editions of the IECC but for
the moment it would serve as a placeholder for this issue of rapidly growing importance. It would also help to establish the IECC's
bona fides as a leader in the green building arena.

Bibliography: See article at:
http://www.pjm.com/about-pjm/exploring-tomorrows-grid/electricity-storage.aspx?p=1 for information on the value of ETS in the PJM
Interconnection service territory.

See article at
http://www.sustainablebusinessoregon.com/articles/2012/04/bonneville-power-calls-for-first -wind.html?page=all for information on
Bonneville Power curtailment of wind generation amounting to almost 100,000 MWH's in 2011.

See Kema Consulting report (Commissioned by the U.S. Department of Energy under the supervision of Sandia National
Laboratory) noting significant reduction in carbon emissions at http://prod.sandia.gov/techlib/access-control.cgi/2008/088229.pdf.

See http://www.steffes.com/off-peak-heating/ets.html for more information on utility benefits of WTS, including energy savings
associated with thermal storage and frequency regulation.

See Sandia National Laboratory website at http://www.sandia.gov/ess/ for information on the contributions of energy storage to
electric grid stability.

For a detailed description of frequency regulation in North America see Department of Energy / National Energy Technology
Laboratory Report Frequency Instability Problems in North American Interconnections, DOE/NETL-2011/1473, Final Report
dated May 1, 2011 found at http://www.netl.doe.gov/energy-analyses/pubs/TransmissionFreqProb.pdf

Cost Impact: Will not increase the cost of construction
This proposal expands the options available for builders and does not impose any additional requirements. Thus, it does not increase the cost of construction.

CE233-16 : C406.1-FOSTER13417

CE234-16

IECC: C406.1, C406.7, C406.7.1.

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

2015 International Energy Conservation Code

Revise as follows:

C406.1 Requirements. **Buildings shall comply with at least one of the following:**

1. **More efficient HVAC performance in accordance with Section C406.2.**
2. **Reduced lighting power density system 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.**~~

Delete without substitution:

~~**C406.7 Reduced energy use in service water heating. Buildings shall 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: Buildings with residential occupancies.**~~
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.**~~

~~**C406.7.1 Load fraction. The building service water-heating system shall have one or more of the following that are sized to provide not less than 60 percent of hot water requirements, or sized to provide 100 percent of hot water requirements if the building shall otherwise comply with Section C403.4.7:**~~

1. ~~**Waste heat recovery from service hot water, heat- recovery chillers, building equipment, process equipment, or a combined heat and power system.**~~
2. ~~**Solar water-heating systems.**~~

Reason: This option should be deleted since it is not available to all commercial buildings, but only a subset of buildings. A review of CBECS 2012 data, which can be found at http://www.eia.gov/consumption/commercial/data/2012/#b4, shows that for building types that cannot use this option (offices, warehouse & storage, mercantile/retail, religious worship, public assembly, and public order & safety) comprise approximately 58.6% of the total number of buildings in the US, and approximately 59.6% of the commercial floorspace.
In other words, for a large majority of buildings, this is not an efficiency option, while other efficiency options are available to 100% of the commercial buildings in the US.

Cost Impact: Will not increase the cost of construction
Removing this option does not change the requirement for an additional efficiency or renewable energy supply requirement in Section C406. As a result, it does not increase construction costs.

CE234-16 : C406.1-ROSENSTOCK11782

CE235-16

IECC: C406.1.1.

Proponent : jim edelson (jim@newbuildings.org)

2015 International Energy Conservation Code

Revise as follows:

C406.1.1 Tenant spaces. Tenant spaces shall comply with 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.

<u>**Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.**</u>

Reason: This proposal clarifies that built-out tenant spaces that are or were occupied, and undergoing an alteration using the existing building provisions, do not need to comply with one or more of the packages in Section C406.

Cost Impact: Will not increase the cost of construction
This proposal is a clarification that narrows the scope of the provision.

CE235-16 : C406.1.1-EDELSON12739

CE236-16

IECC: C406.1.1, C503.7 (New), C505.2 (New).

Proponent : Hope Medina, representing Colorado Chapter of ICC (hmedina@coloradocode.net)

2015 International Energy Conservation Code

Revise as follows:

C406.1.1 Tenant spaces. Tenant spaces shall comply with Section C406.2, C406.3, C406.4, C406.6 or C406.7. Alternatively, tenant spaces <u>in new core and shells that have not been occupied,</u> shall comply with Section C406.5 where the entire building is in compliance.

Add new text as follows:

<u>C503.7 Tenant spaces additional efficiency package Tenant spaces shall comply with Section C406.2, C406.3, C406.4, C406.6, or C406.7.</u>

<u>C505.2 Change of occupancy or use additional efficiency package Tenant spaces with a change in occupancy or use shall comply with Section C406.2, C406.3, C406.4, C406.6, or C406.7.</u>

<u>Exception: Where the change of occupancy or use involves only alterations that are exceptions to Section C503.1 the additional efficiency packages shall not be required.</u>

Reason: When the new Chapter was created to address existing building the requirements for an additional efficiency package was not placed into the existing building chapter, but left in Section C406.1.1. Several issues come into play. Unless the building is being constructed for a specific business or use it is constructed as a core and shell. In most cases the tenants that will occupy the buildng are not known when the core and shell are designed and built. When this section is called out by examiners the architects/building owners will respond with this is a core and shell, and will be addressed by the tenants when a tenant improvement permit is submitted. When the permit is submitted this section becomes a debate because the tenant states this should be addressed with the core and shell, and vice versa.
C406.1.1 doesn't address when this section would be required. By adding the phrase "tenant spaces in new core and shells that have not been occupied" clarifies when this section would be required. This would be the most logical phase of the building's life for it to be feasibly doable.

The added sections to alterations and change of occupancy or use was to place a marker in the existing building sections to address when this section would be required.

Our Theme: A Code for the End User

Is the code section completely understandable to the end user?

Is the code section or requirement easy to find?

Is the code requirement even doable in the real world?

Will the code requirement really save energy or only on paper?

Cost Impact: Will increase the cost of construction
In most cases tenant finishes have not had to comply with this section. There will be additional cost to comply.

CE236-16 : C406.1.1-

CE237-16

IECC: C406.1.1.

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

2015 International Energy Conservation Code

Revise as follows:

C406.1.1 Tenant spaces. Tenant spaces shall comply with Section C406.2, C406.3, C406.4, C406.6 or C406.7. Alternatively, where the entire building is in compliance with Section C406.5, tenant spaces shall comply with Section C406.5 ~~where~~ , in addition to one of the ~~entire building is~~ options listed in ~~compliance.~~ Section C406.1,

Reason: It is very unlikely that a tenant will be able to install an on-site renewable energy production system (or work with the building owner to install such a system), unless the tenant occupies most or all of the rentable space. This proposal modifies the language to ensure that the rented space will be also be more energy efficient.

Cost Impact: Will increase the cost of construction
Where an on-site renewable energy production is installed by the building owner or property management company, this proposal will increase costs to the tenant as it requires the installation of one additional energy efficiency option.

CE237-16 : C406.1.1-ROSENSTOCK11788

CE238-16

IECC: C406.2.

Proponent : Charles Foster, representing self (cfoster20187@yahoo.com)

2015 International Energy Conservation Code

Revise as follows:

C406.2 More efficient HVAC equipment performance. **Equipment shall exceed the minimum efficiency requirements listed in Tables C403.2.3(1) through C403.2.3(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/IES 90.1 by 10 percent. Equipment not listed in Tables C403.2.3(1) through C403.2.3(7) shall be limited to ~~10~~ <u>33</u> percent of the total building <u>heating or cooling</u> system capacity.**

Reason: The IECC should not be a barrier to the deployment of new technologies for space and potable water heating systems. The current restriction of 10% is too limiting in that respect and could inadvertantly serve as a disincentive to the use of new, innovative technologies. Increasing the restriction from 10% to 33% would tend to reduce such disincentives.

Cost Impact: Will not increase the cost of construction
If adopted, this proposal would not add to the cost of construction as it contains no new code requirements. Changing "building system capacity" to "building heating or cooling system capacity" is a mere clarification. Replacing the value of "10%" with a value of "33%" expands the opportunity for builders to utilize new technologies and would not result in higher construction costs.

CE238-16 : C406.2-FOSTER11974

CE239-16

IECC: C406.2.

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

2015 International Energy Conservation Code

Revise as follows:

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.2.3(1) through C403.2.3(7) by ~~10~~ <u>5</u> percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by ~~10~~ <u>5</u> percent. *Variable refrigerant flow systems* shall exceed the energy efficiency provisions of ANSI/ASHRAE/IES 90.1 by ~~10~~ <u>5</u> percent. Equipment not listed in Tables C403.2.3(1) through C403.2.3(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 baseline models and the higher efficiency models is less than 10%. To keep the code up to date, the requirement has been modified from 10% to 5% to account for these changes.

Cost Impact: Will not increase the cost of construction
As this proposal makes the requirement more flexible by making the requirement less stringent, it will not increase the cost of construction.

CE239-16 : C406.2-ROSENSTOCK11792

CE240-16

IECC: C406.2.

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

2015 International Energy Conservation Code

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.2.3(1) through C403.2.3(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/IES 90.1 by 10 percent. ~~Equipment~~ Building designers or owners using equipment not listed in Tables C403.2.3(1) through C403.2.3(7) shall ~~be limited~~ provide evidence of equivalent energy efficiency performance to ~~10 percent~~ the satisfaction of the ~~total building system capacity~~*code official*.

Reason: This proposal provides more flexibility to building owners and designers that want to use new technologies.
As new technologies are developed, this section should not limit their use, especially if they can provide more energy savings. Therefore, if a designer or building owner is using a new technology not shown in the existing tables, they should be allowed to use it if they can show equivalent or improved energy savings to the code official.

Cost Impact: Will not increase the cost of construction
As this proposal makes the requirement more flexible by allowing the use of other or newer energy saving technologies, it will not increase the cost of construction.

CE240-16 : C406.2-ROSENSTOCK11969

CE241-16

IECC: C406.3.

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

2015 International Energy Conservation Code

Revise as follows:

C406.3 Reduced lighting power density. The total interior lighting power (watts) of the building shall be determined by using ~~90~~ <u>95</u> percent of the lighting power values specified in Table C405.4.2(1) times the floor area for the building types, or by using ~~90~~ <u>95</u> percent of the interior lighting power allowance calculated by the Space-by-Space Method in Section C405.4.2.

Reason: There are several proposals dealing with lighting power density that will significantly increase the baseline stringency (lower the current lighting power densities), based on current and future projections of LED technology.
As a result, it will be more difficult to reduce the lighting power density and still meet the lighting needs of building occupants. This proposal adjusts the requirement to reflect the changes.

Cost Impact: Will not increase the cost of construction
This proposal adjusts the requirement and should not result in increased costs for this additional efficiency option.

CE241-16 : C406.3-
ROSENSTOCK11798

CE242-16

IECC: C406.5.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

C406.5 On-site renewable energy. ~~Total~~
The total minimum ratings of on-site renewable energy systems shall ~~comply with~~ be one of the following:

1. ~~Provide not~~ Not less than 1.71 Btu/h per square foot (5.4 W/m^2) or 0.50 watts per square foot (5.4 W/m^2) of conditioned floor area.
2. ~~Provide not~~ 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: The original intent of this provision is to provide a minimum for both types of renewable energy equipment. The Text in 2012 IECC had used the wrong unit of measurement and that was compounded by an incorrect metric equivalence. As an editorial correction the text was removed leaving only the 0.50 watts per square foot. The proposal restores appropriate units . 1.71 Btu/h per square foot was substituted for 1.75 as being the correct conversion of 5.4/W/m^2).
This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The proposal is editorial. It provides equiivalent threshold for equipment rated either in Bth/h or Watts.

CE242-16 : C406.5-COLLINS11465

CE243-16

IECC: C406.5.

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

2015 International Energy Conservation Code

Revise as follows:

C406.5 On-site renewable energy. ~~Total minimum ratings of on-site~~ On-site renewable energy systems shall comply with one of the following:

1. ~~Provide~~ They shall have a peak output capacity of not less than 0.50 watts per square foot (5.4 W/m^2) or 1.71 Btu per square foot (18.4 Btu/m^2) of conditioned floor area.
2. ~~Provide~~ They shall provide 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: This proposal clarifies the design requirement in line 1. The value shown is a capacity value. For example, for a building with 20,000 square feet of conditioned floor area, the system must have a maximum output rating of 10,000 Watts (10 kW) or 34,200 Btus at optimal conditions.
It also ensures that renewable energy systems such as solar thermal, biomass, biogas, and other technologies that produce thermal energy (Btu's) at the building can be used to meet this requirement. Systems that produce thermal energy should qualify along with systems that produce electric energy.

Cost Impact: Will not increase the cost of construction
This proposal does not change the requirement, but only clarifies the qualification, and therefore does not increase the cost. By ensuring that all renewable technologies can use this option, it provides more technology options that may reduce the cost of this option.

CE243-16 : C406.5-ROSENSTOCK11836

CE244-16

IECC: C406.5.

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

2015 International Energy Conservation Code

Revise as follows:

C406.5 On-site renewable energy. Total minimum ratings of on-site renewable energy systems shall comply with one of the following:

1. **Provide not less than 0.50 watts per square foot (5.4 W/m^2) of conditioned floor area.**
2. **Provide 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: This proposal updates the requirement to ensure a minimum amount of savings, based on the energy used by all equipment in the building. As energy efficiency standards have increased for mechanical, water heating, and lighting equipment have increased, along with increased requirements for controls such as variable speed drives and occupancy sensors, the amount of energy used by mechanical, water heating, and lighting systems has declined in commercial buildings, while energy used by miscellaneous loads (cooking equipment, computer servers, etc) has increased. In some commercial buildings, the amount of energy used by miscellaneous equipment may be as high as 40-50% or more of the total building energy usage.
In addition, the cost of renewable energy production systems has declined over the past several years, and will likely decline even further over the next several years.

Cost Impact: Will increase the cost of construction
Depending on the type of commercial building, and the ratio of energy used by "regulated" versus "non-regulated" equipment, along with the decline in the cost of renewable energy production systems, it is likely that the costs for this option will increase compared to the current option. However, the cost increase will decline over the next several years as the costs of energy production will decline.

CE244-16 : C406.5-ROSENSTOCK11837

CE245-16

IECC: C406.6.

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 International Energy Conservation Code

Revise as follows:

C406.6 Dedicated outdoor air system. Buildings covered by Section ~~C403.4~~ C403 shall be equipped with ~~an independent~~ a dedicated outdoor air system (DOAS) and shall comply with the following:

1. Outdoor air shall be provided to each zone by a DOAS that delivers 100 percent outdoor air without requiring operation of the heating and cooling system fans for ventilation ~~system designed~~ air delivery.

2. The DOAS shall include energy recovery ventilation in accordance with Section C403.2.7. Heating coils shall not be installed upstream of the DOAS heat recovery section and heating coils shall not be used to ~~provide~~ temper DOAS supply air to a temperature warmer than 60^{o}F.

> **Exception: Systems serving zones required to comply with Section C403.2.6.1 and are configured to reduce outdoor air by not less than 50 percent below design rates when the ~~minimum 100-percent outdoor air to each individual occupied space, as specified~~ actual occupancy of spaces served by the ~~*International Mechanical Code*~~system is less than design occupancy.**

3. ~~The ventilation system~~ Equipment and controls shall be ~~capable of total energy recovery. The HVAC system shall include supply-air temperature controls that automatically reset~~ configured to cycle off zone heating and cooling equipment fans, pumps, and parallel heating fans and shut off primary cooling air when there is no call for heating or cooling in the ~~supply-air temperature~~ zone.

> **Exception: Fans used for heating and cooling consuming less than 0.1 Watts per cfm and used to provide destratification and air mixing in ~~response to representative building loads~~ the space, ~~or to outdoor air~~ when space temperatures~~. The controls shall reset~~ are within the ~~supply-air temperature at least 25 percent of the difference between the design supply-air temperature and the design room-air temperature~~ setpoint deadband in accordance with Section 403.2.4.1.2.**

Reason: This proposal modifies the requirements for dedicated outdoor air systems currently allowed as an option in the Additional Efficiency Package Options. The modifications are based on current research and code change proposals that were submitted to the Washington State code development process.

The DOAS provisions clarify that 100% of the outside air into a space must be provided without requiring the operation of the heating and cooling system. The majority of commercial HVAC systems are based around a central air handling delivery system. This system typically provides heating, cooling and ventilation air from a single source. Since cooling is typically the largest instantaneous load, the fans must be sized large enough to deliver enough air to meet the peak cooling requirements. When the ventilation is integrated, these large fans must operate during all occupied hours to deliver ventilation effectively to the space. This leads to very high fan energy use. With ventilation separated from the heating and cooling delivery, the large heating/cooling fans can be shut off unless there is a call for heating or cooling and the much smaller ventilation-only fans can

operate to deliver fresh air to the space.

In addition, when the ventilation air is delivered using either Energy Recovery Ventilation (ERV) or Demand Control Ventilation (DCV) the heating energy requirements associated with tempering the ventilation air are significantly reduced or eliminated. The current code text stated that the DOAS system must have a capability to have total energy recovery. The modifications now specifically require an ERV to be installed on the system.

To allow design flexibility, Exception 1 allows the heating/cooling fans to be used to provide air mixing and circulation if they are sufficiently efficient (<0.1W/CFM). For example, a typical wall-mount ductless heat pump fan coil meets this level of energy efficiency. The optimal method for providing for air movement, mixing, and destratification in spaces is through the use of ceiling fans. Note that by removing the ventilation air from the main heating and cooling delivery it makes possible to use of very efficient heating and cooling distribution systems such as radiant systems, ductless fan coils, chilled beams, and other small zonal equipment with no outside air connections and minimal or no ducts.

The modifications also require that the heating and cooling equipment (fans and pumps) only operate when there is a call for conditioning in the zone.

Cost Impact: Will not increase the cost of construction
None. Provision is already in the code and is listed in the Additional Efficiency Packages

CE245-16 : C406.6-MAKELA12492

CE246-16

IECC: C406.7.1.

Proponent : Charles Foster, representing self (cfoster20187@yahoo.com)

2015 International Energy Conservation Code

Revise as follows:

C406.7.1 Load fraction. The building service water-heating system shall have one or more of the following that are sized to provide not less than 60 percent of the building's annual hot water requirements, or sized to provide 100 percent of the building's annual hot water requirements if the building shall otherwise comply with Section C403.4.5.

1. **Waste heat recovery from service hot water, heat- recovery chillers, building equipment, or process equipment~~, or a combined heat and power system~~.**
2. **~~Solar~~*On site renewable energy* water-heating systems.**

Reason: This proposal does three things:
1. it clarifies that the minimum percentage reequirements are related to a building's annual hot water requirements and not simply to first hour rating,

2. it removes combined heat and power system from the list of technologies that can be used to satisfy this sections requirements, and

3. it expands the qualifying renewable energy technology from only solar energy to any on site renewable energy.

Building's annual hot water requirements

It is this proponent's belief that adding the words "of the building's annual" before "hot water requirements" simply clarifies the original intent of the proposal when it was approved. Without this clarification, the requirement might be interpreted to mean meeting only the service hot water system's first hour rating.

Remove combined heat and power system

CHP can be an efficient method of providing space heating and service hot water in certain applications, but it cannot be assumed that it is an efficient method of providing such services in ALL applications. If, for instance, an owner has invested in a building's envelope (insuation, windows, air barrier, etc) and, as a result of that investment, the buidling's HVAC load is relatively small compared to other buildings of its same size and use, then installing a CHP system to meet 60% of the building's annual hot water requirements cannot be assumed to save any energy over other means of providing said hot water. If CHP is to be included it should have an additional performance metric that establishes a minimum annual space heating / cooling load requirement. Until such time as that performance metric is debated, CHP should be removed from the list of qualifying technologies.

Expanding the list of qualifying renewable energy technologies

This change would simply expand the opportunity for builders to use on site renewable energy technologies like wind and/or biomass in addition to solar energy.

Cost Impact: Will not increase the cost of construction
With respect adding the words "of the building's annual" before "hot water requirements," this change simply clarifies the original intent of the proposal when it was approved and would not impose any additional costs.
With respect to removing CHP as a qualifying technology, such a change would not add any new

requirements to the code. To the contrary, it would remove an expensive option that cannot be presumed without further information to be cost effective.

With respect to expanding the solar option to include other technologies, such a change would provide builders with more choices. More choices rather than less is preferred as it puts competitive pressure on the technology providers to keep prices reasonable.

Analysis: An errata was corrected in this section; the reference to Section C403.4.7 was changed to C403.4.5.

CE246-16 : C406.7.1-FOSTER12324

CE247-16

IECC: C406, C406.1, C406.8 (New).

Proponent : Karen Hobbs (khobbs@nrdc.org)

2015 International Energy Conservation Code

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Revise as follows:

C406.1 Requirements. Buildings shall comply with Section C406.8 and at least one of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power density system 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.

Add new text as follows:

C406.8 High-efficiency faucets The flow rate of a lavatory faucet installed in a dwelling unit shall not exceed 1.5 gpm (0.11 L/s) at 60 psi (414 kPa).

Reason: Residential lavatory faucets rated at 1.5 gpm or less are also commonly available and perform as well as those with higher flow rates. WaterSense established criteria for residential lavatory faucets and faucet accessories such as aerators in 2007. Based on recent reports by WaterSense partners, over 5,200 models from 134 brands currently meet the WaterSense specification, showing the widespread availability and commercial viability of more efficient lavatory faucets (Source: MaP Testing: http://www.map-testing.com/).
The Natural Resources Defense Council (NRDC) estimates that significant water and energy savings could accrue nationwide if this revised flow rate for faucets became effective in 2018 :

121.9 million gallons of water per day in 2030;

158 therms of natural gas per year; and

2,198 GWh (Gigawatt Hours) of electricity per year ~~by~~ in 2030.

The California Energy Commission (CEC) adopted a 1.2 gpm standard in August, 2015. In its review, the CEC analyzed the availability and functionality of lavatory faucets operating at 1.5 gpm, the same flow rate contained in this proposal. CEC found that "41 percent of lavatory faucets in the Commission's database would comply with a 1.5 GPM standard. A July, 2015 search of the Commission's database showed 56 percent of lavatory faucets would comply with the 1.5 GPM standard (California Energy Commission, "Staff Analysis of Lavatory Faucet Appliance Standards," Docket Number 15-AAER-05, p. 5, July 24, 2015, http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-05/TN205513_20150724T152718_Staff_Analysis_of_Lavatory_Faucet_Appliance_Standards.pdf). Further, "staff did not encounter any issues with consumer acceptance, health and safety, or heat transfer loss from a 1.5 GPM standard and concludes that a 1.5 GPM maximum flow rate is technically feasible" (California Energy Commission, p. 5).

The CEC also found significant savings in water and energy use as a result of the 1.5 GPM standard, estimating annual savings of 3.4 million gallons of water, 89 GWh savings in electricity, 12 Mthm of natural gas savings and consumer savings of 51 million dollars (California Energy Commission, p. 6).

Bibliography: California Energy Commission, "Staff Analysis of Lavatory Faucet Appliance Standards," Docket Number 15-AAER-05, p. 5, July 24, 2015, http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-05/TN205513_20150724T152718_Staff_Analysis_of_Lavatory_Faucet_Appliance_Standards.pdf.

Cost Impact: Will not increase the cost of construction
As noted above, faucets operating at the flow rates proposed are commonly available and perform as well as less efficient fixtures. EPA WaterSense also found that, "Most high-efficiency faucet accessories that restrict flow are no more expensive that their conventional counterparts. However, pressure compensating faucet accessories that are designed to provide and maintain a constant flow rate despite fluctuations in water pressure typically cost a few dollars more." http://www.epa.gov/WaterSense/faucets.html. Lowe's Home Improvement Store features more than 1,759 residential bathroom faucets that meet the proposed standard of 1.5 gpm from 19 brands, ranging in cost from $15 to $2000 (Source: Lowe's Home Improvement Store website: http://www.lowes.com/Bathroom/Bathroom-Faucets/Bathroom-Sink-Faucets/_/N-1z0wz0vZ1z0z4i4/pl#!). The California Energy Commission (CEC) "concluded that there was no incremental cost between a 1.5 GPM faucet and a 2.2 GPM faucet, based on studies conducted by the investor-owned utilities and verification through a retail price search showing no premium for the more efficient products" (California Energy Commission, p. 6).

CE247-16 : C406.8 (NEW)-HOBBS11698

CE248-16

Part I:
IECC: C407.1.
Part II:
R406.3 (IRC N1106.3)

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 ORDERS FOR THESE COMMITTEES.

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

Part I

2015 International Energy Conservation Code

Revise as follows:

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.

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

Part II

2015 International Energy Conservation Code

Revise as follows:

R406.3 <u>(N1106.3)</u> Energy Rating Index. The Energy Rating Index (ERI) shall be a numerical integer value that is based on a linear scale constructed such that the *ERI reference design* has an Index value of 100 and a *residential building* that uses no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total energy use of the rated design relative to the total energy use of the *ERI reference design*. The ERI shall consider all energy used in the *residential building*. <u>Energy used to recharge or refuel a vehicle for on-road (and off-site) transportation purposes shall not be included in the *ERI reference design* or the *rated design*.</u>

Reason: More commercial buildings are offering amenities for alternatively fueled vehicles. Items such as refueling stations and charging stations are offered to employees, customers, and visitors to provide more options to owners of vehicles that are more energy efficient and provide environmental benefits. The energy for these vehicles will most likely be delivered through a building energy meter. Even though the energy is not being used by the building, or being used by building equipment, or being used by building occupants, it may be considered to be a "process load" under the current scope.
For smaller buildings with several refueling or recharging stations, the amount of energy provided for off-site transportation purposes could be a significant portion of the overall energy use if it is counted as a "process" load.

This proposal provides an exception for this energy used to recharge or refuel a vehicle that is used for on-road (and off-site) transportation purposes. This exception is limited to vehicles that are only

used for off-site purposes that are obtaining their energy through the building energy infrastructure. Please note that vehicles that are used on or at the building site for process or other purposes (e.g., forklifts, campus delivery vehicles, lawn service equipment, etc.) are to be accounted for like other "receptacle" or "process" loads in the total building performance approach.

Cost Impact: Will not increase the cost of construction
This does not change the requirements for total building performance, but clarifies what is to be excluded from scope of this section. Therefore, it will not increase the cost of construction.

CE248-16 : C407.1-ROSENSTOCK11841

CE249-16

IECC: C407.2.1 (New).

Proponent : Duane Jonlin (duane.jonlin@seattle.gov)

2015 International Energy Conservation Code

Add new text as follows:

<u>C407.2.1 Cap on envelope UxA The design heat loss rate of the building envelope shall be not more than 110 percent of the target heat loss rate, calculated in accordance with Section C402.1.5 and Equation 4-2. This UxA component performance calculation is separate from any calculation performed for compliance under Section C402.1.5 and applies only as part of the Section C407 total building performance method.</u>

<u>Exception: The calculation is not required for buildings for which the area and U-value for all envelope components, including roof, wall, floor, door and fenestration in the proposed design are equal to or lower than the prescriptive maximums in Table C402.1.4, Table C402.4, and Section C402.4.</u>

Reason: Total building performance projects frequently trade above-code lighting and HVAC equipment for a building envelope that experiences greater winter heat loss and summer solar gain. This is reasonable in the short term, as the overall energy use is (theoretically) no worse than that of a prescriptive code-minimum building. However, over the life of nearly all buildings, the lighting and equipment will be upgraded multiple times to newer and more efficient technology, while the building envelope is likely to remain largely untouched for generations to come.
This proposal still allows a building envelope that has considerably larger glazing areas or reduced insulation when compared with prescriptive limits, but caps the overall deficiency allowed at 10% worse than prescriptive code.

Since the areas and u-values of all the envelope components already have to be calculated by anyone doing C407 total building performance calculations, the additional work for design teams is minimal.

The exception clarifies that no such calculation is required for projects where none of the envelope U-values or fenestration areas exceed prescriptive code.

Cost Impact: Will not increase the cost of construction
This proposal limits the area of vision glazing, which itself is an expensive component.

CE249-16 : C407.2.1 (NEW)-JONLIN12137

CE250-16

IECC: C407.3.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 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. ~~Nondepletable energy collected off site shall be treated and priced the same as purchased energy.~~ _Energy from ~~nondepletable~~ <u>on-site renewable</u> energy sources~~ collected on site~~ shall be omitted from the annual energy cost of the *proposed design.* <u>The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design.*</u>

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

Reason: The proposal replaces 'non-depletable energy' with the defined term 'on-site renewable' which is the defined term. Further the fourth sentence is replaced by the final sentence. It more clearly states the intent of how purchased renewable energy needs to be treated in the factoring of energy costs for performance-based compliance.
This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: Will not increase the cost of construction
The proposal is editorial and makes no technical changes.

CE250-16 : C407.3-COLLINS11668

CE251-16

IECC: C407.3, C407.4.2.

Proponent : Anthony Floyd, Energy Code Specialist, City of Scottsdale, representing City of Scottsdale (afloyd@scottsdaleaz.gov)

2015 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. ~~Nondepletable energy collected off site shall be treated and priced the same as purchased energy. Energy from nondepletable energy sources collected on site shall be omitted from the annual~~ The reduction in energy cost of the *proposed design*~~.~~ associated with *on-site renewable energy* shall be not more than 10% 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.

C407.4.2 Additional documentation. The *code official*shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the *standard reference design*.
2. Thermal zoning diagrams consisting of floor plans showing the thermal zoning scheme for *standard reference design*and *proposed design*.
3. Input and output reports from the energy analysis simulation program containing the complete input and output files, as applicable. The output file shall include energy use totals and energy use by energy source and end-use served, total hours that space conditioning loads are not met and any errors or warning messages generated by the simulation tool as applicable.
4. An explanation of any error or warning messages appearing in the simulation tool output.
5. A certification signed by the builder providing the building component characteristics of the *proposed design*as given in Table C407.5.1(1).
6. Documentation of the reduction in energy use associated with on-site renewable energy.

Reason: The intent of the IECC (C101.3) is to regulate the design and construction of buildings for use and conservation of energy over the life of each building. The priority of the IECC is energy efficiency. Renewable energy is complimentary, not a substutute for energy efficiency. The 2011 PNNL report on "Integrating Renewable Energy into Building Codes" agrees that energy efficiency should be given priority over renewable energy in energy efficiency codes. For the purposes of code complaince, the maximum 10% renewable energy energy cost reduction ensures that buildings will meet improved energy performance associated with the thermal envelope, mechanical system, service water heating and/or lighting based on the performance-based compliance path. The maximum 10% renewable energy cost reduction does not preclude a building design from incorporating more

renewable energy. It just limits how much energy efficiency can be "traded-off" when determining code compliance under the performance-based path. The 10% limit is twice that permitted in ASHRAE 90.1-2013 and therefore is more permissive in this regard.
Adding the renewable energy documentation requirement to C407.4.2 will document energy cost reductions associated with on-site renewable energy, and is also a requirement in ASHRAE 90.1-2013.

The referenced PNNL report on Integrating Renewable Energy into Building Codes is posted at http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20442.pdf

Cost Impact: Will not increase the cost of construction
The relative cost of on-site renewable energy systems to the cost of meeting the requirements of the IECC is rapidly evolving. Certainly in the preponderance of cases, the IECC requirements are less expensive, but there may be circumstances where the cost of on-site renewable systems does not exceed the cost of meeting IECC requirements. In either case, this code proposal would neither require the installation of a renewable energy system nor limit the size of an installed renewable energy system.

CE251-16 : C407.3-FLOYD12272

CE252-16

IECC: C407.3.

Proponent : Bruce Swiecicki, representing National Propane Gas Association (bswiecicki@npga.org)

2015 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. Nondepletable energy collected off site shall be treated and priced the same as purchased energy. Energy from nondepletable energy sources collected on site shall be omitted from the annual energy cost of the *proposed design.*

> **~~Exception:~~<u>Exception: </u>Jurisdictions that ~~require~~ <u>use either</u> site<u> energy or source</u> energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison. <u>The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.</u>**

Reason: This proposal introduces source energy (full fuel cycle) as a recognized alternative to both "energy cost" and "site energy" for jurisdictions. The multiplying factors are taken from R405.3 in the 2015 IECC.
It's somewhat surprising that the IECC has permitted jurisdictions to utilize site energy but not source energy up to this point. Source energy is an approach that is endorsed by both the U.S. Environmental Protection Agency (letter attached) and the U.S. Department of Energy (letter attached). Model codes should make every effort to implement source energy policies whenever it is possible to do so.

December 15, 2009

Darren B. Meyers, PE, CEM, GBE
Technical Director - Energy Programs
Architectural & Engineering Services
International Code Council, Inc.
4051 W. Flossmoor Rd.,
Country Club Hills, IL 60478

Dear Mr. Meyers:

As the Sustainable Building Technology Committee finalizes its recommendations for the International Green Construction Code (IgCC), EPA urges you to make source energy the basis for energy compliance, as the Committee recommended in its first version released in August of this year.

The use of source energy is the most equitable approach to assessing and comparing the energy efficiency of buildings. The use of site energy provides an incentive to use electricity; in contrast, use of source energy will not provide an incentive for any particular type of fuel, but will provide the right signals to the marketplace to encourage real improvements in energy efficiency and consequent reductions in carbon emissions.

All buildings require heat and electricity to operate. These are both secondary forms of energy, which were derived from an original fuel source. The site energy at any specific building may be delivered as either primary energy (e.g. fuel oil or natural gas) or secondary energy (e.g. heat or electricity). A unit of primary and a unit of secondary energy consumed at the site are not directly comparable because one represents a raw fuel while the other represents a converted fuel. Therefore, the only way to assess the relative efficiencies of buildings with varying proportions of primary and secondary energy consumption is to convert these two types of energy into equivalent units of raw fuel consumed to generate that one unit of energy consumed on-site. Using source energy achieves this equivalency.

For this reason, EPA uses source energy in calculating the ENERGY STAR performance rating for buildings, designed to improve building efficiency and reduce carbon emissions nationally. In order for it to be effective, it is important that the proposed IgCC be based on source energy.

Thank you for your consideration of this important issue. I would appreciate your sending this letter to the entire Sustainable Building Technology Committee. If you have any questions, please contact Cindy Jacobs of EPA at (202) 343-9045.

Sincerely,

Cindy B Jacobs

for Jean Lupinacci
Chief, ENERGY STAR Commercial and Industrial Buildings Branch
Climate Protection Partnerships Division
Office of Air and Radiation
U.S. Environmental Protection Agency

Department of Energy
Washington, DC 20585

March 29, 2010

The Honorable Joseph R. Biden, Jr.
President of the Senate
Washington, DC 20510

Dear Mr. President:

Enclosed, please find a study completed for the U.S. Department of Energy (DOE) by the National Academy of Sciences (NAS) regarding the use of full-fuel-cycle measurements as part of DOE's appliance standards program. As directed by section 1802 of the Energy Policy Act of 2005 (EPACT 2005, Pub. L. 109-58), DOE contracted with the National Academy of Sciences (the Academy) for a study "to examine whether the goals of energy efficiency standards are best served by measurement of energy consumed, and efficiency improvements, at the actual site of energy consumption, or through the full fuel cycle, beginning at the source of energy production."

The enclosed study provides DOE with a number of recommendations for consideration for using full-fuel-cycle approaches as part of the appliance standards program and making full-fuel-cycle information available to consumers and others as they make appliance-related decisions. DOE has reviewed the NAS recommendations and is taking three steps to implement the recommendations.

First, this summer, DOE will propose a policy initiative for public review and comment to develop and use estimates of full-fuel-cycle energy savings and greenhouse gas emissions as the basis for evaluating appliance energy conservation standards. DOE would also propose to use full-fuel-cycle estimates to inform consumers of the impacts of appliance use.

DOE currently assesses the impacts of the appliance energy conservation standards on a primary energy basis (i.e., DOE estimates the impacts of standards on the primary energy and emissions used to generate and transmit the electricity used in appliances, as well as the impacts on fossil fuels used directly). A full-fuel-cycle approach would capture an additional 7 to 13 percent of energy use and greenhouse gas emissions that occur in the production, extraction, and transport of fossil fuel. Full-fuel-cycle information also would enable consumers to more easily compare energy use and emission attributes across products. This exploration of full-fuel-cycle approaches will not change the product classes that DOE uses to establish appliance energy conservation standards, which are consistent with the recommendations of NAS.

Second, at the same time DOE will work with the Federal Trade Commission to consider options for providing consumers with this type of information.

Finally, DOE intends to offer upon request all data used in developing energy efficiency standards for appliances in an open-standard, machine-readable format. This is in addition to DOE's standard practice of providing its data in fully functional Excel spreadsheets.

If you have further questions, please contact Mr. Roland Risser, Program Manager, Building Technologies Program, at (202) 287-1691 or Betty A. Nolan, Senior Advisor, Office of Congressional and Intergovernmental Affairs, at (202) 586-5450.

Sincerely,

Cathy Zoi
Deputy Assistant Secretary
Energy Efficiency and Renewable Energy

Enclosures

Cost Impact: Will not increase the cost of construction
It is difficult to say what impact this proposal will have on the cost of construction. There are too many variables, such as upgrading electrical service versus installing gas piping; the cost of electric versus gas appliances; and the modifications that may be available to the building envelope.

CE252-16 : C407.3-SWIECICKI13448

CE253-16

IECC: C407.3.

Proponent : Ted Williams, representing American Gas Association (twilliams@aga.org)

2015 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. Nondepletable energy collected off site shall be treated and priced the same as purchased energy. Energy from nondepletable energy sources collected on site shall be omitted from the annual energy cost of the *proposed design.***

> **Exception:** ~~Jurisdictions that require site~~ <u>The</u> energy ~~(1 kWh = 3413~~ <u>use based on source energy expressed in</u> Btu~~) rather than~~ <u>or Btu per square foot of conditioned floor area shall be an alternative for the</u> energy cost~~ as the metric of comparison~~. <u>The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.</u>

Reason: The change brings energy performance in commercial buildings under C407.3 into more consistency with R405.3 covering residential building energy performance found in the 2015 edition of the IECC. This consistency in treating source energy performance as an option is fully consistent with Federal programs employing source energy as a metric of performance (e.g., Energy Star for Commercai Bulidngs, Home Energy Score) and is the only pathway to ultimately accounting for fuel cycle emissions and carbon footprints.

Cost Impact: Will not increase the cost of construction
Since the proposed change is as Exception language, its use is not mandatory. Where it is used, it is likely that approaches to increasing source energy performance are more likely to be cost effective and reduce construction costs.

CE253-16 : C407.3-WILLIAMS13196

CE254-16

IECC: C407.3.1 (New).

Proponent : Mark Nowak

2015 International Energy Conservation Code

Add new text as follows:

C407.3.1 Alternative to proposed building and standard reference building designs When using this compliance path, a prototype commercial building approved by the *code official* shall be an alternative to the actual building design. This alternative compliance method shall be limited to new construction in *Climate Zones* 1 through 8. The prototype shall be used for the standard reference design and proposed design. The following component characteristics of the proposed design need not be consistent with the standard reference design:

1. **The percentage of opaque wall, roof, and floor area in the building envelope.**
2. **The percentage of doors, fenestration, and skylight areas.**
3. **U-factors of opaque components, fenestration, and skylights.**
4. **Efficiency of heating, cooling, and water service heating systems.**
5. **Interior lighting power.**

Reason: Designers often prefer to use assemblies that are not addressed in the prescriptive solutions provided in the code. Many times this is for practical reasons, for meeting building owner or market preferences, or because there are more economical solutions than contained in the limited solutions in the prescriptive R-value tables. Developing trade-offs using the performance compliance path has been the only recourse to developing more-cost effective solutions or evaluating alternative assemblies or products. This proposal will allow the development of a wide variety of prescriptive options without expanding the code to include additional pages of text and/or tables. This proposal addresses multiple issues that impact building products and designers.
First, there are many products that are not addressed in the prescriptive tables out of necessity to maintain a simplified prescriptive method. However, not being specifically included in the R-value tables is a severe limitation to a manufacturer if their product always has to comply by the performance option. Designers often will not select a product if they have to show it complies through a simulation.

Second, although the use of building simulations creates opportunity for improved energy savings, the ability to run simulations to create alternative designs is limited by practical barriers. Designers often need to make product and assembly decisions for major systems near the start of the design process when the building design is not far enough along to run simulations. Thus, many decisions are based primarily on what is required by the prescriptive R-values. This proposal gives designers a method of compliance that does not require the proposed design to be used, but allows them to use an approved prototype building such as the U.S Department of Energy's prototype building designs. These designs have been developed by Pacific Northwest National Laboratory (PNNL) and are available at the following link for free download https://www.energycodes.gov/commercial-prototype-building-models.

The PNNL prototype buildings address the most common building types in the market. The PNNL prototype building files include a spreadsheet with "Prototype Building Modeling Specifications" for each building type in each climate zone except the newly created Climate Zone 0. The Prototype Building Modeling Specifications contain the information needed to populate a building energy simulation model. One of the additional benefits of this approach is that PNNL has also developed

building simulation files for Energy Plus, DOE's latest building energy software program. This will allow industry groups to develop their own sets of alternative prescriptive solutions. Manufacturers or even entire industries with products that are not represented in the existing prescriptive solutions in the code can have an alternative method to participate in the market on an equivalent basis to those products or assemblies specifically included in the code.

Cost Impact: Will not increase the cost of construction
This proposal provides a new option for users to comply with the code using alternatives to the prescriptive requirements. Thus, it will never require a user to include more expensive components but will allow them to use lower cost alternatives to achieve equivalent building performance.

CE254-16 : C407.3.1 (NEW)-NOWAK11306

CE255-16

IECC: C407.5.1.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE C407.5.1 (1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Schedules	Same as proposed Exception: Setpoints and schedules for HVAC systems that automatically provide occupant thermal comfort by means other than directly controlling the air dry-bulb and wet-bulb temperature need not be the same, provided that equivalent levels of occupant thermal comfort are demonstrated in accordance with Section 5.2.3 of ASHRAE Standard 55, "Elevated Air Speed," or Appendix D of Standard 55, "Computer Program for Calculation of PMV-PPD."	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.

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 C403.3 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 C403.3.

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 unit efficiency · 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 unit efficiency · 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 unit efficiency · 0.26)].

4. Where Items 1 through 3 are not met, SWHF = 1.0.

Reference standards type: This is an update to reference standard(s) already in the ICC Code Books
Add new standard(s) as follows:
Standard Reference Number
Title **Referenced in Code Section Number**
ASHRAE 55-2013 **Thermal Environmental Conditions for Human Occupancy** **TABLE C407.5.1(1)**

Reason: ***This change provides direction regarding setpoint and schedules requirements for modeling systems that provide occupant thermal comfort via means other than directly controlling the air dry-bulb and wet-bulb temperature (i.e., radiant cooling/heating, elevated air speed, etc.).***

Cost Impact: Will not increase the cost of construction
This proposal simply offers an exception for thermostat setpoints and schedules and will not increase the cost of construction.

CE255-16 : TABLE C407.5.1-FERGUSON11787

CE256-16

IECC: C407.5.1.

Proponent : Amanda Hickman, InterCode Incorporated, representing Air Movement Control Association International (amanda@intercodeinc.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE ~~C407.5.1~~ C407.5.1(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 interior side 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 glazing area; where the proposed glazing area is less than 40 percent of above-grade wall area. 2.40 percent of above-grade wall area; where the proposed glazing 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	Area 1.The proposed skylight area; where the proposed skylight area is less than 3 percent of gross area of roof assembly. 2.3 percent of gross area of roof assembly; where the proposed skylight area is 3 percent or more of gross area of roof assembly	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
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.4.2. 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 C405.5.2(2). Areas and dimensions of tradable and nontradable surfaces shall be the same as proposed.	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. All 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 <u>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 Standard 55.</u>	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 C403.2.6.
Heating systems	Fuel type: same as proposed design	As proposed
	Equipment typea : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.2.3(4) and C403.2.3(5)	As proposed
	Capacityb : 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 typec : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.2.3(1), C403.2.3(2) and C403.2.3(3)	As proposed
	Capacityb : 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
	Economizerd : same as proposed, in accordance with Section C403.3.	As proposed
Service water heatinge	Fuel type: same as proposed	As proposed
	Efficiency: as specified in Table C404.2	For Group R, as proposed multiplied by SWHF. For other than Group R, 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 C403.3 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 C403.3.

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 unit efficiency · 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 unit efficiency · 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 unit efficiency · 0.26)].

4. Where Items 1 through 3 are not met, SWHF = 1.0.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:
ASHRAE 55-13 Thermal Environmental Conditions for Human Occupancy

Reason: This code change proposal provides direction regarding setpoint and schedules requirements for modeling systems that provide occupant thermal comfort via means other than directly controlling the air dry-bulb and wet-bulb temperature (i.e., radiant cooling/heating, elevated air speed, etc.

NOTE TO ICC STAFF: ASHRAE standard 55-2013 has already been submitted with ASHRAE's proposal that deals with the same subject matter as this proposal.

Cost Impact: Will not increase the cost of construction
There is no increase in the cost of construction since this code change proposal only adds an exception...

Analysis: A review of the standard(s) proposed for inclusion in the code, ASHRAE 55, 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 1, 2015.

CE256-16 : TABLE C407.5.1-HICKMAN10981

CE257-16

IECC: C407.5.1.

Proponent : Vickie Lovell, InterCode Incorporated, representing MacroAir (vickie@intercodeinc.com)

2015 International Energy Conservation Code

Revise as follows:

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 interior side 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 glazing area; where the proposed glazing area is less than 40 percent of above-grade wall area. 2.40 percent of above-grade wall area; where the proposed glazing 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

	Area	
	1. The proposed skylight area; where the proposed skylight area is less than 3 percent of gross area of roof assembly.	As proposed
Skylights	2. 3 percent of gross area of roof assembly; where the proposed skylight area is 3 percent or more of gross area of roof assembly	
	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
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.4.2. 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 C405.5.2(2). Areas and dimensions of tradable and nontradable surfaces shall be the same as proposed.	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. All 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 <u>Equivalent levels of occupant thermal comfort shall be demonstrated by means of equal Standard Effective Temperature as calculated in Normative Appendix B of ASHRAE 55 where the the thermostat settings and schedules for HVAC systems utilize radiant heating, radiant cooling and elevated air speed.</u>	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 C403.2.6.
Heating systems	Fuel type: same as proposed design	As proposed
	Equipment typea : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.2.3(4) and C403.2.3(5)	As proposed
	Capacityb : 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 typec : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.2.3(1), C403.2.3(2) and C403.2.3(3)	As proposed
	Capacityb : 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
	Economizerd : same as proposed, in accordance with Section C403.3.	As proposed
Service water heatinge	Fuel type: same as proposed	As proposed
	Efficiency: as specified in Table C404.2	For Group R, as proposed multiplied by SWHF. For other than Group R, 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 C403.3 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 C403.3.

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 unit efficiency · 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 unit efficiency · 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 unit efficiency · 0.26)].

4. Where Items 1 through 3 are not met, SWHF = 1.0.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:
ASHRAE 55-13 Thermal Environmental Conditions for Human Occupancy

Reason: This code change proposal provides direction regarding setpoint and schedules requirements for modeling systems that provide occupant thermal comfort via means other than directly controlling the air dry-bulb and wet-bulb temperature (i.e., radiant cooling/heating, elevated air speed, etc.). This language has already been incorporated into the latest edition of ASHRAE 90.1.

NOTE TO ICC STAFF: ASHRAE standard 55-13 has already been submitted with ASHRAE's proposal that deals with the same subject matter as this proposal.

Cost Impact: Will not increase the cost of construction
There is no increase in the cost of construction since this code change proposal only adds an exception.

Analysis: A review of the standard(s) proposed for inclusion in the code, ASHRAE 55, 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 1, 2015.

CE257-16 : TABLE C407.5.1-LOVELL13418

CE258-16

IECC: C407.5.1.

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

2015 International Energy Conservation Code

Revise as follows:

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 interior side 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 glazing area; where the proposed glazing area is less than 40 percent of above-grade wall area. 2.40 percent of above-grade wall area; where the proposed glazing 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	Area 1.The proposed skylight area; where the proposed skylight area is less than 3 percent of gross area of roof assembly. 2.3 percent of gross area of roof assembly; where the proposed skylight area is 3 percent or more of gross area of roof assembly	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
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.4.2. 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. Controls shall be in accordance with Section C405.2.	As proposed
Lighting, exterior	The lighting power shall be determined in accordance with Table C405.5.2(2). Areas and dimensions of tradable and nontradable surfaces shall be the same as proposed. Controls shall be in accordance with Section C405.2.5.	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
		Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. All end-use load components within and associated with the

Internal gains	Same as proposed	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	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 C403.2.6.
Heating systems	Fuel type: same as proposed design	As proposed
	Equipment typea : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.2.3(4) and C403.2.3(5)	As proposed
	Capacityb : 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 typec : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.2.3(1), C403.2.3(2) and C403.2.3(3)	As proposed
	Capacityb : 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
	Economizerd : same as proposed, in accordance with Section C403.3.	As proposed
Service water heatinge	Fuel type: same as proposed	As proposed
	Efficiency: as specified in Table C404.2	For Group R, as proposed multiplied by SWHF. For other than Group R, 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~~ electric. 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 C403.3 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 C403.3.

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 unit efficiency · 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 unit efficiency · 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 unit efficiency · 0.26)].

4. Where Items 1 through 3 are not met, SWHF = 1.0.

Reason: This proposal updates Table C407.5.1(1). In the lighting section, it refers to the mandatory controls required for interior and exterior lighting. These control requirements are added to the standard reference design, since they are mandatory in the code.
The footnote is also updated for the following reasons: All buildings will receive electric service, but not all buildings will use fossil fuels. So in those rare instances where not heating system exists or has been specified, the heating system should be associated with the type of energy that <u>all</u> commercial buildings will use (which is electricity).

In addition, under Section 433 of the Energy Independence and Security Act of 2007, new and totally renovated federal buildings are required to reduce their use of "fossil fuel generated energy" by <u>65%</u> in 2015, <u>80%</u> in 2020, and <u>100%</u> in 2030 (compared to a 2003 baseline). For federal buildings, the current footnote would violate federal law. The revised footnote would allow new and renovated federal buildings to comply, since many new federal buildings are being installed with renewable electricity production systems.

Cost Impact: Will not increase the cost of construction
The language provides clarifications and updates to the specifications to computer modeling for the total building performance section, and do not have any impact on the cost of construction.

CE258-16 : TABLE C407.5.1-ROSENSTOCK11849

CE259-16

Part I:
IECC: C407.5.1.
Part II:
IRC: N1105.5.2.

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

Proponent : Julie Ruth, representing American Architectural Manufacturers Association (julruth@aol.com)

Part I

2015 International Energy Conservation Code

Revise as follows:

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 interior side 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
	Area	

Vertical fenestration other than opaque doors	1.The proposed ~~glazing~~ vertical fenestration area; where the proposed ~~glazing~~vertical fenestration area is less than 40 percent of above-grade wall area.	As proposed
	2.40 percent of above-grade wall area; where the proposed ~~glazing~~ vertical fenestration area is 40 percent or more of the above-grade wall area.	
	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	Area	As proposed
	1.The proposed skylight area; where the proposed skylight area is less than that permitted by Section C402.1 ~~3 percent of gross area of roof assembly~~.	
	2. The area permitted by Section C402.1 ~~3 percent of gross area of roof assembly~~; where the proposed skylight area exceeds that permitted by Section C402.1 ~~is 3 percent or more of gross area of roof assembly~~	
	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
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.4.2. 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 C405.5.2(2). Areas and dimensions of tradable and nontradable surfaces shall be the same as proposed.	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 C403.3 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 C403.3.

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 unit efficiency · 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 unit efficiency · 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 unit efficiency · 0.26)].

4. Where Items 1 through 3 are not met, SWHF = 1.0.

Part II

2015 International Residential Code

TABLE R405.5.2(1)
[N1105.5.2(1)] SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame.	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Basement and crawl space walls	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: from Table N1102.1.4, with insulation layer on interior side of walls	As proposed
Above-grade floors	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Roofs	Type: composition shingle on wood sheathing	As proposed
	Gross area: same as proposed	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Attics	Type: vented with aperture = 1 ft^2 per 300 ft^2 ceiling area	As proposed
Foundations	Type: same as proposed	As proposed
	Foundation wall area above and below grade and soil characteristics: same as proposed	As proposed
Opaque doors	Area: 40 ft^2	As proposed
	Orientation: North	As proposed
	U-factor: same as fenestration from Table N1102.1.4	As proposed
Vertical fenestration other than opaque doors	Total vertical fenestration area[h] = (a) The proposed ~~glazing~~ vertical fenestration area, where the proposed ~~glazing~~ fenestration area is less than 15 percent of the conditioned floor area (b) ~~15 percent of the conditioned floor area,~~ The adjusted vertical fenestration area, where the proposed ~~glazing~~ fenestration area is 15 percent or more of the conditioned floor area. The adjusted vertical fenestration area shall be calculated as follows: AVF_{adj} - AVF x 0.15 X CFA/AF Where AVF_{adj} = Adjusted Vertical Fenestration Area AVF = Proposed Vertical Fenestration Area CFA = Conditioned Floor Area AF = Proposed Total Fenestration Area	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	SHGC: as specified in Table N1102.1.2 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed

	Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design)	0.92-(0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	~~None~~ Skylight Area = (a) The proposed skylight area where the proposed fenestration area is less than 15 percent of the conditioned floor area, or, (b) The adjusted skylight area where the proposed fenestration area is 15 percent or greater of the conditioned floor area. The adjusted skylight area shall be calculated as follows: $ASKY_{adj}$ = Adjusted Skylight Area ASKY = Proposed Skylight Area CFA = Conditioned Floor Area AF = Proposed Total Fenestration Area	As proposed
continue skylights	Orientation: As Proposed	As Proposed
continue skylights	U-factor: As specified in Table N1102.1.4	As Proposed
continue skylights	SHGC: As specified in Table R402.1.2 including footnore (b) of that table, except that for climates with no requirement (NR): SHGC = 0.40	As Proposed
continue skylights	Interior shade fraction for the area of proposed skylights with SHGC ratings that include a pre-installed interior shade: 0.92 - 0.21 x SHGC for the standard reference design	As Proposed with shades assumed closed 50% of the time.
continue skylights	External Shading: None	As Proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	Air leakage rate of 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8 at a pressure of 0.2 inches w.g (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area N_{br} = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences that are not tested, the same air leakage rate as the standard reference design. For tested residences, the measured air exchange rate[a] . The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, Â°C = (Â°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 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 must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must 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 with 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 with 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 with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with 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 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 x 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.

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: Part I (Commercial)

Part I corrects an inconsistency in the treatment of skylights vs. vertical fenestration in the commercial provisions of the IECC. In the commercial prescriptive provisions two different sets of area limits are given for both vertical fenestration and skylights, based upon whether automatic lighting controls are also used. These two sets of area limits are reflected in the criteria for performance design for vertical fenestration, but not for skylights. Part I of this proposal corrects this inconsistency.

Part I also replaces reference to "glazing" with "vertical fenestration", where appropriate.

Part II (Residential)

Skylights are treated inconsistently between the different compliance alternatives in the 2015 IECC Residential Providions. For example, the UA alternative does not limit the area of vertical fenestration or skylights. Likewise, there are no limits on area in the prescriptive provisions. However, the Simulated Performance Alternative specifically excludes skylight area from the Standard Reference Design, while vertical fenestration area is not to exceed 5% of the conditioned floor area.

The omission of consideration of skylights in the Simulated Performance Alternative path is due, at least in part, to approved RE173-13. This proposal changed "glazing" in Table R405.5.2(1) to "vertical fenestration other then opaque doors" between the 2012 and 2015 IECC, thereby omitting skylights from the provisions of the table for glazing.

Although Table R405.5.2(1) in the 2012 IECC did not include provisions directly for skylights, it did include provisions for "glazing". The definition of glazing given in that same table included skylights as well as vertical glazing, as implied by the first sentence of deleted footnote (a).

"(a). Glazing shall be defined as sunlight-transmitting fenestration, including the area of sash, curbing, or other framing elements, that enclose conditioned space. Glazing includes the area of sunlight-transmitting fenestration assemblies in walls bounding conditioned basements. For doors...."

Additionally, in the 2015 IECC the definition of "glazing" was replaced by a definition of "fenestration" that further separated these products into vertical glazing or skylights.

Our proposed changes to Table R405.5.2(1) corrects this inconsistency by reinstating consideration of skylight area in the Standard Reference Design. This proposal does this by adding the following:

a) Proposed provisions for skylight area, U-Factor and shading that mirror the Vertical Fenestration provisions, where ever practical.

b) Proposed provisions for skylight SHGC that mirror those for Vertical Fenestration, with the addition of a reference to Footnote (b) of Table R402.1.2.

c) Proposed provisions for skylight orientation based upon "As Proposed". Typically skylight installation in residential construction is not evenly distributed to all four cardinal compass

orientations, as assumed for vertical fenestration under the Simulated Performance Alternative provisions.

d) Proposed suitable interior shading provisions that are used when any of the proposed skylights are rated products that include integral shading.

This proposal also includes the following changes to the provisions for Vertical Fenestration:

a) Reference to "glazing area" is replaced by "fenestration area" in footnote b. This is the only remaining use of the phrase "glazing area" in the residential provisions of this code, after the removal of "glazing" as defined in the deleted footnore (a).

b) Provisions are added to reduce the vertical fenestration area (and skylght area) proportionally for the Standard Reference Design, whenever total fenestration area equals or exceeds 15% of conditioned floor area and any skylight area is proposed.

Cost Impact: Will not increase the cost of construction
The changes are editorial to add clarity and understanding to the definition. No new requirements are added and thus, costs are not impacted.

CE259-16 : TABLEC407.5.1(1)-RUTH10965

CE260-16

IECC: C408.1.

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

2015 International Energy Conservation Code

Revise as follows:

C408.1 General. This section covers the commissioning of the building mechanical systems in Section C403, service water heating systems in Section C404, and electrical power and lighting systems in Section C405.

Reason: Added reference to Service Water Heating Systems and associated section for calrification. Section C404 is listed as mandatory, but was not listed in Section C408.1 that list the sections covered for commissiong of certain building systems. This clarifies that Service water heating systems is part of the already manditory systems requried to be commissioned.

Cost Impact: Will not increase the cost of construction
This is a clarification

CE260-16 : C408.1-
MEDINA12955

CE261-16

IECC: C408.1, C408.2.

Proponent : Joseph Zimmer, representing Joseph Zimmer, Architect (joe@studiojosephzimmer.com)

2015 International Energy Conservation Code

Revise as follows:

C408.1 General. This section covers the documentation of components in Section C402 and the commissioning of the building mechanical systems in Section C403, service water heating systems in Section C404 and electrical power and lighting systems in Section C405.

C408.2 Mechanical systems and service water-heating systems commissioning and completion requirements. Prior to the final mechanical, electrical and plumbing inspections, *the registered design professional or approved agency* shall provide evidence of mechanical, service water heating, electrical power and lighting systems commissioning and completion in accordance with the provisions of this section and documentation of compliance with Sections C402.5, C403.2.3, C403.2.4, C403.2.5, C403.2.6, C403.2.7, C403.2.8, C403.2.9, C403.2.10, C403.2.12, C403.2.14, C403.2.15, C403.2.16, C403.2.17, C404, C405.2, C405.3, C405.5, C405.6, C405.7, C405.8 and C405.9. Prior to final inspection, documentation summarizing the as-built building envelope characteristics in accordance with Section C402, C407 or C409 as applicable to the project compliance method, shall, where requested, be submitted to the *code official*.

~~*Construction document*~~*Construction document* notes shall clearly indicate provisions for commissioning and completion requirements in accordance with this section and are permitted to refer to specifications for further requirements. Copies of all documentation shall be given to the owner or owner's authorized agent and made available to the ~~*code official*~~*code official* upon request in accordance with Sections C408.2.4 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 C403.3 that serve individual dwelling units and sleeping units.~~

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 C403.3 that serve individual dwelling units and sleeping units.

Reason: Commissioning insures that energy consuming systems will operate as design intended with intent of intended performance and efficiency levels.
If commissioning, by the *design professionals* or *approved agencies* also verifies that building envelope charateristics and system equipment efficiency, distribution and controls are as required

by other sections of Commercial provisions Chapter 4, the building as a whole will perform as the design and code requirements intended.

The added documentation by the *design professional* or *approved agency(ies)* often would require specialized equipment or be beyond the level of expertise of the *code official* and would likely vary by specific project design.

Cost Impact: Will not increase the cost of construction
Construction cost should not increase, as commissioning and documentation does not increase construction requirements established in other Commercial provisions Chapter 4 sections. There may be a small increase in project cost for the added time and efforts of the design professional and/or *approved agencies* to verify and document provisions of the code have been incorporated into the as-built construction.

CE261-16 : C408.1-ZIMMER12074

CE262-16

IECC: C202 (New), C408.2, C408.2.1, C408.2.4, C408.3.1, C408.3.1.2.

Proponent : Eric Makela, Cadmus Group, representing RESNET

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

CERTIFIED COMMISSIONING PROFESSIONAL An individual who is certified by an ANSI/ISO/IEC 17024 accredited organization.

Revise as follows:

C408.2 Mechanical systems and service water-heating systems commissioning and completion requirements. Prior to the final mechanical and plumbing inspections, ~~the registered design~~ *certified commissioning professional* ~~or approved agency~~ shall provide evidence of mechanical systems commissioning and completion in accordance with the provisions of this section.

Construction document notes shall clearly indicate provisions for commissioning and completion requirements in accordance with this section and are permitted to refer to specifications for further requirements. Copies of all documentation shall be given to the owner or owner's authorized agent and made available to the *code official* upon request in accordance with Sections C408.2.4 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 C403.3 that serve individual dwelling units and sleeping units.

C408.2.1 Commissioning plan. A *commissioning plan* shall be developed by a ~~registered design professiona~~ *certified commissioning professional*~~l or approved agency~~ and shall include the following items:

1. A narrative description of the activities that will be accomplished during each phase of *commissioning*, including the personnel intended to accomplish each of the activities.
2. A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be performed.
3. Functions to be tested including, but not limited to, calibrations and economizer controls.
4. Conditions under which the test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions.
5. Measurable criteria for performance.

C408.2.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and certified by the ~~registered design~~ *certified commissioning professional* ~~or approved agency~~ and provided to the building owner or

owner's authorized agent. The report shall be organized with mechanical and service hot water findings in separate sections to allow independent review. The report shall be identified as "Preliminary Commissioning Report" and shall identify:

1. **Itemization of deficiencies found during testing required by this section that have not been corrected at the time of report preparation.**
2. **Deferred tests that cannot be performed at the time of report preparation because of climatic conditions.**
3. **Climatic conditions required for performance of the deferred tests.**

C408.3.1 Functional testing. Prior to passing final inspection, the *~~registered design~~* *certified commissioning* *professional* 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 and C408.3.1.2 for the applicable control type.

C408.3.1.2 Time-switch controls. Where time-switch controls are provided, the following procedures shall be performed:

1. **Confirm that the time-switch control is programmed with accurate weekday, weekend and holiday schedules.**
2. **Provide documentation to the owner of time- switch controls programming including weekday, weekend, holiday schedules, and set-up and preference program settings.**
3. **Verify the correct time and date in the time switch.**
4. **Verify that any battery back-up is installed and energized.**
5. **Verify that the override time limit is set to not more than 2 hours.**
6. **Simulate occupied condition. Verify and document the following:**
    6.1. **All lights can be turned on and off by their respective area control switch.**
    6.2. **The switch only operates lighting in the enclosed space in which the switch is located.**
7. **Simulate unoccupied condition. Verify and document the following:**
    7.1. **Nonexempt lighting turns off.**
    7.2. **Manual override switch allows only the lights in the enclosed space where the override switch is located to turn on or remain on until the next scheduled shutoff occurs.**
8. **Additional testing as specified by the *~~registered design~~* *certified commissioning* *professional*.**

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:

ANSI/ ISO /IEC 17024:2012	Conformity assessment - General requirements for bodies operating certification of persons

Reason: Providing commissioning service involve a broad knowledge set of building systems from mechanical and plumbing to lighting systems. Currently individual providing commissioning service have no clear defined certification for demonstrating expertise in the services provided. Requiring certifying bodies that accredit commissioning professionals meet the requirements of ANSI 17024:2012 will establish a more rigorous defined skill level for those who provide commissioning services. Accredited certifying bodies that meet the requirements of ANSI 17024 will establish the knowledge set and experience level for a certified commissioning professional and provide value to

the building owners and clear requirements of commissioning professionals for code officials.

Cost Impact: Will not increase the cost of construction
The proposal is editorial in nature and will not increase the cost of constuction. The proposal is modifying the requirements for the person perfoming the commissioning task to ensure that the person is qualified.

Analysis: A review of the standard(s) proposed for inclusion in the code, ANSI/ISO/IEC 17024, 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 1, 2015.

CE262-16 : C408.2-MAKELA12632

CE263-16

IECC: 0, C408.2, C408.2.1, C408.2.4, C408.3.1.

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

2015 International Energy Conservation Code

Add new definition as follows:

C202
QUALIFIED COMMISSIONING AUTHORITY
The individual or agency identified by the owner or owner's agent that serves as an objective and independent advocate for the owner and is responsible for the execution of the commissioning process. The individual or agency serving as the qualified commissioning authority has a building commissioning certificate from an accredited agency,or has not less than two years experience in commissioning of projects of a similar scale and complexity and is a professional engineer licensed by the State.~~"~~

Revise as follows:

C408.2 Mechanical systems and service water-heating systems commissioning and completion requirements. Prior to the final mechanical and plumbing inspections, *the ~~registered design professional or approved agency~~ qualified commissioning authority* shall provide evidence of mechanical systems commissioning and completion in accordance with the provisions of this section.

Construction document notes shall clearly indicate provisions for commissioning and completion requirements in accordance with this section and are permitted to refer to specifications for further requirements. Copies of all documentation shall be given to the owner or owner's authorized agent and made available to the *code official* upon request in accordance with Sections C408.2.4 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 C403.3 that serve individual dwelling units and sleeping units.

C408.2.1 Commissioning plan. A *commissioning plan* shall be developed by a *~~registered design professiona~~ qualified commissioning authority*~~l or approved agency~~ and shall include the following items:

1. A narrative description of the activities that will be accomplished during each phase of *commissioning*, including the personnel intended to accomplish each of the activities.
2. A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be performed.
3. Functions to be tested including, but not limited to, calibrations and economizer controls.
4. Conditions under which the test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions.
5. Measurable criteria for performance.

C408.2.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and certified by the ~~*registered design professional or approved agency*~~qualified commissioning authority and provided to the building owner or owner's authorized agent. The report shall be organized with mechanical and service hot water findings in separate sections to allow independent review. The report shall be identified as "Preliminary Commissioning Report" and shall include a statement indicating the qualified commissioning authority's qualifications in accordance with Section C202, and shall identify:

1. Itemization of deficiencies found during testing required by this section that have not been corrected at the time of report preparation.
2. Deferred tests that cannot be performed at the time of report preparation because of climatic conditions.
3. Climatic conditions required for performance of the deferred tests.

C408.3.1 Functional testing. Prior to passing final inspection, the~~*registered design professional*~~ *qualified commissioning authority*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 and C408.3.1.2 for the applicable control type.

Reason: Registered Design Professional is confusing in that some may mistakenly believe that the project's Design Engineer is being required to self-execute the commissioning of their design. As this presents a conflict of interest this terminology should be removed.
Additionally, Approved Agency, is not a common term used in the commissioning industry. Qualified Commissioning Authority is a more common term to the industry and requiring the Commissioning Authority to be qualified in the practice will ensure better execution of the process and in turn improve building energy performance.

IECC Section C104.4 recognizes that third-party inspection agency require "qualifications and reliability relevant to the building components and systems they are inspecting." As commissioning is a specialized industry with skilled professionals. you should recognize that qualifications are necessary to adequately execute this scope of work. There are currently multiole commissioning credentials from various organizations and identifying which crediential best suites is difficult.

Cost Impact: Will not increase the cost of construction
These are items to demonstrate credentials outside

CE263-16 : C408.2-
MEDINA12954

CE264-16

IECC: C408.2.1.

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

2015 International Energy Conservation Code

Add new text as follows:

C408.2.1 Commissioning plan. A *commissioning plan* shall be developed by a~~registered design professiona~~ Qualified Commissioning Authority~~l or approved agency~~ and shall include the following items:

1. A narrative description of the activities that will be accomplished during each phase of *commissioning*, including the personnel intended to accomplish each of the activities.
2. A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be performed.
3. Functions to be tested including, but not limited to, calibrations and economizer controls.
4. Conditions under which the test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions.
5. Measurable criteria for performance.
6. Where the Qualified Commissioning Authority is an employee of one of the registered design professional of record or an employee or subcontractor of the project contractor, an In-House Commissioning Disclosure and Conflict Management Plan shall be included in the commissioning plan. This plan shall disclose the Qualified Commissioning Authority's contractual relationship with other team members and provide a conflict management plan demonstrating that the qualified commissioning authority is free to identify issues discovered and report directly to the owner.

Reason: The addition of an In-House Commissioning Disclosure and Conflict Management Plan helps ensure that a conflict of interest does not arise when Design Engineers and Contractors self execute commissioning of their own designs and installations.
Requiring third party independence of the Commissioning Authority is advocated by multiple building industry groups to avoid conflict of interest inherent in any process that permits self execution of a quality control or verification process.

Section C104.4 does not speak directly to the independence of the commissioning authority, but rather addressed the requirements for third-party inspection agencies to not be affiliated with the building design and construction. The code clearly recognizes that potential conflict can arise when independence of quality control agencies is not required by the code.

The IECC defines Building Commissioning as a "process that verifies" building systems installation and functionality according to number of minimum requirements including "code requirements".

Bibliography: ASHRAE; The Strategic Guide to Commissioning, 2014

Cost Impact: Will not increase the cost of construction
This change will not add any cost. It requires a form to be supplied when a potential conflict of independence.

CE264-16 : C408.2.1-MEDINA12958

CE265-16

IECC: C408.2.4, C408.2.4.1 (New).

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

2015 International Energy Conservation Code

Revise as follows:

C408.2.4 Preliminary commissioning report. **A preliminary report of commissioning test procedures and results shall be completed and certified by the *registered design professional* or *approved agency* and provided to the building owner or owner's authorized agent. The report shall be organized with mechanical and service hot water findings in separate sections to allow independent review. The report shall be identified as "Preliminary Commissioning Report," shall include the completed Commissioning Compliance Checklist Table C408.2.4.1 and shall identify:**

1. **Itemization of deficiencies found during testing required by this section that have not been corrected at the time of report preparation.**
2. **Deferred tests that cannot be performed at the time of report preparation because of climatic conditions.**
3. **Climatic conditions required for performance of the deferred tests.**

Add new text as follows:

TABLE C408.2.4.1
Commissioning Compliance Checklist

Project Information	**Project Name:** **Project Address:** **Commissioning Authority:**
Commissioning Plan (Section C408.2.1)	**________ Commissioning Plan was used during construction and includes all items required by Section C408.2.1**

________ Commissioning Plan was used during construction and includes all items required by Section C408.2.1

________ Commissioning Plan was used during construction and includes all items required by Section C408.2.1

_______ Systems Adjusting and Balancing has been completed.

_______ Systems Adjusting and Balancing has been completed.

_____ HVAC Equipment Functional Testing has been executed. If applicable, deferred and/or follow-up testing is scheduled to be provided on:___________________________

_____ HVAC Equipment Functional Testing has been executed. If applicable, deferred and/or follow-up testing is scheduled to be provided on:___________________________

_______ HVAC Controls Functional Testing has been executed. If applicable, deferred and/or follow-up testing is scheduled to be provided on :_____________________

_______ HVAC Controls Functional Testing has been executed. If applicable, deferred and/or follow-up testing is scheduled to be provided on :_____________________

_______ Economizers Functional Testing has been executed. If applicable, deferred and/or follow-up testing is scheduled to be provided on: ________________

_______ Economizers Functional Testing has been executed. If applicable, deferred and/or follow-up testing is scheduled to be provided on:________________

_______ Lighting Controls Functional Testing has been executed. If applicable, deferred and/or follow-up testing is scheduled to be provided on:_______________

_______ Lighting Controls Functional Testing has been executed. If applicable, deferred and/or follow-up testing is scheduled to be provided on:________________

_____ Service Water Heating System Functional Testing has been executed. If applicable, deferred and/or follow-up testing is scheduled to be provided on:________________

Service Water Heating System Functional Testing has been executed. If applicable, deferred and/or follow-up testing is scheduled to be provided on:_______________

Manual, record documents and training have been completed or scheduled

Manual, record documents and training have been completed or scheduled

Preliminary Commissioning Report submitted to owner and includes all items required by Section C408.2.4

Preliminary Commissioning Report submitted to owner and includes all items required by Section C408.2.4

I hereby certify that the commissioning provider has provided me with evidence of mechanical, service water heating and lighting systems commissioning in accordance with the 2018 IECC.

Signature of Building Owner or Owner's Representative Date

I hereby certify that the commissioning provider has provided me with evidence of mechanical, service water heating and lighting systems commissioning in accordance with the 2018 IECC.

Signature of Building Owner or Owner's Representative Date

Reason: The addition of a Commissioning Compliance Checklist will streamline the final inspection submission process as it relates to building system commissioning execution. It will also streamline the submission process to the code officials for final inspections.

Cost Impact: Will not increase the cost of construction
This will not effect the cost of design nor will is increase the cost of construction. It is a checklist provided for everyone involved to verify that all requirements have been completed. It is similar to the air barrier and insulation checklist found in the Residential Energy code. This is a tool to aid those involved with the process to verify for final inspection.

CE265-16 : C408.2.4-MEDINA12966

CE266-16

IECC: C408.2.4.

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

2015 International Energy Conservation Code

Revise as follows:

C408.2.4 Preliminary commissioning report. **A preliminary report of commissioning test procedures and results shall be completed and certified by the *registered design professional* or *approved agency* and provided to the building owner or owner's authorized agent. The report shall be organized with mechanical and service hot water findings in separate sections to allow independent review. The report shall be identified as "Preliminary Commissioning Report" and shall identify:**

1. **Itemization of deficiencies found during testing required by this section that have not been corrected at the time of report preparation.**
2. **Deferred tests that cannot be performed at the time of report preparation because of climatic conditions.**
3. **Climatic conditions required for performance of the deferred tests.**
4. **<u>Results of functional performance tests.</u>**
5. **<u>Functional performance test procedures used during the commissioning process including measurable criteria for test acceptance.</u>**

Reason: Testing results and testing procedures are required for the final commissioning report. These documents are also readily available when drafting the preliminary report. Not including this documentation in the preliminary commissioning report limits the transfer of valuable information in a timely manor.
Testing results are valuable in understanding what the commissioning provider did, how they did it, and under what conditions the testing was executed. This can be especially helpful for contractors and building owners troubleshooting poor system operation.

Cost Impact: Will not increase the cost of construction
Testing procedures will not increase the cost of design or construction.

CE266-16 : C408.2.4-MEDINA12989

CE267-16

IECC: C104.2.6, C408.2.4.1.

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

2015 International Energy Conservation Code

Revise as follows:

C408.2.4.1 Acceptance of report. Buildings, or portions thereof, shall not be considered acceptable for a final inspection pursuant to Section ~~C104.3~~ C104.2.6 until the *code official* has received ~~a letter of transmittal~~ the Preliminary Commissioning Report from ~~the building owner acknowledging that~~ the building owner or owner's authorized agent ~~has received the Preliminary Commissioning Report~~.

C104.2.6 Final inspection. The building shall have a final inspection and shall not be occupied until *approved*. The final inspection shall include verification of the installation and proper operation of all required building controls, and documentation verifying activities associated with required *building commissioning* have been conducted and findings of noncompliance corrected. Buildings, or portions thereof, shall not be considered for a final inspection until the *code official* has received a letter of transmittal from the building owner acknowledging that the building owner has received the Preliminary Commissioning Report as required in Section C408.2.4.

Reason: Section C104.2.6 directly references commissioning, the process of submitting a preliminary commissioning report and explicitly references section C408.2.4. This appears to be an obvious error in the code.
Testing, adjusting and balancing reports are commonly required for Certificates of Occupancy. The commissioning report is equally important in validating the building's readiness for final inspection and as such should be submitted to the code official prior to final inspection. Additionally the burden of transferring a preliminary commissioning report to the code official is no more burdensome that writing and delivering a letter of transmittal.

Cost Impact: Will not increase the cost of construction
these are already required, so there should not be any additional cost involved.

CE267-16 : C408.2.4.1-MEDINA12951

CE268-16

IECC: (New), C103.6 (New), C103.6.1 (New), C103.6.3 (New), C103.6.4 (New), C408.2.5.1, C408.2.5.2, C408.2.5.3, C408.2.5.4.

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 International Energy Conservation Code

Delete without substitution:

Add new text as follows:

C103.6 Building documentation and closeout submittal requirements The *construction documents* shall specify that the *documents* described in this section be provided to the *building* owner or owner's authorized agent within 90 days of the date of receipt of the *certificate of occupancy*.

C103.6.1 Record documents. Construction documents shall be updated to convey a record of the completed work. Such updates shall include mechanical, electrical and control drawings that indicate all changes to size, type and locations of components, equipment and assemblies.

C103.6.3 Compliance documentation. All energy code compliance documentation and supporting calculations shall be delivered in one document to the building owner as part of the project record documents, manuals, or as a standalone document. This document shall include the specific energy code year utilized for compliance determination for each system, documentation demonstrating compliance with Section C303.1.3 for each fenestration product installed and the interior lighting power compliance path, building area or space-by-space, used to calculate the lighting power allowance.
For projects complying with Item 2 of Section C401.2, the documentation shall include:

1. **The envelope insulation compliance path,**
2. **All compliance calculations including those required by Sections C402.1.5, C403.2.12.1, C405.4, and C405.5.**

For projects complying with Section C407 the documentation shall include all documentation required by Sections C407.4.1 and C407.4.2.

C103.6.4 Systems operation control. Training shall be provided to those responsible for maintaining and operating equipment included in the manuals required by Section C103.6.2.
The training shall include:

1. **Review of manuals and permanent certificate.**
2. **Hands-on demonstration of all normal maintenance procedures, normal operating modes, and all emergency shutdown and start-up procedures.**
3. **Training completion report.**

Delete without substitution:

~~C408.2.5.1 Drawings. Construction documents shall include the location and~~

~~**performance data on each piece of equipment.**~~

Revise as follows:

~~C408.2.5.3~~ C408.2.5.1 System balancing report. ***No change to text.***

~~C408.2.5.4~~ C408.2.5.2 Final commissioning report. A report of test procedures and results identified as "Final Commissioning Report" shall be delivered to the building owner or owner's authorized agent. The report shall be organized with mechanical system and service hot water system findings in separate sections to allow independent review. The report shall include the following:

1. **Results of functional performance tests.**
2. **Disposition of deficiencies found during testing, including details of corrective measures used or proposed.**
3. **Functional performance test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.**

    Exception:Deferred tests that cannot be performed at the time of report preparation due to climatic conditions.

Delete without substitution:

~~**C408.2.5.2 Manuals. An operating and maintenance manual shall be provided and include all of the following:**~~

1. ~~**Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.**~~
2. ~~**Manufacturer's operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.**~~
3. ~~**Name and address of at least one service agency.**~~
4. ~~**HVAC and service hot water controls system maintenance and calibration information, including wiring diagrams, schematics and control sequence descriptions. Desired or field-determined set points shall be permanently recorded on control drawings at control devices or, for digital control systems, in system programming instructions.**~~
5. ~~**Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.**~~
6. ~~**Operation and maintenance manuals for each piece of lighting equipment. Required routine maintenance actions, cleaning and recommended relamping shall be clearly identified.**~~
7. ~~**A schedule for inspecting and recalibrating all lighting controls.**~~
8. ~~**A narrative of how each system is intended to operate, including recommended set points.**~~

Reason: This code change proposal moves the requirements from the commissioning requirements to the overall documentation requirements to ensure that the building owner receives all of the documentation related to energy code compliance and the operation and maintenance (O&M) manuals for the HVAC and lighting system within 90 days after the certificate of occupancy. Similar requirements are already included in the Section C408 Commissioning but it only applies to projects with over 480,000 Btu/hr cooling capacity and 600,000 heating capacity, leaving out small commercial

buildings less than approximately 15,000 sf. It is important for the building owners to be provided with the O&M manuals for the smaller buildings to ensure that the systems can be maintained and operated to maintain their efficiencies. Note that this provision was a requirement for all system types prior to the development of the 2012 IECC when it was put into the commissioning section. It is also important for the building owner to be provided with accurate drawings and energy code documentation for future changes to the building. Demonstrating compliance for future additions and alterations to the energy using features of the building is made difficult without knowing how the existing building was made to comply with the IECC, in addition to other codes, for the building envelope, mechanical and lighting systems.

The code change proposal also specifies the type of documentation that should be submitted to demonstrate documentation with the energy code. This will ensure that the plan review and inspection staff have the necessary documentation to determine compliance with the energy code.

Cost Impact: Will not increase the cost of construction
None. The documentation is already required for buildings that are commissioned. This expands the requirements to all buildings.

CE268-16 : C408.2.5.1-MAKELA12457

CE269-16

IECC: C408.2.4, C408.2.5.4, C408.3.

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

2015 International Energy Conservation Code

C408.2.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and certified by the *registered design professional* or *approved agency* and provided to the building owner or owner's authorized agent. The report shall be organized with mechanical and service hot water findings in separate sections to allow independent review. The report shall be identified as "Preliminary Commissioning Report" and shall identify:

1. Itemization of deficiencies found during testing required by this section that have not been corrected at the time of report preparation.
2. Deferred tests that cannot be performed at the time of report preparation because of climatic conditions.
3. Climatic conditions required for performance of the deferred tests.

Revise as follows:

C408.2.5.4 Final commissioning report. A report of test procedures and results identified as "Final Commissioning Report" shall be delivered to the building owner or owner's authorized agent. The report shall be organized with mechanical system<u>, lighting controls, </u>and service hot water system findings in separate sections to allow independent review. The report shall include the following:

1. Results of functional performance tests.
2. Disposition of deficiencies found during testing, including details of corrective measures used or proposed.
3. Functional performance test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

    Exception: Deferred tests that cannot be performed at the time of report preparation due to climatic conditions.

C408.3 Lighting system functional testing. Controls for automatic lighting systems shall comply with this section.<u> Prior to the final electrical inspection, the Qualified Commissioning Authority shall provide evidence of lighting systems functional testing in accordance with the provisions of this section and in accordance with Sections C408.2.4 and C408.2.5.</u>

<u>**Exception:** Lighting systems are exempt from the functional testing requirements in Section C408.3.1 in buildings where the total installed lighting load is less than 20 kW and less than 10 kW of lighting load is controlled by occupancy sensors or automatic daylighting controls.</u>

Reason: C408.2.4 and C408.2.5.4- Requiring lighting controls to be a specific part of the commissiong reports provides the Owner and Code Officials a clear indication of commissioning performed and allows for an "independaent review" of all the systems commissioning.
C408.3 - The IECC does not appear to explicitly state that lighting controls testing must be completed prior ro the final electrical inspection. As lighting controls is a system required to be commissioned, it seems only logical to include this system be commissioned prior to the final electrical inspection.

The IECC provides system size exemptions for HVAC and Service Water Heating, but doesn't provide similar requirements pertaining to lighting systems commissioning. It would be absurd to require a project include lighting system testing of a handful of devices. FOr example, there is little value in requiring lighting control commissioning on a small coffee shop with a storage room and a single occupancy sensor.

Cost Impact: Will not increase the cost of construction
This change may actually reduce construction cost with addition of the exemption of testing under the circumstances listed above.

CE269-16 : C408.2.5.4-MEDINA12980

CE270-16

IECC: C202 (New), C409 (New), C409.1 (New), C409.2 (New), C409.3 (New), C409.4 (New), C409.5 (New), C409.6 (New), C409.7 (New), C409.8 (New), C409.8.1 (New), C409.8.2 (New).

Proponent : Duane Jonlin (duane.jonlin@seattle.gov)

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

SOLAR ZONE A section or sections of the roof or building overhang designated and reserved for the future installation of a solar photovoltaic or solar thermal system.

Add new text as follows:

SECTION C409 SOLAR READINESS

C409.1 General A *solar zone* shall be located on the roof of the building or on another structure elsewhere on the site. The *solar zone* shall be in accordance with Sections C409.2 through C409.8 and the *International Fire Code*.

Exceptions
1. A solar zone is not required for buildings that are more than 20 stories above grade plane.
2. A *solar zone* is not required where the solar exposure of the building's roof area is less than 75 percent of that of an unshaded area in accordance with Section C409.1, in the same location, as measured by one of the following:
1. Incident solar radiation expressed in kWh/ft^2-yr using typical meteorological year data.
2. Annual sunlight exposure expressed in cumulative hours per year using typical meteorological year data.
3. Shadow studies indicating that the roof area is more than 25 percent in shadow on September 21 at 10am, 11am, 12pm, 1pm and 2pm solar time.

C409.2 Minimum area The minimum area of the *solar zone* shall be the smallest area determined by one of the following:
1. 40 percent of net roof area. The net roof area shall be calculated as the horizontally-projected gross roof area less the area covered by skylights, occupied roof decks, planted areas, mechanical equipment and the required work space adjacent to the mechanical equipment.
2. A *solar zone* sized to provide peak power equal to 20 percent of the rated capacity of the building's electrical service at an assumed peak photovoltaic power production of 10 watts per square foot of *solar zone* area.

C409.3 Contiguous area The *solar zone* shall consist of one zone or separate sub-zones. Each sub-zone shall be not less than 5 feet in width in the narrowest dimension.

C409.4 Obstructions The *solar zone* shall be free of pipes, vents, ducts, HVAC equipment, skylights and other obstructions, except those serving photovoltaic or solar water

heating systems within the *solar zone*.

C409.5 Shading The *solar zone* shall be set back from any existing or new object on the building or site that is located south, east, or west of the *solar zone*, a distance not less than two times the object's height above the nearest point on the roof surface. Such objects include taller portions of the building itself, parapets, chimneys, antennas, signage, rooftop equipment, and any trees and roof plantings at their existing size at the time of permit application. Portions of the *solar zone* shall not be located on a roof slope greater than 2:12 that faces within 45 degrees of true north.

C409.6 Access Areas contiguous to the *solar zone* shall provide access pathways and provisions for emergency smoke ventilation as required by the *International Fire Code*.

C409.7 Structural integrity The as-designed dead load and live load for the *solar zone* shall be clearly marked on the record drawings, and shall accommodate future photovoltaic or solar water heating systems at an assumed dead load of 4 pound per square foot in addition to the other required live and dead loads. Where photovoltaic or solar water heating systems are installed in the solar zone, structural analysis shall be based upon calculated loads, not upon these assumed loads.

C409.8 Photovoltaic or solar water heating interconnection provisions. Buiildings shall provide for the future interconnection of either photovoltaics in accordance with Section C409.8.1 or solar water heating in accordance with Section C409.8.2.

C409.8.1 Photovoltaic interconnection. A capped roof penetration sleeve shall be provided adjacent to the *solar zone.* The sleeve shall be sized to accommodate a conductor and conduit large enough for 10 peak watts per square foot of the required *solar zone* area. Provisions for interconnection of the future photovoltaics shall be made at the main service panel, either ahead of the service disconnecting means or at the end of the bus opposite the service disconnecting means in one of the following forms:
1. A space for the mounting of a future overcurrent device, sized to accommodate the largest standard rated overcurrent device that is less than 20 percent of the bus rating, or;
2. Lugs sized to accommodate conductors with an ampacity of not less than 20 percent of the bus rating, to enable the mounting of an external overcurrent device for interconnection.

The electrical construction documents shall indicate the following:
1. The s*olar zone* boundaries and access pathways.
2.The location for future inverters and metering equipment.
3. The route for future wiring between the photovoltaic panels and the inverter, and between the inverter and the main service panel.

C409.8.2 Solar water heating interconnection. Two capped pipe tees shall be provided upstream of the domestic water heating equipment to provide plumbing interconnections between a future solar water heating system and the domestic water heating system. Two roof penetration sleeves shall be provided adjacent to the *solar zone*, capable of accommodating supply and return piping for a future solar water heating system.

The plumbing construction drawings shall indicate the following:
1. The s*olar zone* boundaries and access pathways;
2. The location for future hot water storage tanks, and:

3. The route for future piping between the *solar zone* and the plumbing interconnection point.

Reason: Solar energy is already cost-effective in parts of the country, and its plummeting cost indicates that it will become cost-effective in the remainder of the country within this decade. For this reason, solar *readiness* is more critical for long-term energy savings than installation of solar energy. This proposal requires that a certain amount of rooftop space be suitable for future PV (or solar water heating) installation, that the electrical panel be configured to accommodate the future connection, and that a reasonable pathway from one to the other be made available. Conduit is not required - just a capped sleeve through the roof.
The roof area used for the 40% calculation is based on the net area, exclusive of skylights, planted areas or roof decks. Exceptions are provided for heavily shaded roofs and those (such as labs) with extensive rooftop equipment.

The second compliance path shown allows warehouses and similar buildings to provide a smaller solar zone that's more proportionate to their electrical demand.

Example: A building with a 10,000 SF total roof area, 1,000 SF skylight area, and a 400 Amp, 240 volt single phase electrical service is required to provide a *solar zone* area of the smaller of the following:

1. [40% x (10,000 SF roof area – 1,000 SF skylights)] = 3,600 SF; or
2. [400 Amp x 240 Volts x 20% / 10 watts per SF] = 1,920 SF

Therefore, a *solar zone* of 1,920 square feet is required.

Cost Impact: Will increase the cost of construction
The cost increase is extremely minimal - mostly just the cost of the roof penetration. The 4 psf upgrade for the roof load is easily accommodated by structural systems.

CE270-16 : C409 (NEW)-JONLIN12148

CE271-16

IECC: , C401.2, C408.1 (New), C408.2 (New), C408.2.1 (New), C408.2.1.1 (New), C408.2.1.2 (New), C408.3 (New), C408.3.1 (New), C408.3.2 (New).

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

2015 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. 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, C404, C405.2, C405.3, C405.5, C405.6 and C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.
4. <u>The requirements of Section C408 to achieve a zEPI of 50.</u>

Add new text as follows:

<u>C408.1 Scope This section establishes requirements for compliance using predictive modeling. Predictive modeling shall use source energy kBtu/sf-y unit measure based on compliance with Section C408.2 and CO_2*e* emissions in Section C408.3. Where a building has mixed uses, all uses shall be included in the performance based compliance.</u>

<u>C408.2 Energy performance modelling Performance-based designs shall demonstrate a zEPI of not more than 50 as determined in accordance with Equation C408-1.</u>

<u>zEPI = 52 x (Proposed building performance/Baseline building performance) Equation 408-1</u>

<u>Where:</u>

<u>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 C408.2.1.</u>

<u>Baseline building performance = The baseline building performance in source kBtu for a baseline building and its site calculated in accordance with Section C408.2.1.</u>

<u>52 = A fixed value representing the performance of a baseline building designed to comply with ASHRAE 90.1.</u>

<u>C408.2.1 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 of ASHRAE 90.1, as modified by Sections C408.2.1.1 and C408.2.1.2. The energy use modeling shall include all energy used for the building and</u>

site functions and anticipated occupancy.

C408.2.1.1 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 non-renewable energy fossil fuel use at the utility meter or measured point of delivery to Btus and multiplying by the conversion factor in Table C408.2.1.1 based on the geographical location of the building.

TABLE C408.2.1.1
ELECTRICITY GENERATION ENERGY CONVERSION FACTORS FOR EPA eGRID SUB-REGIONS

eGRID 2015 SUB-REGION ACRONYM	e-GRID 2015 SUB-REGION NAME	ENERGY CONVERSION FACTOR
AKGD	ASCC Alaska Grid	3.15
AKMS	ASCC miscellaneous	1.9
ERCT	ERCOT all	3.08
FRCC	FRCC all	3.26
HIMS	HICC miscellaneous	3.67
HIOA	HICC Oahu	3.14
MROE	MRO East	3.5
MROW	MRO West	3.64
NYLI	NPCC Long Island	3.47
NEWE	NPCC New England	3.03
NYCW	NPCC NYC/Westcheter	3.21
NYUP	NPCC Upstate NY	2.66
RFCE	RFC East	3.28
RFCM	RFC Michigan	3.35
RFCW	RFC West	3.29

SRMW	SERC Midwest	3.4
SRMV	SERC Mississippi Valley	3.2
SRSO	SERC South	3.2
SRTV	SERC Tennessee Valley	3.3
SRVC	SERC Virginia/Carolina	3.24
SPNO	SPP North	3.57
SPSO	SPP South	3.26
CAMX	WECC California	2.89
NWPP	WECC Northwest	2.32
RMPA	WECC Rockies	3.82
AZNM	WECC Southwest	3.1
National	National Average	3.14

C408.2.1.2 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 C408.2.1.1 and C408.2.1.2 based on the geographical location of the building.

TABLE C408.2.1.2
U.S. AVERAGE BUILDING FUELS ENERGY CONVERSION FACTORS BY FUEL TYPE

FUEL TYPE	ENERGY CONVERSION FACTOR
Natural Gas	1.09
Fuel Oil	1.19
LPG	1.15

Purchased District Heating - Hot Water	1.35
Purchased District Heating - Steam	1.45
District Cooling	0.33 x value in Table C408.2.1.1
Other	1.1

C408.3 CO2e emissions modelling The CO_2e emissions for the proposed and baseline building and building site shall be based on the proposed and baseline building performance calculated in accordance with Section C408.2.1 and as modified by Section C408.3.1 and C408.3.2. The emissions associated with the proposed design shall be less than the CO_2e emissions associated with the standard reference design in accordance with Equation C408-2

C408.3.1 CO2e emissions from electricity Emissions associated with the use of electric power shall be calculated by converting the electric power used by the building at the electric utility meter or measured point of delivery, to kWh, and multiplying by the CO_2e conversion factor in Table C408.3.1 based on the EPA eGRID Sub-region in which the building is located.

TABLE C408.3.1
ELECTRICITY EMISSION RATE BY EPA eGRID SUB-REGION

eGRID 2015 SUB-REGION ACRONYM	eGRID 2015 SUB-REGION NAME	CO_2e RATE (Kg/kWh)
AKGD	ASCC Alaska Grid	0.685
AKMS	ASCC miscellaneous	0.265
ERCT	ERCOT all	0.698
FRCC	FRCC all	0.617
HIMS	HICC miscellaneous	0.722
HIOA	HICC Oahu	0.825

MROE	MRO East	0.909
MROW	MRO West	0.964
NYLI	NPCC Long Island	0.698
NEWE	NPCC New England	0.428
NYCW	NPCC NYC/Westchester	0.391
NYUP	NPCC Upstate NY	0.369
RFCE	RFC East	0.543
RFCM	RFC Michigan	0.874
RFCW	RFC West	0.82
SRMW	SERC Midwest	0.96
SRMV	SERC Mississippi Valley	0.572
SRSO	SERC South	0.78
SRTV	SERC Tennessee Valley	0.818
SRVC	SERC Virginia/Carolina	0.581
SPNO	SPP North	0.972
SPSO	SPP South	0.873
CAMX	WECC California	0.37
NWPP	WECC Northwest	0.453
RMPA	WECC Rockies	1.149
AZNM	WECC Southwest	0.671
None	Not included	0.692

C408.3.2 Onsite nonrenewable energy. Emissions associated with the use of nonrenewable energy sources other than electric power shall be calculated by multiplying the fossil fuel energy used by the building and its site at the utility meter or measured point of delivery by the national emission factors in Table C408.3.2. Emissions associated with purchased district cooling shall be calculated by multiplying by the factors in Table C408.2.1.1 based on the EPA eGRID Sub-region in which the building is located.

TABLE C408.3.2
FOSSIL FUEL EMSSION FACTORS

STATIONARY FUEL TYPE	EMISSION FACTOR
Natural Gas	141
Fuel Oil	198
Propane	172
Other Fossil Fules	217
Purchased District Energy - Hot water	191
Purchased District Energy -Steam	205
Purchased District Energy - Coolng	147

Reason: The procedures for determining advanced energy performance by use of the zEPI procedures have been in all versions of the ICC IgCC. zEPI uses a scale of 100 to zero allowing the code users to continue to improve energy performance by designing to a lower point on the scale. zEPI is a critical piece of the goals included in the IgCC that focuses the energy performance of buildings and sites on achieving a zero net energy design for buildings. zEPI points to a unit on a scale that goes from a theoretical 100 to zero where 100 equal actual performance for existing buildings as identified in the CBECS data based and 57 equals the 2012 IECC. The 57 on that scale is a fixed number which was assumed as part of the 2012 IgCC to equate to the performance of the 2012 IECC energy performance. The 50 represents a 10% reduction from what the 2012 IECC would allow . To truly get to a zero energy performance goal will require adjusting zEPI each code cycle.
This change indicates that zEPI should be adjusted to 50, which would lead to future steps as follows:
2015 - zEPI = 50
2018 - zEPI = 40
2021 -zEPI = 30
2024 - zEPI = 20
2027 - zEPI = 10
2030 - zEPI = 0

ASHRAE 189.1 that has begun the process of developing the technical requirements of the 2018

energy conservation code is working to incorporate a performance approach based on the zEPI concept. By placing zEPI procedures in the IECC building owners and designers wishing to follow this advanced performance design approach w ill not be required to do the work to design to one system and then change to another when using the IgCC.

The code change affects two sections of the code; C401.2 and C408. C401.2 simply adds a direction allowing the use of the zEPI design as one of f our options. C408 then puts the provisions for the zEPI design approach into the IECC. Fundamentally this proposal creates coordination between the IECC and what will be the technical provisions of ASHRAE 189.1 in the 2018 IgCC.

Cost Impact: Will not increase the cost of construction
As an option, the owner and design team that choose to use zEPI for advanced energy design.

CE271-16 : C408.1-COLLINS13501

CE272-16

Part I:

IECC: , 0, C101.2, C101.4.1, C202, C202 (New), C501.1, C601 (New), C601.1 (New), C601.2 (New), C601.2.1 (New), C602 (New), C602.1 (New), C602.1.1 (New), C602.1.2 (New), C602.1.2.1 (New), C602.1.3 (New), C602.2 (New), C602.2.1 (New), C602.2.2 (New), C602.2.3 (New), C602.2.4 (New), C602.2.5 (New), C602.2.6 (New), C602.2.7 (New), C602.3 (New), C602.4 (New), C602.4.1 (New), C602.4.2 (New), C602.4.3 (New), C602.4.3.1 (New), C602.4.3.2 (New), C602.4.3.3 (New), C602.4.3.4 (New), C602.5 (New), C602.5.1 (New), C602.5.2 (New), C602.5.2.1 (New), C602.5.2.2 (New), C602.5.3 (New), C602.5.4 (New), C602.5.5 (New), C602.5.6 (New), C603 (New), C603.1 (New), C603.2 (New), C603.3 (New), C603.3.1 (New), C603.3.2 (New), C603.3.3 (New), C603.4 (New), C603.4.1 (New), C603.5 (New), C603.5.1 (New), C603.5.2 (New), C603.5.2.1 (New), C603.5.3 (New), C603.5.4 (New), C603.5.5 (New), C603.6 (New), C603.6.1 (New), C604 (New), C604.1 (New), C604.2 (New), C604.3 (New), C605 (New), C605.1 (New), C605.2 (New), C606 (New), C606.1 (New), C606.2 (New), C606.3 (New), C606.4 (New), C606.4.1 (New), C607 (New), C607.1 (New), C607.2 (New), C607.3 (New), C608 (New), C608.1 (New), C608.2 (New), C608.2.1 (New), C608.2.2 (New), C608.2.3 (New), C608.2.4 (New), C608.2.5 (New), C608.2.6 (New), C608.2.6.1 (New), C608.2.6.2 (New), C608.3 (New), C608.3.1 (New), C608.3.2 (New), C608.3.2.1 (New), C608.3.2.2 (New), C608.3.2.3 (New), C608.3.3 (New), C608.3.4 (New), C608.3.5 (New).

Part II:

IECC: , 0, R202 (New).

Proponent : Sean Denniston (sean@newbuildings.org)

Part I

2015 International Energy Conservation Code

Revise as follows:

C101.4.1 Mixed occupancy. Where a building includes ~~both~~ any combination of *multifamily*, *residential* and *commercial* occupancies, each occupancy shall be separately considered and meet the applicable provisions ~~of IECC—Commercial Provisions or IECC—Residential Provisions~~ for each occupancy.

C101.2 Scope. This code applies to *commercial* and *multifamily* *buildings* and the buildings' sites and associated systems and equipment.

Add new definition as follows:

SECTION C202 DEFINITIONS

C202 GENERAL DEFINITIONS

Revise as follows:

COMMERCIAL BUILDING. For this code, all buildings that are not included in the definition of "Residential building" or "Multifamily building."

Add new definition as follows:

COMMON AREA. For this code, all portions of a multifamily building that are not *dwelling units* or *sleeping units*.

MULTIFAMILY BUILDING. For this code, all Group R-2 buidlings.

Revise as follows:

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

C501.1 Scope. The provisions of this chapter shall control the *alteration*, *repair*, *addition* and change of occupancy of existing *commercial* buildings and structures.

Add new text as follows:

CHAPTER 6 MULTIFAMILY BUILDINGS.

SECTION C601 GENERAL

C601.1 Scope. The provisions in this chapter are applicable to *multifamily buildings* and their building sites.

C601.2 Application. Multifamily buildings shall comply with one of the following:

1. **The requirements of ANSI/ASHRAE/IESNA 90.1, provided that the *building* has four or more stories.**
2. **The requirements of Sections C602 through C605.**
3. **The requirements of Sections C602.5, C603.2, C604, C605.2, C605.3, C605.4, C605.6 and C607. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.**

C601.2.1 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 C602.4.

> **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 C602.4 shall be permitted to satisfy the U-factor requirements for each fenestration product category listed in Table C602.4. Individual fenestration products from different product categories listed in Table C602.4 shall not be combined in calculating the area-weighted average U-factor.**

SECTION C602 BUILDING ENVELOPE REQUIREMENTS

C602.1 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 C601.2, shall comply with the following:

1. **The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C602.2 and the thermal requirements of either the R-value-based method of Section C602.1.1; the U-, C-and F-factor-based method of Section C602.1.2; or the component performance alternative of Section C602.1.3.**
2. **Roof solar reflectance and thermal emittance shall comply with Section C602.3.**
3. **Fenestration in building envelope assemblies shall comply with Section C602.4.**
4. **Air leakage of building envelope assemblies shall comply with Section C602.5.**

C602.1.1 Insulation component R-value-based method. Building thermal envelope opaque assemblies shall meet the requirements of Sections C602.2 and C602.4 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 for insulation in framing cavities, where required, and for continuous insulation, where required, shall be not less than that specified in Table C602.1.1, based on the climate zone specified in Chapter 3. The thermal resistance or R-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope required in accordance with Table C602.1.1 shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below grade wall, whichever is less. Opaque swinging doors shall comply with Table C602.1.2 and opaque roll-up or sliding doors shall comply with Table C602.1.1.

TABLE C602.1.1
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQRUIEMENTS, R-VALUE METHOD[a]

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		
	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-: Stor
Roofs													
Insulation entirely above roof deck	NA[g]	R-25ci	NA[g]	R-25ci	NA[g]	R-25ci	NA[g]	R-30ci	NA[g]	R-30ci	NA[g]	R-30ci	NA
Metal buildings[a, b]	NA[g]	R-19 + R-11 LS	NA[g]	R-19 + R-11 LS	NA[g]	R-19 + R-11 LS	NA[g]	R-19 + R-11 LS	NA[g]	R-19 + R-11 LS	NA[g]	R-25 + R-11 LS	NA
Steel Truss ceiling[f]	R-38 or R-30+3ci		R-49 or R-38+3ci		R-49 or R-		R-38+5ci		R-38+5ci		R-38+5ci		R-38-

	or R-26+5ci				38+3ci								
Steel Joist Ceiling[f]	R-38 in 2×4 or 2×6 or 2×8, or R-49 in any framing		R-49 in 2×4 or 2×6 or 2×8 or 2×10		R-49 in 2×4 or 2×6 or 2×8 or 2×10		R-49		R-49		R-49		R-4
Attic and other	R-30	R-38	R-38	R-38	R-38	R-38	R-49	R-38	R-49	R-49	R-49	R-49	R-4
Walls, Above Grade													
Mass[i]	3/4	R-5.7ci[c]	4/6	R-7.6ci	8/13	R-9.5ci	8/13	R-11.4ci	13/17	R-13.3ci	15/20	R-15.2ci	19/2
Metal building	NA[g]	R-13 + R-6.5ci	NA[g]	R-13 + R-13ci	NA[g]	R-13 + R-13ci	NA[g]	R-13 + R-13ci	NA[g]	R-13 + R-13ci	NA[g]	R-13 + R-13ci	NA
Metal framed, 16" OC	R13+4.2ci or R-19+2.1ci or R-21+2.8ci or R-0+11.2ci or R-15+3.8ci or R-21+3.1ci	R-13 + R-5ci	R13+4.2ci or R-19+2.1ci or R-21+2.8ci or R-0+11.2ci or R-15+3.8ci or R-21+3.1ci	R-13 + R-7.5ci	R-0+14.0ci or R-13+8.9ci or R-15+8.5ci or R-19+7.8ci or R-19+6.2ci or R-21+7.5	R-13 + R-7.5ci	R-0+14.0ci or R-13+8.9ci or R-15+8.5ci or R-19+7.8ci or R-19+6.2ci or R-21+7.5	R-13 + R-7.5ci	R-0+14.0ci or R-13+8.9ci or R-15+8.5ci or R-19+7.8ci or R-19+6.2ci or R-21+7.5	R-13 + R-7.5ci	R-13+12.7ci or R-15+12.3ci or R-19+11.6ci or R-21+11.3ci or R-25+10.9ci	R-13 + R-7.5ci	R- 13+12 or F 15+12 or F 19+11 or F 21+11 or F 25+10
Metal framed, 24" OC	R-0+9.3ci or R-13+3.0ci or R-15+2.4ci		R-0+9.3ci or R-13+3.0ci or R-15+2.4ci		R-0+14.0ci or R-13+7.7ci or R-15+7.1ci or R-19+6.3ci		R-0+14.0ci or R-13+7.7ci or R-15+7.1ci or R-19+6.3ci		R-0+14.0ci or R-13+7.7ci or R-15+7.1ci or R-19+6.3ci		R-13+11.5ci or R-15+10.9ci or R-19+10.1ci or R-21+9.7ci		R- 13+11 or F 15+10 or F 19+10 or F 21+9

					or R-21+5.9ci		or R-21+5.9ci		or R-21+5.9ci		or R-25+9.1ci		or R 25+9
Wood framed and other	R-13	R-13 + R-3.8ci or R-20	R-13	R-13 + R-3.8ci or R-20	R-20 or R-13+5 ci	R-13 + R-3.8ci or R-20	R-20 or R-13+5 ci	R-13 + R-3.8ci or R-20	R-20 or R-13+5 ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-20+5 or R-13+10	R-13 + R-7.5ci or R-20 + R-3.8ci	R-20 or R 13+
Walls, Below Grade													
Below-grade wall[d, h]	NR	NR	NR	NR	5/13[i]	NR	10/13[i]	R-7.5ci	15/19[i]	R-7.5ci	15/19[i]	R-7.5ci	15/1
Floors													
Mass[e]	R-13	NR	R-13	R-8.3ci	R-19	R-10ci	R-19	R-10.4 ci	R-30	R-12.5 ci	R-30	R-12.5 ci	R-3
Metal framed	R-19 in 2×6 or R-19+6ci in 2×8 or 2×10	NR	R-19 in 2×6 or R-19+6ci in 2×8 or 2×10	R-30	R-19+6ci in 2×6 or R-19+12ci in 2×8 or 2×10	R-30	R-19+6ci in 2×6 or R-19+12ci in 2×8 or 2×10	R-30	R-30	R-30	R-30	R-38	R-3
Wood joist/framing	R-13	NR	R-13	R-30	R-19	R-30	R-19	R-30	R-30	R-30	R-30	R-30	R-3
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 48" below	R-15 for 24" below	R-10 48" be
Heated slabs[f]	R-5 for 24" below	R-7.5 for 12" below	R-5 for 24" below	R-7.5 for 24" below	R-5 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 36" below	R-15 for 48" below	R-20 for 36" below	R-15 48" be

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.

1. **Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.**
2. **Where using R-value compliance method, a thermal spacer block shall be provided, otherwise use the U-factor compliance method in Table C602.1.2.**

3. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C 90, 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 °F.
4. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
5. "Mass floors" shall include floors weighing not less than:
6. 35 pounds per square foot of floor surface area; or
7. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.
8. Insulation exceeding the height of the framing shall cover the framing.
9. Where NA is listed, a U-factor method in accordance with Sections C602.1.2 or C602.1.3 shall be used.
10. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the wall or R-13 cavity insulation at the interior of the basement wall.
11. Below grade wall insulation is not required in warm-humid locations as defined by Figure C301.1 and Table C301.1.
12. The second R-value applies when more than half the insulation is on the interior of the mass wall.

C602.1.2 Assembly U-factor, C-factor or F-factor-based method. 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 C602.1.2. The C-factor for the below-grade exterior walls of the building envelope, as required in accordance with Table C602.1.2, shall extend to a depth of 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor, whichever is less. Opaque swinging doors shall comply with Table C602.1.2 and opaque roll-up or sliding doors shall comply with Table C602.1.1.

TABLE C602.1.2
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQRUIEMENTS, U-FACTOR METHOD[a, b]

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8
	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories
Roofs															
Insulation entirely above roof deck	U-0.035	U-0.039	U-0.030	U-0.039	U-0.030	U-0.039	U-0.026	U-0.032	U-0.026	U-0.032	U-0.026	U-0.032	U-0.026	U-0.028	U-0.026
Metal buildings[a, b]		U-0.035		U-0.035		U-0.035		U-0.035		U-0.035		U-0.031		U-0.029	

Attic and other		U-0.027		U-0.027		U-0.027		U-0.027		U-0.021		U-0.021		U-0.021	
Walls, Above Grade															
Mass	U-0.197[h]	U-0.151	U-0.165[h]	U-0.123	U-0.098[h]	U-0.104	U-0.098[h]	U-0.090	U-0.082[h]	U-0.080	U-0.060[h]	U-0.071	U-0.057[h]	U-0.061	U-0.057[h]
Metal building	U-0.084	U-0.079	U-0.084	U-0.079	U-0.060	U-0.052	U-0.060	U-0.052	U-0.060	U-0.052	U-0.045	U-0.052	U-0.045	U-0.039	U-0.045
Metal framed		U-0.077		U-0.064		U-0.064		U-0.064		U-0.064		U-0.057		U-0.052	
Wood framed and other		U-0.064		U-0.064		U-0.064		U-0.064		U-0.064		U-0.051		U-0.051	
Walls, Below Grade															
Below-grade wall[c]	U-0.360	C-1.140[e]	U-0.360	C-1.140[e]	U-0.091[i]	C-1.140[e]	U-0.059	C-0.119	U-0.050	C-0.119	U-0.050	C-0.119	U-0.050	C-0.092	U-0.050
Floors															
Mass[d]	U-0.064	U-0.322[e]	U-0.064	U-0.087	U-0.047	U-0.076	U-0.047	U-0.074	U-0.033	U-0.064	U-0.033	U-0.057	U-0.028	U-0.051	U-0.028
Joist/framing		U-0.066[e]		U-0.033		U-0.033		U-0.033		U-0.033		U-0.033		U-0.033	
Slab-on-grade floors															
Unheated slabs	NA[g]	F-0.73[e]	NA[g]	F-0.73[e]	NA[g]	F-0.73[e]	NA[g]	F-0.54	NA[g]	F-0.54	NA[g]	F-0.52	NA[g]	F-0.40	NA[g]
Heated slabs[f]	NA[g]	F-0.70	NA[g]	F-0.70	NA[g]	F-0.70	NA[g]	F-0.65	NA[g]	F-0.65	NA[g]	F-0.58	NA[g]	F-0.55	NA[g]

For SI: 1 pound per square foot = 4.88 kg/m2, 1 pound per cubic foot = 16 kg/m.3
ci = Continuous insulation, NR = No requirement, LS = Liner system.

1. **Use of Opaque assembly U-factors, C-factors, and F-factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.**
2. **Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. The R-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.**
3. **Where heated slabs are below grade, below-grade walls shall comply with the F-factor requirements for heated slabs.**

4. "Mass floors" shall include floors weighing not less than:
5. 35 pounds per square foot of floor surface area; or
6. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.
7. These C-, F-and U-factors are based on assemblies that are not required to contain insulation.
8. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.
9. Where NA is listed, a R-value method in accordance with Section C602.1.1 shall be used.
10. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
11. Basement wall U-factor of 0.360 in warm-humid locations as defined by Figure C301.1 and Table C301.1.

C602.1.2.1 Thermal resistance of cold-formed steel walls. U-factors of walls with cold-formed steel studs shall be permitted to be determined in accordance with Section C402.1.4.1

C602.1.3 Component performance alternative. Building envelope values and fenestration areas calculated in accordance with Section C402.1.5 utilizing the values from Table C602.1.2.

C602.2 Specific insulation requirements (Prescriptive). In addition to the requirements of Section C602.1, insulation shall meet the specific requirements of Sections C602.2.1 through C602.2.7.

C602.2.1 Multiple layers of continuous insulation board. Where two or more layers of continuous insulation board are used in a construction assembly, the continuous insulation boards shall be installed in accordance with Section C303.2. Where the continuous insulation board manufacturer's instructions do not address installation of two or more layers, the edge joints between each layer of continuous insulation boards shall be staggered.

C602.2.2 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 C602.1.1 or Table C602.1.2, based on construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.
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 specified in Table C402.1.4.
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 Table C602.1.1.
3. 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.

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

C602.2.3 Thermal resistance of above-grade walls. The R-value of integral insulation installed in concrete masonry units shall not be used in determining compliance with Table C602.1.1 or C602.1.2.
"Mass walls" shall include walls:

1. Weighing not less than 35 psf (170 kg/m2) of wall surface area.
2. Weighing not less than 25 psf(120 kg/m) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m3).
3. Having a heat capacity exceeding 7 Btu/ft2 •°F (144 cage/m2• K).
4. Having a heat capacity exceeding 5 Btu/ft2 •°F (103 kJ/m2 • K), where the material weight is not more than 120 pcf (1900 kg/m3).

C602.2.4 Floors. Floor framing cavity insulation or structural slab insulation shall be installed to maintain permanent contact with the underside of the subfloor decking or structural slabs.
Exceptions:

1. The floor framing cavity insulation or structural slab insulation shall be permitted to be in contact with the top side of sheathing or continuous insulation installed on the bottom side of floor assemblies where combined with insulation that meets or exceeds the minimum R-value in Table C602.1.1 for "Metal framed" or "Wood framed and other" values for "Walls, Above Grade" and extends from the bottom to the top of all perimeter floor framing or floor assembly members.
2. Insulation applied to the underside of concrete floor slabs shall be permitted an airspace of not more than 1 inch (25 mm) where it turns up and is in contact with the underside of the floor under walls associated with the building thermal envelope.

C602.2.5 Slabs-on-grade perimeter insulation. The insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The insulation shall extend downward from the top of the slab for a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least 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.

C602.2.6 Crawl space walls. As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated in accordance with the requirements for above grade walls in Table C602.1.1 when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the International Building Code or International Residential Code, as applicable. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.

C602.2.7 Insulation of radiant heating systems. Radiant heating system panels, and their associated components that are installed in interior or exterior assemblies shall be insulated with a minimum of R-3.5 (0.62 m2/K • W) on all surfaces not facing the space being heated. Radiant heating system panels that are installed in the building thermal envelope shall be separated from the exterior of the building or unconditioned or exempt spaces by not less than the R-value of insulation required in the opaque assembly in which they are installed, or the assembly shall comply with Section C602.1.2.
Exception: Heated slabs on grade insulated in accordance with Section C602.2.5.

C602.3 Roof solar reflectance and thermal emittance. Low-sloped roofs directly above cooled conditioned spaces in Climate Zones 1, 2 and 3 shall comply with Section C402.3.

C602.4 Fenestration (Prescriptive). Fenestration shall comply with Sections C602.4.1 through C602.4.3 and Table C602.4.

TABLE C602.4
BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6	
	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories	1-3 Stories	≥ 4 Stories
Vertical Fenestration												
U-factor												
Fixed fenestration	0.50	0.50	0.40	0.50	0.35	0.46	0.35	0.38	0.32	0.38	0.32	0.36
Operable fenestration	0.50	0.65	0.40	0.65	0.35	0.60	0.35	0.45	0.32	0.45	0.32	0.43
Entrance doors	0.50	1.10	0.40	0.83	0.35	0.77	0.35	0.77	0.32	0.77	0.32	0.77

SHGC	1			2			3			4 EXCEPT MARINE			5 AND MARINE 4			6		
Orientationa	All	SEW	N	All	SEW	N	All	SEW	N	All	SEW	N	All	SEW	N	All	SEW	N
PF < 0.2	0.25	0.25	0.33	0.25	0.25	0.33	0.25	0.25	0.33	0.40	0.40	0.53	NR	0.40	0.53	NR	0.40	0.5
0.2 ≤ PF < 0.5	0.25	0.30	0.37	0.25	0.30	0.37	0.25	0.30	0.37	0.40	0.48	0.58	NR	0.48	0.58	NR	0.48	0.5
PF ≥ 0.5	0.25	0.40	0.40	0.25	0.40	0.40	0.25	0.40	0.40	0.40	0.64	0.64	NR	0.64	0.64	NR	0.64	0.6

Opaque Doors	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6	
Swinging	0.50	U-0.61	0.4	U-0.61	0.35	U-0.61	0.35	U-0.61	0.32	U-0.37	0.32	U-0.37
Skylights												

U-factor	0.75	0.75	0.65	0.65	0.55	0.55	0.55	0.5	0.55	0.5	0.55	0.5
SHGC	0.25[b]	0.35	0.25[b]	0.35	0.25[b, c]	0.35	0.40[c]	0.40	NR	0.40	NR	0.40

NR = No requirement, PF = Projection factor.

3. **"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.**
4. **Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.**
5. **There are no SHGC requirements in the Marine Zone.**

C602.4.1 Maximum vertical fenestration area. The vertical fenestration area (not including opaque doors and opaque spandrel panels) shall not be greater than 30 percent of the gross above-grade wall area. The skylight area shall not be greater than 3 percent of the gross roof area.

C602.4.2 Minimum skylight fenestration area. Enclosed *common area* 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, or workshop shall comply with Section C402.4.2.

C602.4.3 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 Section C402.4.3.

C602.4.3.1 Increased skylight SHGC. In Climate Zones 1 through 6, skylights shall be permitted a maximum SHGC of 0.60 where located above daylight zones provided with daylight responsive controls.

C602.4.3.2 Increased skylight U-factor. Where skylights are installed above daylight zones provided with daylight responsive controls, a maximum U-factor of 0.9 shall be permitted in Climate Zones 1 through 3 and a maximum U-factor of 0.75 shall be permitted in Climate Zones 4 through 8.

C602.4.3.3 Dynamic glazing. Where dynamic glazing is intended to satisfy the SHGC and VT requirements of Table C602.4, the ratio of the higher to lower labeled SHGC shall be greater than or equal to 2.4, and the dynamic glazing shall be automatically controlled to modulate the amount of solar gain into the space in multiple steps. Dynamic glazing shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing shall not be permitted.
Exception: Dynamic glazing is not required to comply with this section where both the lower and higher labeled SHGC already comply with the requirements of Table C402.4.

C602.4.3.4 Area-weighted U-factor.
An area-weighted average shall be permitted to satisfy the U-factor requirements 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.

C602.5 Air leakage-thermal envelope (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with this section.

C602.5.1 Verification. *Multifamily buildings* with four or more stories shall comply with Section C402.5. All other *multifamily buildings* shall comply with one of the following:

1. The requirements of Sections C602.5.2 through C602.5.6.
2. The building thermal envelope shall have an air leakage rate of not greater than 0.40 cfm/ft2 (0.2 L/s • m2) when 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 when the tested. The *building* shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

C602.5.2 Building thermal envelope.
The building thermal envelope shall comply with Sections C602.5.2.1 and C602.5.2.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

C602.5.2.1 Installation. The components of the building thermal envelope as listed in Table C602.5.2.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table C602.5.2.1, as applicable to the method of construction. Where required by the code official, an approved third party shall inspect all components and verify compliance.

TABLE C602.5.2.1
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope

		insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between window/door jambs and framing, and skylights and framing shall be sealed.	_
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends from the bottom to the top of all perimeter floor framing members.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	_
Narrow cavities	_	Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	_
Recessed lighting	Recessed light fixtures installed in the building	Recessed light fixtures installed in the

	thermal envelope shall be sealed to the drywall.	building thermal envelope shall be air tight and IC rated.
Plumbing and wiring	_	Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the showers and tubs.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.	_
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	_
Concealed sprinklers	When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	_

1. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

C602.5.2.2 Testing. **The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.**

During testing:

1. **Exterior windows and doors, fireplace and stove doors shall be closed, but not**

sealed, beyond the intended weather stripping or other infiltration control measures.

2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, if installed at the time of the test, shall be open.
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
5. Heating and cooling systems, if installed at the time of the test, shall be turned off.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

C602.5.3 Fireplaces.

New wood-burning fireplaces shall have tight-fitting flue dampers or doors, and outdoor combustion air. Where using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace. Where using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907.

C602.5.4 Fenestration air leakage.

Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.2 cfm per square foot (1.5 L/s/m2), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m2), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled by the manufacturer.

Exception: Site-built windows, skylights and doors.

C602.5.5 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, isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Tables C602.1.1 or C602.1.2 and C602.4, 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 C603. The combustion air duct shall be insulated where it passes through conditioned space to a minimum of 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 C602.5.3 and Section R1006 of the International Residential Code.

C602.5.6 Recessed lighting. Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

SECTION C603 BUILDING MECHANICAL SYSTEMS

C603.1 General. Single-zone mechanical systems and equipment serving the heating, cooling or ventilating needs of individual *dwelling units* or *sleeping units* shall comply with this section. All mechanical equipment serving the heating, cooling or ventilating needs of other portions of the building shall comply with Section C403.

C603.2 Equipment sizing and efficiency rating. 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 meet the minimum efficiency requirements of Tables C403.2.3(1), C403.2.3(2), C403.2.3(3), C403.2.3(4), C403.2.3(5), C403.2.3(6), C403.2.3(7), C403.2.3(8) and C403.2.3(9) when tested and rated in accordance with the applicable test procedure.

C603.3 Controls. At least one thermostat shall be provided for each separate heating and cooling system.

C603.3.1 Programmable thermostat. The thermostat controlling the primary heating or cooling system of the *dwelling unit* or *sleeping unit* shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability 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). The thermostat shall initially be programmed by the manufacturer with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 78°F (26°C).

C603.3.2 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.

C603.3.3 Hot water boiler outdoor temperature setback. Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor setback control that lowers the boiler water temperature based on the outdoor temperature.

C603.4 Mechanical ventilation. The building shall be provided with ventilation that meets the requirements of the *International Residential Code* or *International Mechanical Code*, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

C603.4.1 Mechanical ventilation system fan efficiency. Mechanical ventilation system fans shall meet the efficacy requirements of Table C603.4.1.

> **Exception:** Where mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.

TABLE C603.4.1
Mechanical Ventilation System fan Efficiency

FAN LOCATION	AIR FLOW RATE MINIMUM	MINIMUM EFFICACY	AIR FLOW RATE MAXIMUM

	(CFM)	(CFM/WATT)	(CFM)
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom, utility room	10	1.4 cfm/watt	<90
Bathroom, utility room	90	2.8 cfm/watt	Any

For SI: 1 cfm = 28.3 L/min.

C603.5 Ducts. Ducts and air handlers shall be in accordance with Sections C603.5.1 through C603.5.5.

C603.5.1 Insulation. Supply and return ducts in attics shall be insulated to a minimum of R-8 where 3 inches (76 mm) in diameter and greater and R-6 where less than 3 inches (76 mm) in diameter. Supply and return ducts in other portions of the building shall be insulated to a minimum of R-6 where 3 inches (76 mm) in diameter or greater and R-4.2 where less than 3 inches (76 mm) in diameter.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

C603.5.2 Sealing. 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.

Exceptions:

1. Air-impermeable spray foam products shall be permitted to be applied without additional joint seals.
2. For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems shall not be required for continuously welded joints and seams, and locking-type joints and seams of other than the snap-lock and button-lock types.

C603.5.2.1 Sealed air handler. Air handlers shall have a manufacturer's designation for an air leakage of no more than 2 percent of the design air flow rate when tested in accordance with ASHRAE 193.

C603.5.3 Duct testing. 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. All registers shall be taped or otherwise sealed during the test.
2. Post construction 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.

Exception: A duct air leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

C603.5.4 Duct leakage. The total leakage of the ducts, where measured in accordance with Section C603.5.3, 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. Post construction 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.

C603.5.5 Building cavities. Building framing cavities shall not be used as ducts or plenums.

C603.6 Mechanical system piping insulation. Mechanical system piping capable of carrying fluids above 105°F (41°C) or below 55°F (13°C) shall be insulated to a minimum of R-3.

C603.6.1 Protection of piping insulation. Piping insulation exposed to 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.

SECTION C604 WATER HEATING

C604.1 General. The equipment, piping, controls and storage for hot water systems shall comply with the requirements of with Sections C404.2 through C404.8 and Section C404.11.

C604.2 Pools and Permanent Spas. The energy consumption of pools and permanent spas shall be in accordance with Sections C404.9.1 through C404.9.3 and APSP-15.

C604.3 Energy consumption of portable spas. The energy consumption of electric-powered portable spas shall be shall be in accordance with Section C404.10.

SECTION C605 ELECTRICAL POWER AND LIGHTING SYSTEMS

C605.1 General. The lighting system controls, maximum lighting power for interior and exterior applications and electrical energy consumption of *dwelling units and sleeping units* shall comply with this section. The lighting system controls, maximum lighting power for interior and exterior applications and electrical energy consumption of all other parts of the *building* shall comply with Section C405.

C605.2 Lighting equipment. Not less than 75 percent of the lamps in permanently installed lighting fixtures shall be *high-efficacy lamps* or not less than 75 percent of the permanently installed lighting fixtures shall contain only *high-efficacy lamps*.

Exception: Low-voltage lighting.

SECTION C606 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

C606.1 Requirements. Buildings shall comply with at least one of the following:

1. More efficient HVAC performance in accordance with C406.2.
2. On-site supply of renewable energy in accordance with Section C406.5.
3. High-efficiency service water heating in accordance with Section C406.7.
4. Reduced lighting power in accordance with Section C606.2.
5. Enhanced envelope performance in accordance with Section C606.3.
6. Reduced air infiltration in accordance with Section C606.4

Exception: *Multifamily buildings* that have three or fewer stories.

C606.2 Reduced lighting power density. The total interior lighting power (watts) of the *common areas* shall be determined by using 90 percent of the interior lighting power allowance calculated by the Space-by-Space Method in Section C405.4.2. Additionally, ninety-five percent (95%) of the lamps in permanently installed light fixtures in *dwelling units* and *sleeping units* shall be lamps with a minimum efficacy of:

1. 90 lumens per watt for lamps over 40 watts;
2. 60 lumens per watt for lamps over 15 watts to 40 watts;
3. 45 lumens per watt for lamps over 5 watts to 15 watts and
4. 30 lumens per watt for lamps 5 watts or less.

C606.3 Enhanced Envelope Performance. The total UA of the *building thermal envelope* shall be no greater than eighty-five percent (85%) of the total UA of the *building thermal envelope* allowed in accordance with Section C602.1.4.

C606.4 Reduced Air Infiltration. Air infiltration shall be verified by whole building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air leakage rate of the building envelope shall not exceed 0.25 cfm/ft2 (2.0 L/s•m2) under a pressure differential of 0.3 in. water (75 Pa), with the calculated surface area being the sum of the above and below grade building envelope. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner.

C606.4.1 Large buildings. Buildings having over 250,000 ft2 (25,000 m2) of conditioned floor area shall be permitted to conduct air infiltration testing on representative above grade sections of the building provided tested areas total at least 25% of the conditioned floor area.

SECTION C607 TOTAL BUILDING PERFORMANCE

C607.1 Scope. This section establishes criteria for compliance using total building performance.

C607.2 Mandatory requirements. Compliance with this section requires that the criteria of Sections C602.5, C603.2, C604 and C605 be met.

C607.3 Requirements. Buildings shall comply with one of the following:

1. Section C407, provided the *building* has four or more stories.
2. Section R405, provided the *building* has three or fewer stories.
3. Section R406, provided the *building* has three or fewer stories.

SECTION C608 EXISTING MULTIFAMILY BUILDINGS

C608.1 Scope. The *alteration*, *repair*, *addition* and *change of occupancy* of existing *multifamily buildings* and structures shall be in accordance with Sections C501, C504 and C505 and this section.

C608.2.1 Vertical fenestration. New vertical fenestration area that results in a total building fenestration area less than or equal to that specified in Section C602.4.1 shall comply with Section C602.4. Additions that result in a total building vertical fenestration area exceeding that specified in Section C402.4.1 shall comply with Section C607.

C608.2 Additions. 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 complying with ANSI/ASHRAE/IESNA 90.1.need not comply with Sections C602, C603, C604 and C605.

C608.2.2 Skylight area. New skylight area that results in a total building fenestration area less than or equal to that specified in Section C602.4.2 shall comply with Section C602.4. Additions that result in a total building skylight area exceeding that specified in Section C602.4.2 shall comply with Section C607.

C608.2.3 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 C603.

> Exception: Where ducts from an existing heating and cooling system are extended to an addition, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section C603.5.3.

C608.2.4 Service water-heating systems. New service water-heating equipment, controls and service water heating piping shall comply with Section C604.

C608.2.5 Pools and permanently installed spas. New pools and permanently installed spas shall comply with Section C604.2.

C608.2.6 Lighting power and systems. New lighting systems that are installed as part of the addition shall comply with Section C605.

C608.2.6.1 Interior lighting power. The total interior lighting power for the addition shall comply with Sections C405.4.2 and C605.2 for the addition alone, or the existing building and the addition shall comply as a single building.

C608.2.6.2 Exterior lighting power. The total exterior lighting power for the addition shall comply with Sections C405.5.1 and C605.2 for the addition alone, or the existing building and the addition shall comply as a single building.

C608.3 Alterations. 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 no 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 C602, C603, C604 and C605.

Exception: The following alterations need not comply with the requirements for new construction, provided 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 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.

C608.3.1 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.

C608.3.2 Building envelope. New building envelope assemblies that are part of the alteration shall comply with Sections C602.1 through C602.5.

C608.3.2.1 Roof replacement. Roof replacements shall comply with Table C602.1.1 or Table C602.1.2 where the existing roof assembly is part of the building thermal envelope and contains insulation entirely above the roof deck.

C608.3.2.2 Vertical fenestration. The addition of vertical fenestration that results in a total building fenestration area less than or equal to that specified in Section C602.4.1 shall comply with Section C602.4. Alterations that result in a total building vertical fenestration area exceeding that specified in Section C402.4.1 shall comply with Section C607.

C608.3.2.3 Skylight area. The addition of skylight area that results in a total building skylight area less than or equal to that specified in Section C602.4.2 shall comply with Section C602.4. Alterations that result in a total building skylight area exceeding that specified in Section C402.4.2 shall comply with Section C607.

C608.3.3 Heating and cooling systems. New heating, cooling and duct systems that are part of the alteration shall comply with Sections C603.

> Exception: Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section C603.5.3.

C608.3.4 Service hot water systems. New service hot water systems that are part of the alteration shall comply with Section C604.

C608.3.5 Lighting systems. New lighting systems that are part of the alteration shall comply with Section C605.

> 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.

Part II

2015 International Energy Conservation Code

Revise as follows:

SECTION R202 DEFINITIONS

COMMERCIAL BUILDING. For this code, all buildings that are not included in the definition of "Residential building" or "Multifamily building."

Add new definition as follows:

COMMON AREA. For this code, all portions of a multifamily building that is not a dwelling unit or sleeping unit.

MULTIFAMILY BUILDING. For this code, all Group R-2 buildings.

Revise as follows:

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

Reason:

Part I: 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.

This proposal will solve these problems by creating a single set of requirements for all multifamily

buildings and placing them in a dedicated chapter of the IECC. The proposal is the result of an extensive analysis of the existing code language and requirements and a broad-reaching stakeholder engagement process.

New Buildings Institute, with the assistance of the Britt Makela Group, did a side-by side analysis of all of the code provisions that apply to multifamily buildings from the commercial and residential sections of the IECC. This analysis revealed the similarities and differences between the provisions of the two sections as well as where one section covers a topic and another doesn't.

NBI recruited a Technical Advisory Group of experts in multifamily housing, codes and energy efficiency to help advise the process. Over the course of multiple conference calls, the group helped identify the key issues facing the effort to create a single set of requirements for multifamily buildings, and provided feedback on the emerging proposal language. This group included Louis Starr of the Northwest Energy Efficiency Alliance, Don Surrena and Craig Drumheller of the National Association of Home Builders, Darren Port of the Northeast Energy Efficiency Partnership, Bing Liu, Todd Taylor and Jian Zhang of the Pacific Northwest National Laboratory, Jay Bhakta of Southern California Edison, Kosol Kiatreungwattana of the National Renewable Energy Laboratory, Doug King of King Sustainability, Eric Makela of the CADMUS Group, Jim Meyers of Southwest Energy Efficiency Project, Ron Nickson of the National Multifamily Homes Council, Thomas Culp of Birch Point Consulting, Nehemiah Stone of Stone Energy Associates, Matthew Root of CLEAResult, Jim Edelson of NBI, David Cohan of the US Department of Energy and Eric Foley of Earth Advantage (the involvement of the above individuals and organizations should not be taken as support for the proposal or inclusion as co-proponents).

NBI also engaged other groups and individuals outside of the TAG on dedicated topics such as envelope requirements, infiltration, energy rating systems and usability for code officials.

Finally, NBI promoted and hosted a national webinar with nearly 100 attendees to inform a wide array of stakeholders in order to inform them about the effort, explain the proposal in its current draft at the time and to solicit additional feedback.

The entire process was informed by an energy analysis performed by the Pacific Northwest National Lab. The lab compared energy impact of the residential and commercial provisions using a set of standard multifamily building prototypes: a two-story breezeway eight-plex, a 4 story mid-rise and a 10 story high-rise. Each prototype was modeled using the commercial code provisions and the residential code provisions and the results compared. This comparison demonstrates the gap in energy outcomes that exists between the two sets of provisions. It also was used to help identify the regulation differences that have the greatest energy impact.

The table below shows the impact of moving from one code to the other. In all cases, the other code was less stringent than the native code. In the case of low-rise multifamily, this is largely because for the two-story low-rise prototype, the enhanced lighting option was chosen to meet the additional efficiency requirements from Section C406. This option was chosen since it would be the least costly; however, it is the least costly because it requires this prototype to do almost nothing. For context, when a 3-story version of the 4-story midrise building was created, switching to the commercial code resulted in greater efficiency. In this case, the additional efficiency option made a larger impact and the difference in infiltration requirements made a larger difference in part due to increased height and stack effect.

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The result of this analysis shows that the two sets of energy requirements in the code result in significantly and inconsistently different energy outcomes in multifamily buildings. This fact emphasizes the importance of this effort to bring coherence to the multifamily market.

One issue in particular, the difference in the infiltration requirements between the commercial and residential sections, represents such a significant difference between the codes that it was modeled separately. Each prototype was modeled using its native code and then only the infiltration requirement from the other code was substituted for comparison. The results of this analysis demonstrates how it would not be possible to move to a single infiltration standard for infiltration without having a significant impact on stringency.

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Once the proposal was substantially complete, the provisions of the proposal were compared back

against the commercial and residential requirements. The results of this analysis shows that the proposal had absolutely no impact on the 10-story high-rise and 4-story mid-rise prototypes currently subject to commercial code. The proposal had a very small impact (.1% on average) on the low-rise prototype had due to the extension of commercial outdoor lighting requirements to low-rise multifamily projects.

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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
- Over time, the multifamily section of the code can be tuned to better address the issues particular to multifamily buildings
- Multifamily code issues will no longer complicate the development of the Residential and Commercial codes

The result is a proposal that gathers all multifamily provisions into a single chapter in the commercial section of the IECC. The commercial section was chosen since, in general, multifamily buildings are built more like commercial buildings. The proposal was developed in line with a handful of principles developed largely through the input of the broad body of stakeholders:

- Leverage existing code language: Existing code language was used almost exclusively. This minimizes the disruption of the structural change for code users and code officials since most of the language will be familiar. It also focuses the nature of the proposal on restructuring.
- Avoid stringency changes: The proposal is intended to primarily be a structural change. It was crafted to keep minimize any impact on stringency, either to increase or decrease it. In some places, this means maintaining the high- and low-rise split where the requirements of the residential and commercial sections of the code are very different.
- Maximize Usability: As the proposal makes extensive use of existing code language, there are two competing usability issues. References to existing sections in the commercial and residential sections of the code has the advantage of reducing code length and minimizing the chance of code language divergence in parallel requirements but has the disadvantage of necessitating a lot of flipping back and forth between parts of the code book by the code user and code official. Replication of existing code sections in the new multifamily chapter has the advantage of clarity and minimizing the need to move around the code book but has the disadvantage of increasing code length, creating greater likelihood of language divergence in parallel requirements and burdening the chapter with code requirements that only apply to a small percentage of multifamily buildings (eg, requirements for complex HVAC systems will only apply to the small percentage of multifamily projects that have complex HVAC systems, most multifamily projects have simple HVAC systems and users only need to use the much smaller set of requirements that apply to those systems).

To balance these competing usability needs, the proposal uses references when requirements align with commercial requirements since the commercial energy chapter is in the same part of the code and those requirements only apply to a small part of multifamily projects (the non-dwelling unit and non-sleeping unit areas) of small percentage of multifamily projects. Where requirements align with requirements from the residential section, that code language was duplicated in the new multifamily chapter. These requirements are often the primary requirements for multifamily projects and locating the language in the multifamily chapter eliminates the need for code users and officials to frequently flip to a whole other part of the code.

Following those principles, the following goes into detail about some specific parts of the proposal.

Definitions:

The proposal creates a new definition for "multifamily building" and modifies the existing definitions for "residential building" and "commercial building" to remove multifamily buildings from them. The definition for multifamily building leverages the occupancy designation R-2 that already exists in the IBC. This defines what is most often considered "multifamily" construction as it encompasses apartment buildings. It also excludes hotels and motels as well as institutional housing arrangements like prisons and long-term care facilities as these have usages and usage patterns that are less residential in character and less like what most people think of as multifamily. The definitions are modified in both the residential and commercial sections of the code.

C101.2 Scope:

Since the proposal removes multifamily buildings from the definitions of commercial and residential buildings, the scope of the commercial section is also modified to include the newly defined multifamily building. No change is needed for the residential scoping section since it depends on the definition of "residential building" and the modification is made there.

C101.4.1 Mixed occupancy.

The mixed occupancy section is also modified to include multifamily buildings. This is vitally importance as commercial/multifamily is the dominant mixed occupancy type.

C601:

The rest of the language largely mirrors the same language and structure of the commercial energy chapter, using the same section order and divisions as much as possible. The application section (C601.2) defines the ASHRAE 90.1 alternative compliance option (but limits that option to multifamily buildings four stories and taller since that is 90.1's scope), a prescriptive compliance option and a performance compliance option.

C602:

C602 includes the envelope requirements. Much of the envelope language was very similar between the commercial and residential sections. There are two areas of significant difference between the two sections: insulation/window requirements and infiltration requirements. The envelope tables in both the commercial and residential sections are the result of prolonged debate and compromise. To simply pick a single set of requirements for the multifamily chapter would result in a change of stringency in many situations – sometimes more stringent, sometimes less – and would circumvent that process of compromise. Therefore, the envelope requirements in the proposal preserve the split between high and low rise multifamily. Both high and low rise will be subject to the same requirements that they were in the 2015 IECC. However, both sets of requirements are gathered in a single table (rather than two), so that if that process of debate and compromise can come to a single set of requirements that are appropriate for all multifamily buildings, the structure of the section will be able to accommodate it without significant change.

The other significant difference between the commercial and residential sections is the infiltration requirements. Infiltration testing is required in the residential section, but is a compliance alternative in the commercial. Further, both the metrics and testing pressures are different for the two chapters. The commercial uses a metric based on the surface area of the envelope and residential uses a metric based on volume. When the two requirements were applied to the set of prototypes used in the analysis, PNNL found significantly different energy outcomes. Additionally, it is currently a hot debate topic over which metric is superior. Therefore, it would be impossible to come to a single set of requirements for infiltration without creating a significant change in requirements for at least part of the multifamily market. For this reason, the proposal maintains the high- low-rise split here as well. Hopefully, a single set of requirements can be developed in the future. When that happens the structure created by the proposal will be able to easily accept it.

The infiltration section in the proposal is structured so that multifamily projects that are four or more stories are directed to the commercial infiltration requirements. For multifamily projects with 3 or fewer projects, the proposal reproduces the infiltration requirements from the residential section. Low-rise multifamily projects have been given the additional option of meeting the commercial testing requirements instead of the residential testing requirements. Although PNNL's analysis found that the commercial testing requirements are most stringent, this is only an option so it does not increase the stringency for low-rise multifamily projects. The option is being included to offer simplified testing for mixed use, low-rise multifamily projects so that the entire project can be tested with a single testing protocol.

The 30% window to wall ratio limit is preserved from the commercial section because it is an essential part of the energy performance of high-rise multifamily, but low-rise multifamily projects rarely include that much glass. The market reality allows the requirement to be retained for the high-rise market segment and added to the low-rse market segment without really creating an impact on stringency.

C603:

The mechanical section takes an approach meant to both preserve the simplicity of the approach in the residential section but still adequately address the complex systems that can be found in larger multifamily buildings. The requirements for single-zone systems that serve dwelling units and sleeping units are reproduced from the residential system. These simple systems will, therefore, have simple requirements. More complex systems and systems that serve the parts of the building other than dwelling units and sleeping units are required to meet the mechanical system requirements of the commercial chapter by reference. This way, more complex systems, and systems serving common areas, which are more like commercial spaces in character, are adequately covered without requiring simple, residential style systems in dwelling units and sleeping units to comply with the more complex set of requirements or for users to have to parse through them.

C604:

The water heating requirements in the commercial chapter adequately cover both simple tanked systems and more complex central systems and is substantively the same as the residential requirements. This section therefore is largely a reference to the commercial chapter. There is specific language for spas and pools since the commercial language is somewhat incomplete and the residential language makes specific reference to singe family homes. This section also provides the structure so that future, multifamily-specific requirements can be accommodated.

C605:

The lighting requirements follow the same approach as the HVAC requirements. The section defines the requirements for dwelling units and sleeping units and those requirements are drawn from the residential section. Lighting in the non-dwelling unit non-sleeping unit areas of the building, with their more commercial character, are subject to the commercial chapter requirements by reference. The high-efficacy lamp requirements in the proposal are reproduced from the residential chapter.

C606:

Section 406 is an important part of the energy savings of the commercial section. However, only three of the six options offered in Section C406 apply well to multifamily. In order to address this, the proposal adds three more options to the three options that work for multifamily in C406. The options for more efficiency HVAC performance, onsite renewable energy and high efficiency water heating are included as references to section C406. The three additional options are reduced lighting power, enhanced envelope performance and reduced air infiltration. These three options are derived largely from new language going into the Washington State code for section C406. Because the additional efficiency options would represent a change in stringency for low-rise multifamily, the proposal exempts multifamily projects that are three stories or less, maintaining the stringency level for low-rise multifamily.

C607:

Section provides the total building performance compliance alternative for the chapter. The existing software and energy rating tools that enable modeled performance-based compliance or energy rating system-based performance in the existing commercial and residential sections have been crafted to serve those code baselines. Residential modeling software and energy rating systems are not set up to serve high-rise multifamily projects. And the modeling software that serves the commercial section and high-rise multifamily projects is much more complicated and costly than the tools available for the typically smaller low-rise projects. Because of the importance of these tools, a new approach just for a unified multifamily project cannot be created at this time.

Therefore, the section preserves the high- and low-rise split in multifamily and directs projects to the residential and commercial "Total Building Performance" options already in the code. However, many people in the multifamily market feel that multifamily project types are not served well by the existing tools. This structure easily accommodates the later addition of total building performance models that have been created to serve the multifamily market. And by eliminating the split in that market,

the proposal also makes it easier for dedicated multifamily tools to be created since those tools would only have to deal with a single code baseline instead of two.

C608:

For the 2015 IECC, a whole new chapter for existing buildings was created. The way that chapter is created, parts of it are very specific to commercial buildings. The additions and alterations sections are filled with specific references to the energy requirements of chapter 4. With this proposal, those requirements would no longer apply to multifamily buildings. Adding the references to make the existing chapter 5 work for both commercial and multifamily buildings would significantly complicate that chapter.

Therefore, the proposal leverages the portions of chapter 5 that are not commercial building specific – C501 General, C504 Repairs and C505 Change of Occupancy. It then creates new versions of the Additions and Alterations sections that have been crafted to work with the new multifamily requirements.

Section 501.1

The scope of Chapter 5 was also modified to make it applied specifically to commercial buildings and not all buildings regulated by the commercial section.

Part II: 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.**

This proposal will solve these problems by creating a single set of requirements for all multifamily buildings and placing them in a dedicated chapter of the IECC. The proposal is the result of an extensive analysis of the existing code language and requirements and a broad-reaching stakeholder engagement process.

New Buildings Institute, with the assistance of the Britt Makela Group, did a side-by side analysis of all of the code provisions that apply to multifamily buildings from the commercial and residential sections of the IECC. This analysis revealed the similarities and differences between the provisions of the two sections as well as where one section covers a topic and another doesn't.

NBI recruited a Technical Advisory Group of experts in multifamily housing, codes and energy efficiency to help advise the process. Over the course of multiple conference calls, the group helped identify the key issues facing the effort to create a single set of requirements for multifamily buildings, and provided feedback on the emerging proposal language. This group included Louis Starr of the Northwest Energy Efficiency Alliance, Don Surrena and Craig Drumheller of the National Association of Home Builders, Darren Port of the Northeast Energy Efficiency Partnership, Bing Liu, Todd Taylor and Jian Zhang of the Pacific Northwest National Laboratory, Jay Bhakta of Southern California Edison, Kosol Kiatreungwattana of the National Renewable Energy Laboratory, Doug King of

King Sustainability, Eric Makela of the CADMUS Group, Jim Meyers of Southwest Energy Efficiency Project, Ron Nickson of the National Multifamily Homes Council, Thomas Culp of Birch Point Consulting, Nehemiah Stone of Stone Energy Associates, Matthew Root of CLEAResult, Jim Edelson of NBI, David Cohan of the US Department of Energy and Eric Foley of Earth Advantage (the involvement of the above individuals and organizations should not be taken as support for the proposal or inclusion as co-proponents).

NBI also engaged other groups and individuals outside of the TAG on dedicated topics such as envelope requirements, infiltration, energy rating systems and usability for code officials.

Finally, NBI promoted and hosted a national webinar with nearly 100 attendees to inform a wide array of stakeholders in order to inform them about the effort, explain the proposal in its current draft at the time and to solicit additional feedback.

The entire process was informed by an energy analysis performed by the Pacific Northwest National Lab. The lab compared energy impact of the residential and commercial provisions using a set of standard multifamily building prototypes: a two-story breezeway eight-plex, a 4 story mid-rise and a 10 story high-rise. Each prototype was modeled using the commercial code provisions and the residential code provisions and the results compared. This comparison demonstrates the gap in energy outcomes that exists between the two sets of provisions. It also was used to help identify the regulation differences that have the greatest energy impact.

The table below shows the impact of moving from one code to the other. In all cases, the other code was less stringent than the native code. In the case of low-rise multifamily, this is largely because for the two-story low-rise prototype, the enhanced lighting option was chosen to meet the additional efficiency requirements from Section C406. This option was chosen since it would be the least costly; however, it is the least costly because it requires this prototype to do almost nothing. For context, when a 3-story version of the 4-story midrise building was created, switching to the commercial code resulted in greater efficiency. In this case, the additional efficiency option made a larger impact and the difference in infiltration requirements made a larger difference in part due to increased height and stack effect.

{{1452}}

The result of this analysis shows that the two sets of energy requirements in the code result in significantly and inconsistently different energy outcomes in multifamily buildings. This fact emphasizes the importance of this effort to bring coherence to the multifamily market.

One issue in particular, the difference in the infiltration requirements between the commercial and residential sections, represents such a significant difference between the codes that it was modeled separately. Each prototype was modeled using its native code and then only the infiltration requirement from the other code was substituted for comparison. The results of this analysis demonstrates how it would not be possible to move to a single infiltration standard for infiltration without having a significant impact on stringency.

{{1469}}

Once the proposal was substantially complete, the provisions of the proposal were compared back against the commercial and residential requirements. The results of this analysis shows that the proposal had absolutely no impact on the 10-story high-rise and 4-story mid-rise prototypes currently subject to commercial code. The proposal had a very small impact (.1% on average) on the low-rise prototype had due to the extension of commercial outdoor lighting requirements to low-rise multifamily projects.

{{1427}}

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

- **Over time, the multifamily section of the code can be tuned to better address the issues particular to multifamily buildings**
- **Multifamily code issues will no longer complicate the development of the Residential and Commercial codes**

The result is a proposal that gathers all multifamily provisions into a single chapter in the commercial section of the IECC. The commercial section was chosen since, in general, multifamily buildings are built more like commercial buildings. The proposal was developed in line with a handful of principles developed largely through the input of the broad body of stakeholders:

- **Leverage existing code language: Existing code language was used almost exclusively. This minimizes the disruption of the structural change for code users and code officials since most of the language will be familiar. It also focuses the nature of the proposal on restructuring.**
- **Avoid stringency changes: The proposal is intended to primarily be a structural change. It was crafted to keep minimize any impact on stringency, either to increase or decrease it. In some places, this means maintaining the high- and low-rise split where the requirements of the residential and commercial sections of the code are very different.**
- **Maximize Usability: As the proposal makes extensive use of existing code language, there are two competing usability issues. References to existing sections in the commercial and residential sections of the code has the advantage of reducing code length and minimizing the chance of code language divergence in parallel requirements but has the disadvantage of necessitating a lot of flipping back and forth between parts of the code book by the code user and code official. Replication of existing code sections in the new multifamily chapter has the advantage of clarity and minimizing the need to move around the code book but has the disadvantage of increasing code length, creating greater likelihood of language divergence in parallel requirements and burdening the chapter with code requirements that only apply to a small percentage of multifamily buildings (eg, requirements for complex HVAC systems will only apply to the small percentage of multifamily projects that have complex HVAC systems, most multifamily projects have simple HVAC systems and users only need to use the much smaller set of requirements that apply to those systems).**

To balance these competing usability needs, the proposal uses references when requirements align with commercial requirements since the commercial energy chapter is in the same part of the code and those requirements only apply to a small part of multifamily projects (the non-dwelling unit and non-sleeping unit areas) of small percentage of multifamily projects. Where requirements align with requirements from the residential section, that code language was duplicated in the new multifamily chapter. These requirements are often the primary requirements for multifamily projects and locating the language in the multifamily chapter eliminates the need for code users and officials to frequently flip to a whole other part of the code.

Following those principles, the following goes into detail about some specific parts of the proposal.

Definitions:

The proposal creates a new definition for "multifamily building" and modifies the existing definitions for "residential building" and "commercial building" to remove multifamily buildings from them. The definition for multifamily building leverages the occupancy designation R-2 that already exists in the IBC. This defines what is most often considered "multifamily" construction as it encompasses apartment buildings. It also excludes hotels and motels as well as institutional housing arrangements like prisons and long-term care facilities as these have usages and usage patterns that are less residential in character and less like what most people think of as multifamily. The definitions are modified in both the residential and commercial sections of the code.

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Section 406 is an important part of the energy savings of the commercial section. However, only three of the six options offered in Section C406 apply well to multifamily. In order to address this, the proposal adds three more options to the three options that work for multifamily in C406. The options for more efficiency HVAC performance, onsite renewable energy and high efficiency water heating are included as references to section C406. The three additional options are reduced lighting power, enhanced envelope performance and reduced air infiltration. These three options are derived largely from new language going into the Washington State code for section C406. Because the additional efficiency options would represent a change in stringency for low-rise multifamily, the proposal exempts multifamily projects that are three stories or less, maintaining the stringency level for low-rise multifamily.

C607:

Section provides the total building performance compliance alternative for the chapter. The existing software and energy rating tools that enable modeled performance-based compliance or energy rating system-based performance in the existing commercial and residential sections have been crafted to serve those code baselines. Residential modeling software and energy rating systems are not set up to serve high-rise multifamily projects. And the modeling software that serves the commercial section and high-rise multifamily projects is much more complicated and costly than the tools available for the typically smaller low-rise projects. Because of the importance of these tools, a new approach just for a unified multifamily project cannot be created at this time.

Therefore, the section preserves the high- and low-rise split in multifamily and directs projects to the residential and commercial "Total Building Performance" options already in the code. However, many people in the multifamily market feel that multifamily project types are not served well by the existing tools. This structure easily accommodates the later addition of total building performance models that have been created to serve the multifamily market. And by eliminating the split in that market, the proposal also makes it easier for dedicated multifamily tools to be created since those tools would only have to deal with a single code baseline instead of two.

C608:

For the 2015 IECC, a whole new chapter for existing buildings was created. The way that chapter is created, parts of it are very specific to commercial buildings. The additions and alterations sections are filled with specific references to the energy requirements of chapter 4. With this proposal, those requirements would no longer apply to multifamily buildings. Adding the references to make the existing chapter 5 work for both commercial and multifamily buildings would significantly complicate that chapter.

Therefore, the proposal leverages the portions of chapter 5 that are not commercial building specific – C501 General, C504 Repairs and C505 Change of Occupancy. It then creates new versions of the Additions and Alterations sections that have been crafted to work with the new multifamily requirements.

Section 501.1

The scope of Chapter 5 was also modified to make it applied specifically to commercial buildings and not all buildings regulated by the commercial section.

Cost Impact:

Part I: Will not increase the cost of construction
As this proposal almost exclusively restructures the requirements of the code without changing them, there will be no increase in cost for projects. Project cost may actually go down in some cases as the proposal improves the usability of the code for multifamily building projects, which should reduce the amount of time that must be dedicated to code compliance.

Part II: Will not increase the cost of construction
As this proposal almost exclusively restructures the requirements of the code without changing them, there will be no increase in cost for projects. Project cost may actually go down in some cases as the proposal improves the usability of the code for multifamily building projects, which should reduce the amount of time that must be dedicated to code compliance.

CE272-16 : C501.1-DENNISTON12705

CE273-16

IECC: C101.2, C501.1.

Proponent : Lee Stegall, representing self (lee@rhsmithpc.com)

2015 International Energy Conservation Code

Revise as follows:

C101.2 Scope. This code applies to *commercialbuildings*and the buildings' sites and associated systems and equipment.

> <u>**Exception:** Buildings occupied not more than 100 hours per year shall not be required to comply with this code.</u>

C501.1 Scope. The provisions of this chapter shall control the *alteration*, *repair*, *addition* and change of occupancy of existing buildings and structures.

> <u>**Exception:** Buildings occupied not more than 100 hours per year shall not be required to comply with this chapter.</u>

Reason: There are a number of buildings not cost effective to insulate per the building envelope requirements. At present, I am trying to design a 10x10' ticket booth. When occupied, there are permanent openings for transactions. The rather small building has 4 ticket windows and a door. Meeting energy efficiency requirements would require additional walls constructed within the exterior block walls creating a wall too thick for transactions. The pressbox is a similar problem. The field side of the pressbox is a full glass wall for viewing the game. If Junior Varsity and Varsity have 6 home games each year, the ticket agents occupying the buildings for 4 hours, that is less than 50 hours of occupancy for the year. Significant construction cost savings should be realized with this change.

Cost Impact: Will not increase the cost of construction
The proposed change to the section will decrease cost of construction because less insulation will be needed, less expensive windows can be used and lower efficiency/lesser cost equipment can be used for these infrequently inhabited buildings.

CE273-16 : C501.2 (NEW)-
STEGALL5885

CE274-16

Part I:
IECC: C501.4.
Part II:
R501.4 (IRC N1107.4)

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

Proponent : Hope Medina, representing Colorado Chapter of ICC (hmedina@coloradocode.net)

Part I

2015 International Energy Conservation Code

Revise as follows:

C501.4 Compliance. ***Alterations*****,** ***repairs*****,** ***additions*** **and changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for** ***alterations*****,** ***repairs*****,** ***additions*** **and changes of occupancy or relocation, respectively, in** <u>**this code and in**</u> **the** ***International Building Code*****,**<u>***International Existing Building Code,***</u>***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.**

Part II

2015 International Energy Conservation Code

Revise as follows:

R501.4<u>**(N1107.4)**</u> **Compliance.** ***Alterations*****,** ***repairs*****,** ***additions*** **and changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for** ***alterations*****,** ***repairs*****,** ***additions*** **and changes of occupancy or relocation, respectively, in** <u>**this code and**</u> **the** ***International Residential Code*****,** ***International Building Code*****,** <u>***International Existing Building Code,***</u> ***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.**

Reason:
It doesn't make sense for alterations, repairs, additions, change of occupancies, and relocated buildings to not need to comply with the IECC and the Existing Building Code. Especially since this section deals with existing buildings in one form or the other. We feel this was just an oversight in the creation of the new Chapter, and would like to correct the over sight.

Our Theme: A Code for the End User

Is the code section completely understandable to the end user?

Is the code section or requirement easy to find?

Is the code requirement even doable in the real world?

Will the code requirement really save energy or only on paper?

Cost Impact: Will not increase the cost of construction
These were missing codes to the list,

CE274-16 : C501.4-MEDINA12936

CE275-16

Part I:
IECC: C501.6.
Part II:
R501.6 (IRC N1107.6)

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

Proponent : Hope Medina (hmedina@coloradocode.net)

Part I

2015 International Energy Conservation Code

Revise as follows:

C501.6 Historic buildings. No provisions of this code relating to the construction, *repair, alteration*, restoration and movement of structures, and *change of occupancy* shall be mandatory for *historic buildings* provided ~~a~~ that one of the following applies:

1. A report has been submitted to the *code official* and signed by the owner and a *registered design professional*~~, or a representative of the State Historic Preservation Office or the historic preservation authority having jurisdiction~~, demonstrating that compliance with that provision would threaten, degrade or destroy the contributing historic character or features, or the historic form, materials or function of the building. If the subject matter of the report does not require a *registered design professional*, either a registered design professional or the licensed contractor responsible for the work shall prepare the report.

2. The state Historic Preservation Office or local preservation authority having jurisdiction provides a letter to the *code official* with a finding that compliance with that provision would be in conflict with the Secretary of the Interior's Standards for Rehabilitation, outlining th specific provisions that are in conflict and how compliance would threaten, degrade or destroy the contributing historic character or features, or the historic form, fabric or function of the building.

3.. The local historic preservation authority having jurisdiction provides documentation to the *code official* with a finding that the compliance with that provision would be in conflict with locally adopted historic preservation policies, standards and guidelines, outlining the specific provisions that are in conflict and how compliance would threaten, degrade or destroy the historic character or features, or the historic form, fabric or function of the building.

Part II

2015 International Energy Conservation Code

Revise as follows:

R501.6 (N1107.6) Historic buildings. No provision of this code relating to the construction, *repair, alteration,* restoration and movement of structures, and *change of occupancy* shall

be mandatory for *historic buildings* provided ~~a~~ <u>that one of the following applies:</u>

<u>1. A</u> report has been submitted to the code official and signed by the owner~~,~~ <u>and</u> a registered ~~*design professional*, or a representative of the State Historic Preservation Office or the historic preservation authority having jurisdiction~~<u>*design professional*</u>, demonstrating that compliance with that provision would threaten, degrade or destroy the <u>contributing historic character or features, or the historic form, materials or function of the *building*. If the subject matter of the report does not require a registered design professional, a licensed contractor responsible for the work can prepare the report.</u>

<u>2. The state Historic Preservation Office or local preservation authority having jurisdiction provides a letter to the *code official* with a finding that compliance with that provision would be in conflict with the Secretary of the Interior's Standards for Rehabilitation, outlining th specific provisions that are in conflict and how compliance would threaten, degrade or destroy the contributing historic character or features, or the</u> historic form, fabric or function of the ~~*building*~~<u>building</u>.

<u>3.. The local historic preservation authority having jurisdiction provides documentation to the *code official* with a finding that the compliance with that provision would be in conflict with locally adopted historic preservation policies, standards and guidelines, outlining the specific provisions that are in conflict and how compliance would threaten, degrade or destroy the historic character or features, or the historic form, fabric or function of the building.</u>

Reason: Purpose: The purpose of this revision is for the report submittal qualifications to be more aligned with the intent of the IEBC, allowing the registered design professional to submit the report, or alternately, a licensed contractor, if no design professional is involved in the project. Other minor revisions such as the insertion of "contributing" and "materials" is consistent with language in the IEBC and with standard historic preservation practice. Consistent with the intent of C501.6, the proposed amendment would also exempt IECC compliance for specific improvements when "documentation" is provided from the local preservation authority or a letter is provided from the State Historic Preservation Office demonstrating that compliance with the specific IECC provisions will pose negative impacts to a historic structure (as opposed to a report).
The involvement of the local preservation authority or the State Historic Preservation office helps to avoid conflicts between the Secretary of the Interior's Standards for Rehabilitation, and other preservation design guidelines used by the local preservation authority of the State Historic Preservation Office.

The proposal changes the requirement for the local preservation authority to submit documentation instead of a report. Similarly, to change the requirement for the State Historic Preservation Office to submit a letter instead of a report. It is the intent that this documentation or letter would specify the direct negative impact on the historic building caused by compliance with the specific IECC provision. The letter and documentation requirement reflect current practice and means of communication between the local preservation authority, the State Historic Preservation Office and the code official.

Cost Impact: Will not increase the cost of construction
This proposal will not increase cost as it simply changes who files documentation and what type of documentation gets submitted.

CE275-16 : C501.6-MEDINA13279

CE276-16

IECC: C502.1, C503.1.

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

2015 International Energy Conservation Code

Revise as follows:

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 ~~Section~~ 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.

C503.1 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 no 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 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 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. *Alterations* that replace less than 50 percent of the luminaires in a space, provided that such *alterations* do not increase the installed interior lighting power.

Reason: Section 502.1 - The code was modified to require application of C405.2 without requiring the application of Sections C402, C403, C404 and C405. For an addition, the expected performance is to

meet the requirements of the IECC, this change puts back the requirements that were left out of the code change.
Section 503.1 - There is no direction in the IECC for what soecufuc provisions of the IECC are to be applied to an existing building. Section 503.1 references the requirements for applying the provisions for new construction, but never directs that this section also addresses when things are not required to be applied to the existing building undergoing an alteration.

Cost Impact: Will not increase the cost of construction
This change simply clarifies how this code is intended to be applied to existing buildings. Greater clarification of when the code does and does not apply will most likely lower the cost of construction because planning and design can predictably provide direction.

CE276-16 : C503.1-COLLINS13489

CE277-16

IECC: C202, C503.1, C503.7 (New).

Proponent : Sean Denniston (sean@newbuildings.org)

2015 International Energy Conservation Code

Add new definition as follows:

<u>LEVEL 3 ALTERATION</u> <u>An *alteration* where the *work area* exceeds 50 percent of the building area.</u>

Revise as follows:

C503.1 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 no 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<u> except as required by Section C503.7</u>. *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 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 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. *Alterations* that replace less than 50 percent of the luminaires in a space, provided that such *alterations* do not increase the installed interior lighting power.

Add new text as follows:

<u>**C503.7 Level 3 alterations.** *Buildings* undergoing *Level 3 alterations* shall comply with not less than two of the following:</u>

1. <u>The *building* thermal envelope shall comply with the requirements for "Walls, Above Grade" in Table C402.1.4.</u>
2. <u>The *building* thermal envelope shall comply with the requirements for "Roofs"</u>

in Table C402.1.4.

3. **<u>Fenestration shall comply with Table C402.4.</u>**
4. **<u>Where the *building* meets the conditions of Section C402.4.2.1, the *building* shall comply with Section C402.4.2.1.</u>**
5. **<u>The *building* shall comply with the air leakage testing requirement of Section C402.5.</u>**
6. **<u>The *building* shall comply with Section C403.2.9.</u>**
7. **<u>Where the *building* meets the conditions of Section C403.4.5, it shall comply with Section C403.4.5 without exceptions.</u>**
8. **<u>The *building* shall comply with Sections C405.2 and C405.3.</u>**
9. **<u>The *building* shall comply with Section C406.2.</u>**
10. **<u>The *building* shall comply with Section C406.3.</u>**
11. **<u>The *building* shall comply with Section C406.4.</u>**
12. **<u>The *building* shall comply with Section C406.5.</u>**
13. **<u>The *building* shall comply with Section C406.6.</u>**
14. **<u>The *building* shall comply with Section C406.7.</u>**

<u>Exception: *Buildings* that demonstrate a 5 percent improvement of energy performance over the pre-alteration conditions using Section C407 or another *approved* method.</u>

Reason: According to the Urban Land Institute, New Construction and Major Renovations account for only 1-2% of the building stock in a typical year. For the larger population of existing buildings, energy codes' primary means of improving energy efficiency are through alterations. However, as current energy codes are formulated, the scope of that impact is generally limited to the scope of the alteration. Energy code requirements generally apply only to the alterations and not to the whole building. Even in large-scale alterations, it is possible to avoid triggering most or even all of the energy code by configuring a project to avoid touching a building's energy systems (HVAC, lighting, service hot water, envelope, etc). This represents a tremendous missed opportunity for the energy code to improve the energy efficiency of the whole building stock.
Bearing in mind the dangers of unintended consequences, this proposal narrowly targets its new code requirements for existing buildings, and the proposal is built on four principles:

- Requirements should focus on the largest class of alterations to reduce the possibility of discouraging alterations.
- Requirements should only be triggered in projects configured to have little impact on the energy systems of a building.
- Existing buildings encompass wildly variable features and conditions, so requirements should have a built-in flexibility to respond to this reality.
- As this represents new ground in codes, requirements should leverage existing code mechanisms, code language and code requirements as much as possible.

The International Existing Building Code defines three classes of Alterations (I, II and III). This proposal creates a trigger only for the most extensive Level III alterations. The definition for Level 3 alterations is drawn from the text description of that alteration class in the IEBC. This list leverages code requirements already found in the International Energy Conservation Code (IECC) and so will be familiar to contractors and code officials. The list represents a full range of options affecting every part of the building so that projects can choose actions that are appropriate and cost effective for that particular building's particular circumstances. Flexibility of this type is fundamental in writing code provisions that seek to have a greater impact on a jurisdiction's existing building stock.

The compliance options all refer to provisions from the IECC and apply to a broad variety of energy aspects within a building. This allows projects to select the most appropriate compliance option for the specifics of that project's alteration.

- Option 1 would require compliance with the "Above Wall" insulation requirements of the IECC.
- Option 2 would require compliance with the "Roof" insulation requirements of the IECC.
- Option 3 would require compliance with the fenestration performance requirements of the

IECC.

- **Option 4 would require compliance with the daylighting control requirements of the IECC for toplit spaces that meet the conditions of the provision.**
- **Option 5 would require compliance with the infiltration requirements of the IECC through the air leakage testing requirement.**
- **Option 6 would require compliance with the duct insulation and sealing requirements of the IECC.**
- **Option 7 would require compliance with the service hot water heat recovery requirements of the IECC for buildings that meet the conditions of the provision**
- **Option 8 would require compliance with all of the lighting control requirements of the IECC.**
- **Option 9 would require compliance with one of the "Additional Efficiency Package Options" (Efficient HVAC performance, Efficient Lighting System, Onsite Renewable Energy Supply) of the IECC**

The trigger is defined so that it will only apply to buildings that have been configured in such a way that avoids the existing triggers in the energy code. Projects that have already triggered the energy code and already comply with two of the many options available in the new provision will not have to do anything additional. The proposal language does not use any "in addition" language, so projects that meet these requirements because they have already triggered them will also meet this requirement. Additionally, projects complying through the ASHRAE 90.1compliance alternative already exempt from the alterations section. The trigger really only impacts large alteration projects that would not otherwise trigger the energy code in any substantial way despite the alteration being otherwise substantial.

Current energy codes have a limited means of impacting the energy performance of the vast majority of buildings in the existing building stock. This proposed addition will create a new trigger for IECC provisions when a building undergoes an extensive alteration.

Cost Impact: Will increase the cost of construction
This proposal will increase the cost of some projects, but only large alteration projects that would have otherwise not triggered the energy code.

CE277-16 : C503.1-DENNISTON13174

CE278-16

IECC: C503.1, C503.6.

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

C503.1 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 no 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 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 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. ~~*Alterations*~~Lighting alterations that ~~replace less than 50 percent~~ involve only the replacement of lamps and ballasts or involve only one-for-one luminaire replacement, need comply only with the ~~luminaires~~ LPD requirements in ~~a space, provided that such *alterations* do not increase~~ Section C405.4 and the ~~installed interior lighting power~~ control requirements of Section C405.2.2.
8. Routine maintenance and repair of lighting system.

C503.6 Lighting systems. New lighting systems that are part of the *alteration* shall comply with Section C405.

Exception. *Alterations* that ~~replace~~ involve 20 percent or less ~~than 10 percent~~ of the ~~luminaires~~ connected lighting load in a space, provided that such *alterations* do not increase the installed interior lighting power.

Reason: *The proposed change aligns the IECC with ASHRAE 90.1-2016. Current requirements for existing building alterations don't require compliance with most mandatory control requirements even* *if it is a major alteration (e.g. gutting the space or building). Alterations of lighting should require the same compliance as new construction. This proposal will require compliance in more areas, (20% instead of 50%) but limits the cost by only requiring time control requirements*

Cost Impact: Will not increase the cost of construction
Often a lower LPD requirement results in fewer fixtures and reduced costs. In the event that higher quality ballasts and lamps are required, there is may be a cost increase, but is would be nominal and offset by energy savings. Often standard available replacement lamps and ballasts will meet today's efficiency requirements compared to the original equipment being replaced. The cost of lighting controls has decreased and can probably be expected to decrease further, so the addition of time based lighting controls in an alteration no longer represents a large barrier.

CE278-16 : C503.1-FERGUSON11735

CE279-16

IECC: C503.1.

Proponent : Eric Makela, Cadmus Group, representing Northwest Energy Codes Group

2015 International Energy Conservation Code

Revise as follows:

C503.1 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 no 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 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 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. ~~***Alterations*** **that replace less than 50 percent of the luminaires in a space, provided that such** ***alterations*** **do not increase the installed interior lighting power.**~~

Reason: The Northwest Energy Codes Group, New Buildings Institute and the ICC SEHPCAC, submitted code change proposals that created the new Chapter 5 for Existing Buildings. Section C503. When the approved proposals were correlated with the existing language by ICC staff, ICC staff did not strike exception 7 of C503 as was intended by the authors - and as was made clear in testimony at the Final Action Hearings in Atlantic City, New Jersey. The exception 7 artifact now in the 2015 IECC clearly conflicts with the language in GEW-4 that is now found at C503.6 of the 2015 IECC. This proposed amendment will resolve that conflict.

Cost Impact: Will not increase the cost of construction
This proposal is an editorial correction based on an action that occured during the development of the 2015 IECC. The change to this portion of the code was not caught by staff during the publication of the 2015. There is no additional cost over the 2015 IECC.

CE279-16 : C503.1-MAKELA12511

CE280-16

IECC: C503.1, C503.1.1 (New).

Proponent : Bill McHugh, representing Chicago Roofing Contractors Association

2015 International Energy Conservation Code

C503.1 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 no 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*~~<u>*Alterations*</u> 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 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 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. ~~*Alterations* that replace less than 50 percent of the luminaires in a space, provided that such *alterations* do not increase the installed interior lighting power.~~

<u>Exception: The following *alterations* need not comply with the requirements for new construction, provided the energy use of the building is not increased:</u>

1. <u>Storm windows installed over existing *fenestration*.</u>
2. <u>Surface-applied window film installed on existing single-pane *fenestration* assemblies reducing solar heat gain, provided the code does not require the glazing or *fenestration* to be replaced.</u>
3. <u>Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.</u>
4. <u>Construction where the existing roof, wall or floor cavity is not exposed.</u>
5. <u>*Roof recover*.</u>
6. <u>*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</u>

building envelope.

7. *Alterations* that replace less than 50 percent of the luminaires in a space, provided that such *alterations* do not increase the installed interior lighting power.

Add new text as follows:

C503.1.1 Roofs Roofs, where the sheathing or insulation is exposed during reroofing, shall be insulated either above or below the sheathing.

Reason: This is an important way to provide maximum insulation R value to the building by using spaces inside the structure to provide the insulation where it is practical.

Cost Impact: Will not increase the cost of construction
This proposal has the potential to decrease the cost of compliance by not having to rework the roof flashing heights to accommodate added insulation thicknesses.

CE280-16 : C503.1-MCHUGH13189

CE281-16

IECC: C202 (New), C503.1.

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

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

ROOF MEMBRANE REPLACEMENT. Where an existing roof membrane is removed, exposing insulation or sheathing and only a new roof membrane installed.

Revise as follows:

C503.1 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 no 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 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 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 and roof membrane replacement*****where an existing roof membrane is removed, exposing insulation, and a new roof membrane installed.**
6. ***Air barriers*** **shall not be required for** ***roof recover, roof membrane replacement*** **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. ***Alterations*** **that replace less than 50 percent of the luminaires in a space, provided that such** ***alterations*** **do not increase the installed interior lighting power.**

Reason: The purpose of this proposal is to provide guidance to code users when preparing for a rooftop operation that is not covered well by the code. This situation occurs frequently where the roof insulation life may be extended by adding a new roof membrane after 'peeling' off the old.
This operation – peeling the roof membrane to repair insulation – then putting a new roof membrane on top of the insulation - is very similar to a roof recover application and should not trigger the requirements of the current IECC.In 'roof recover' applications, typically a very thin 'recover board' is used to provide a new surface for roofing to be applied. For 'peel and recover' applications, especially

with loose laid single ply roofing membranes, the surface of the insulation is not damaged during the 'peel'. Therefore, this operation should be allowed as it is technically sound and provides the building owner and manager the opportunity to get an extended service life of the insulation.

If the building owner and manager invests a 'peel and roof recover', they extend the roof life increasing useful life of the insulation. This extended life cycle reduces waste in landfills.

The new definition for 'roof membrane replacement is needed to provide clear direction to the code user on situations that are not currently covered by the code.This situation occurs frequently. Usually, with 'roof recover', a 'recover board', with very little insulation value is used to act as a smooth surface for accepting a new membrane over an old roof. In the case of the 'roof membrane replacement' when replacing a loose laid roof membrane, the insulation is not damaged and a new roof membrane can be installed without a 'recover board' to 'smooth' the surface for the new membrane.

Based on this information, and a code proposal to follow it in 503.1, General, exceptions, this defintion is needed.

Cost Impact: Will not increase the cost of construction
By adding this new definition, it allow s the code user another more competitive option than 'roof recover', in
situations w here the roof insulation can be reused.

CE281-16 : C503.1-MCHUGH13291

CE282-16

IECC: C503.1.

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

2015 International Energy Conservation Code

Revise as follows:

C503.1 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 no 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 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 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. *Alterations* that replace less than 50 percent of the luminaires in a space, provided that such *alterations* do not increase the installed interior lighting power.
8. <u>For roofs on existing buildings with slopes less than 2"/12", where the roof covering is removed and insulation remains, and where the required R-Value cannot be provided because of thickness limitations presented by existing rooftop conditions, including heating, ventilating and air-conditioning equipment, low door or glazing heights, weep holes, and roof flashing heights not meeting the manufacturers specifications, the maximum thickness of insulation compatible with the available space and existing uses shall be installed. The insulation used shall have an R-value of not less than R-5.0 per inch. In areas where flashing is terminated not less than 8 inches above the roof covering, including required insulation, insulation shall be as required by Table C402.1.3.</u>

Reason: The purpose of this code proposal is to provide guidance to the code user who is trying to comply with the code but has existing building conditions that may preclude compliance. Where codes are practical and reasonable, compliance is increased.

This proposal gives a path to compliance to building owners and managers who are faced with hugely increased costs – sometimes 20-50% more – when having to raise curbs that hold HVAC units and other rooftop equipment, raisling door and window sills, then replacing those doors and windows, and plumbing vent stacks, gas and electrical piping, and many other rooftop equipment service items. This brings common sense to the code through using the flashing heights for the driver of insulation thicknesses for existing buildings.

Roofing Flashings are where a large percentage of leaks occur. While we hear exceptions are granted by manufacturers of roofing membranes for less than 8" heights. However, the baseline dimension used in legal cases is 8" as stated by The National Roofing Contractors Association (NRCA) Manuals. These manuals have recommended 8" flashing heights for at least 40 years.

Cost Impact: Will not increase the cost of construction

This will not increase the cost of construction and has the potential to decrease the cost of compliance by not having to rework the roof flashing heights to accommodate insulation.

CE282-16 : C503.1-MCHUGH13313

CE283-16

IECC: C503.1.

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

2015 International Energy Conservation Code

Revise as follows:

C503.1 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 no 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 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 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. ***Alterations*** **that replace less than 50 percent of the luminaires in a space, provided that such** ***alterations*** **do not increase the installed interior lighting power.**
8. **<u>The R-value for roof assemblies where tapered insulation is used above deck to provide slope to drains shall be insulated to average R-values as stated in Table C402.1.3 instead of minimum R-values.</u>**

Reason: Low sloped roofs where there is not enough drainage is a building owner and manager's worst nightmare. Where water stands, leaks have a constant stream of water to feed into the building. Tapered insulations have been used for generations to provide slope to drain on existing buildings where the structural slope cannot be altered. Using insulation for slope to drain, the code mandated R-Value means meeting minimum thicknesses very close to drains or scuppers and then continuing to pile huge amounts of insulation over the minimums required by Table 402.1.3.

There currently is no credit given for the extra insulation to the building owner for adding insulation over and above the code minimum. Using the 'average method' for tapered insulation, allows the building owner to take advantage of the extra insulation at the high points of insulation thickness offsetting the lower insulation thickness in other areas.

Cost Impact: Will not increase the cost of construction
This will not increase the cost of construction and has the potential to decrease the cost of compliance by not having to rework the roof flashing heights as much as would be required currently to accommodate insulation.It also uses less insulation than the current continuous insulation requirement.

CE283-16 : C503.1-MCHUGH13330

CE284-16

IECC: C503.1.

Proponent : Hope Medina, Cherry Hills Village, representing CCICC (hmedina@coloradocode.net)

2015 International Energy Conservation Code

Delete without substitution:

C503.1 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 no 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 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 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. ~~**Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.**~~

Reason: Exception #7 contradicts what section C503.6 states in it's exception. We felt one of these sections was going to need to be addressed to make this consistent. We chose to go with deleting exception #7 since in the last code cycle at the committee hearings both sections had been approved with the 10%. At the Public Commit hearings is were the conflict came about. A public comment was approved for Section 503.1 exception #7 to increase from the 10% to the 50%. A point of order was called concerning the discrepancy. We are attempting to make these sections work together without creating a loophole.

Our Theme: A Code for the End User

Is the code section completely understandable to the end user?

Is the code section or requirement easy to find?

Is the code requirement even doable in the real world?

Will the code requirement really save energy or only on paper?

Cost Impact: Will not increase the cost of construction
This change should not increase the cost. It is to bring consistancy with the two sections.

CE284-16 : C503.1-MEDINA12942

CE285-16

IECC: C503.2, C505.1.

Proponent : Duane Jonlin, Seattle Dept of Construction and Inspections (duane.jonlin@seattle.gov)

2015 International Energy Conservation Code

Revise as follows:

C503.2 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.

<u>Exceptions:</u>
<u>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.</u>
<u>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 110 percent of the annual energy cost otherwise permitted by Section C407.3.</u>

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 C405.4.2(1) or C405.4.2(2) to another use in Table C405.4.2(1) or C405.4.2(2), the installed lighting wattage shall comply with Section C405.4.
<u>Exceptions:</u>
<u>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.</u>
<u>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.</u>

Reason: Where existing buildings undergo a change in space conditioning or change in occupancy or use, the current code requires "full compliance with this code." Such a stringent requirement is overly burdonsome and in many cases unachievable, particularly for the building envelope. Details such as slab edges, basement wall insulation, entry doors and the like can be diffucult or impossible to bring up to current code without completely rebuilding the facades.
This proposal allows a limited amount of "wiggle room" for buildings undergoing a change in space conditioning or change in use, where they use either the component performance tradeoff method in Section C402.1.5 or the total building performance method in Section C407.

Cost Impact: Will not increase the cost of construction
This will decrease the cost of construction. Bringing any existing building into full compliance with every aspect of the current energy code would be expensive and impractical. This proposal provides a slightly less-stringent option, allowing more design flexibility, and will thus be less expensive.

CE285-16 : C503.2-JONLIN12141

CE286-16

IECC: C503.3, C503.3.2, C503.3.3, C505.1.

Proponent : Thomas Culp, Birch Point Consulting LLC, representing the Glazing Industry Code Committee and Aluminum Extruders Council (culp@birchpointconsulting.com)

2015 International Energy Conservation Code

Revise as follows:

C503.3 Building envelope. New building envelope assemblies that are part of the *alteration* shall comply with Sections C402.1 through C402.5.

Exception. Where the existing building exceeds the *fenestration area* limitations of Section C402.4.1 prior to *alteration*, the building is exempt from Section C402.4.1 provided that there is not an increase in *fenestration area.*

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 ~~C402.4~~ C402.4.3 or C407. The addition of *verticalfenestration* 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 glass~~ *vertical fenestration* area exceeding that specified in Section C402.4.1.1 shall comply with Section 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).*

C503.3.3 Skylight area. The addition of *skylight* area that results in a total building *skylight* area less than or equal to that specified in Section C402.4.1 shall comply with Section C402.4. The addition of *skylight* area that results in a total building skylight area greater than Section C402.4.1 shall comply with Section C402.4.1.2 for the space adjacent to the new skylights. *Alterations* that result in a total building skylight area exceeding that specified in Section C402.4.1.2 shall comply with Section C407. Provided that the *skylight* area is not changed, using the same skylight area in the *standard reference design* as the building prior to *alteration shall be an alternative to using the skylight area specified in Table C407.5.1 (1).*

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 C405.4.2(1) or C405.4.2(2) to another use in Table C405.4.2(1) or C405.4.2(2), the installed lighting wattage shall comply with Section C405.4. 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.

Reason: Last cycle, the provisions related to additions, alterations, and repairs were significantly clarified. However, the language regarding alterations needs further correction. The current language works well for deep retrofits where multiple components of the space are being modified (e.g. windows, walls, lighting, HVAC). However, as currently written, it would actually discourage building owners from making improvements in individual parts of certain existing buildings. For example, in an existing office building that may have 50% window area (greater than the prescriptive window area limit), the last sentence of Section C503.3.2 would not allow someone to simply replace the existing

fenestration with more efficient windows to bring them up to code, unless they also did something else in the building to show overall compliance in the performance path. Likewise, this also hinders improvements in opaque areas, such as redoing a roof or adding cavity insulation, in buildings that already have greater than 40% window area – the current language of C503.3 and C503.3.2 would not allow someone to simply bring that roof or wall insulation up to code without doing something else in the building too via the performance path to show equivalence in a hypothetical building with a different baseline window area. While deep retrofits are certainly the most effective, many building owners do not have access to the required capital, and they could very well stop or delay making any improvements at all. Discouraging partial retrofits or even simple window replacement was surely not the intent. Therefore, this change clarifies that when a retrofit is done with no change in fenestration area, the true improvement is assessed on its own by comparing the building with its same window area.

In Section C503.3.2, it is also clarified that fenestration added in buildings under the fenestration area limits shall comply with C402.4.3, not all of C402.4 which includes other unrelated requirements like minimum skylight area. The proposal also adds the option to use the performance path even for buildings under 40% window area, which can be especially useful in deep retrofits.

Finally, a related change is included in Section 505 regarding spaces undergoing change of occupancy. The current language could imply that the building is out of compliance and would require something cost prohibitive such as removing windows and reconstructing walls for a simple change of occupancy.

Cost Impact: Will not increase the cost of construction
This proposal will decrease the cost of construction, and encourage more cost effective partial improvements of existing buildings that are not undergoing deep retrofits.

CE286-16 : C503.3-CULP12531

CE287-16

IECC: C503.3.1.

Proponent : Jason Wilen AIA CDT RRO, National Roofing Contractors Association (NRCA), representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net)

2015 International Energy Conservation Code

Revise as follows:

C503.3.1 Roof replacement. ***Roof replacements*** **shall comply with Table C402.1.3 or C402.1.4 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 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: The purpose of this change is to address the installation challenge of providing additional above deck roof insulation in reroofing situations where existing conditions may not allow for the full thickness of insulation required to comply with Table C402.1.3 or C402.1.4.
The proposed exception is word-for-word from IgCC 2015, Section 1003.2.7-Roof Replacement Insulation and would make clear the maximum thickness of insulation compatible with available space is required be installed.

Cost Impact: Will not increase the cost of construction
The proposed change does not increase the stringency of existing code requirements so the cost of construction will not be increased.

CE287-16 : C503.3.1-WILEN AIA CDT RRO12633

CE289-16

IECC: C503.3.4 (New).

Proponent : Mike Fischer, Kellen, representing the Plastic Glazing Coalition of the American Chemistry Council (mfischer@kellencompany.com)

2015 International Energy Conservation Code

Add new text as follows:

C503.3.4 Skylight UA alternative for roof replacements. For the installation of new skylights as part of a roof replacement, where the roof assembly is part of the thermal envelope and is part of a metal building or incorporates insulation entirely above the roof deck, the roof assembly and skylights shall be considered to be in compliance with Table C402.1.4 and the skylights shall not be required to comply with Table C402.4 where the sum of the roof assembly and skylight areas multiplied by their respective U-factors is less than or equal to what would be determined from using the applicable opaque roof U-factors in Table C402.1.4. The UA calculation shall be performed using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. Skylights shall comply with the SHGC requirements in Table C402.4.

Reason: The addition of skylights as part of a roof replacement project can provide added design benefit through the addition of natural light and daylighting, but the prescriptive path does not provide any flexibility on the skylight requirements in terms of U-Factor. The code does provide some flexibility for skylight U-Factor requirements via the performance path, but that method usually doesn't make sense for reroofing. The vast majority of roof replacement projects are governed by the prescriptive path method in the code because it is unlikely a designer would or could use a performance or whole building approach when the project is limited to the roof of the building. Since the code does not permit any trade-off from the fenestration requirements in these applications, there is no remedy for the use of skylights that fall outside of the prescriptive values.
Including an option for skylights in the prescriptive path for roof replacement projects, but requiring overall UA compliance at least equivalent to the opaque roof requirement ensures that the installed system will have appropriate energy efficiency performance while gaining the benefits of added lighting. This option is not necessary if the new skylights comply with the U-Factor requirements in Table C402.4, but use of this method will result in a more efficient assembly than the prescriptive path currently permits, while expanding the available skylight products that can be used.

This proposal is consistent with the intent of the code as expressed in the performance path in that the U-Factors for skylights could be increased if that thermal loss is made up elsewhere in the building envelope. It allows for additional natural lighting in the building while requiring equivalent SHGC performance, and sets the UA bar higher than is currently permitted by this code for new construction.

Cost Impact: Will not increase the cost of construction
The proposal provides additional options and increased flexibility, which should reduce cost.

CE289-16 : C503.3.4 (NEW)-FISCHER13266

CE290-16

IECC: C503.4.2 (New), C503.5.1 (New), C503.6.1 (New).

Proponent : jim edelson (jim@newbuildings.org)

2015 International Energy Conservation Code

Add new text as follows:

C503.4.2 Commissioning New heating, cooling and duct system components that are part of the alteration and the existing systems to which they are connected, shall comply with Sections C408.2.2, C408.2.3 and C408.2.5.

C503.5.1 Commissioning. New service hot water system components that are part of the alteration and the existing systems to which they are connected, shall comply with Sections C408.2.2, C408.2.3 and C408.2.5

C503.6.1 Commissioning. New lighting system components that are part of the alteration and the existing systems to which they are connected shall comply with Section C408.3.

Reason: Replacement of a mechanical or service hot water system represents a significant event in the building's life where there are opportunities to save energy by testing the entire system to ensure it is operating efficienctly and the operating conditions correctly match the new equipment being installed. When new HVAC, hot water and lighting equipment are installed in a building, it is also important to ensure that the new components work properly in the existing system.
The current text of the IECC does not even require that the new equipment itself, that is part of an alteration, be commisssioned in accordance with Section 408. This proposal fixes that hole. It also goes a step further and uses the equipment replacement to ensure that the entire system is working properly with the new equipment installed. The parts of the commissioning section that require the involvement of a registered design professional are not referenced by this proposal. Most simple equipment replacement projects will not have an architect involved, so these requirements are tailored to ensure that they will not add the expense of adding an architect to the project.

Cost Impact: Will increase the cost of construction
This proposal is similar to retrocommissiong of existing buildings for those systemss of the buildings that are being altered. The representative cost estimate for the New York City retrocommissioning requirements passed into code for three system types (Lighting, mechanical, and envelope) is estimated are 35 cents per square foot. This cost for this proposal will be reduced from that figure in proportion to the fraction of systems being altered, and the proportion of the building square footage being altered.
It is also the most cost-effective time to retro-commission a building when the mechanical contractors are already involved and on-site.

CE290-16 : C503.4.2 (NEW)-EDELSON12629

CE291-16

IECC: C503, C503.1, C503.6, C503.6.1 (New), C503.6.2 (New), C503.6.3 (New), C503.6.4 (New), C503.6.5 (New).

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

SECTION C503 ALTERATIONS

Revise as follows:

C503.1 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 no 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 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 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. ~~***Alterations*** **that replace less than 50 percent of the luminaires in a space, provided that such** ***alterations*** **do not increase the installed interior lighting power.**~~

C503.6 Lighting systems. ~~**New lighting**~~
Lighting systems~~**that are part of the** ***alteration***~~ **shall comply with** ~~**Section C405**~~ **Sections C503.6.1 through C503.6.5.**

~~**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.**~~

Add new text as follows:

C503.6.1 Reconfiguration of spaces. Where the size or configuration of interior spaces is altered, lighting systems in such spaces shall comply with Section C405.

C503.6.2 Alteration of interior lighting power. Where the connected interior lighting power within a space is altered, the lighting system in such space shall comply with Section C405.4.

Exception: Any space where the connected lighting power is reduced by 20 percent or more is not required to comply with Section C405.4.

C503.6.3 Alteration of exterior lighting power Where the connected exterior lighting power is increased by more than 10 percent, all exterior lighting, including lighting that is not proposed to be altered, shall comply with Section C405.5, and all lighting that is added or altered shall be controlled in accordance with Section C405.2

C503.6.4 Interior lighting controls Where lighting controls are added or altered within a space, the lighting controls within such space shall comply with Section C405.2.

C503.6.5 Exterior lighting controls Where exterior lighting controls are added or altered, those portions of the lighting control system that are altered shall comply with Section C405.2.

Reason: There is a perceived conflict between Exception 7 to Section C503.1 and the Exception to Section C503.6. The SEHPCAC explored many options and had difficulty reaching consensus until it explored a series of alteration scenarios. It became clear that simply removing one exception versus the other did not result in clear understanding of the application of the code. The various remodelling/alteration scenarios are spelled out in the two tables below, and the committee worked through these scenarios to arrive at a sensible set of requirements. This proposal eliminates both existing provisions and replaces them with a set of comprehensive provisions for the alteration of lighting systems which addresses several longstanding problems with the existing code language:

1. **It is not clear whether existing light fixtures can be altered without a requirement that existing lighting controls also be altered to comply with the current code, and vice-versa. This proposal clearly de-links these, so that existing lighting controls can be upgraded without triggering a mandatory upgrade of existing light fixtures, and vice-versa.**
2. **It is not clear how compliance should be determined for exterior lighting alterations. For interior spaces compliance can always be determined for one individual room, but for exterior lighting compliance can only be determined for the entire site.**
3. **The existing exceptions do not acknowledge the type of alterations that people actually make to existing lighting systems, as they only address one-for-one replacement of light fixtures within a room. This proposal would create more meaningful exceptions for smaller projects.**

This proposal was submitted by the ICC Sustainability 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 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Interior Lighting System Alterations

Proposed Alteration	**Require Compliance**	**Exempt**	**Reason**
Add a luminaire(s)	Lighting power	Lighting	If wattage is proposed to be increased then compliance should be

		controls	demonstrated for the lighting in that space.
Remove a luminaire(s) that results in <20% power reduction	Lighting power	Lighting controls	Given the dramatic improvements in lighting technology it should always be possible to either reduce connected lighting power by 20% or comply with current code.
Remove a luminaire(s) that results in ≥20% power reduction		Lighting power and controls	
Relocate existing luminaires within a space		Lighting power and controls	If the overall quantity of lights within the space is not changing then let people move lights around for better distribution, etc.
Relocate existing luminaires from one space to another.	Covered under "add a luminaire" / "remove a luminaire" above.		
Combine existing spaces or subdivide an existing space.	Lighting power and controls		Quite often an Owner will try to reduce the cost of planning changes by not doing any "above ceiling work". This is problematic in a number of ways including fire protection systems and HVAC. From a lighting standpoint it will often mean that lighting controls no longer work properly, with resulting wasted energy.
Change the type of an existing space.		Lighting power and controls	Not a "change of use or occupancy". Rather, a private office is converted to a storage room, or a teacher lounge is converted to a classroom. It would be too difficult to enforce efficiency requirements in a situation like this as these types of changes would not ordinarily require a filing.
Reballast / relamp existing luminaire where the wattage increases.	Lighting power	Lighting controls	If wattage is proposed to be increased then compliance should be demonstrated.
Reballast / relamp existing luminaire(s) resulting in <20% power reduction	Lighting power	Lighting controls	Given the dramatic improvements in lighting technology it should always be possible to either reduce connected lighting power by 20% or comply with current code.
Reballast / relamp existing luminaire(s) resulting in ≥20% power reduction		Lighting power and controls	
Alter or add to existing lighting control systems.	Lighting controls	Lighting power	An alteration to an existing lighting control system could cause the system to become less efficient, so it is necessary to demonstrate compliance in any spaces where controls are being added or altered. For example, you could add a switch to an existing control system which improves lighting efficiency by subdividing an existing control zone, or you could add that switch in such a way that it bypasses an occupancy sensor or overrides the daylight responsive controls and makes the lighting less efficient. There are also instances where experts could honestly disagree about whether a particular proposed alteration is more efficient or less efficient than the existing lighting controls. For all of these reasons, the simplest option is to always require compliance when control systems are being altered. However, it should be possible to upgrade lighting controls without being required to simultaneously upgrade the luminaires.

Exterior Lighting Alterations

Proposed Alteration	**Require Compliance**	**Exempt**	**Reason**
Add luminaire(s) with >10% increase in connected lighting power across the site	Lighting power for entire site + lighting controls for added lighting	Lighting controls for existing lighting	Where a significant increase in installed lighting wattage is proposed it should be necessary to demonstrate compliance with current code, even though this is not easy as compliance must be demonstrated for the entire site. It is not clear how you could determine the allowed lighting wattage for just a portion of the site. For example, how would you apportion the "Base Site Allowance" across a 10-acre site when you are only proposing to alter the lighting in one small corner? For lighting controls, on the other hand, it is straightforward to comply with the lighting controls requirements only for the added light(s).
Reballast / relamp existing luminaire(s) with >10% increase in connected lighting power across the site			
Add luminaire(s) with ≤ 10% increase in connected lighting power across the site			

Remove a luminaire(s)			
Relocate existing luminaires		Lighting power and controls	These projects are not ordinarily filed, and given the difficulty of demonstrating compliance for exterior lighting (see above) demonstrating compliance with current code would be a significant administrative burden for these small projects.
Reballast / relamp existing luminaire(s) with ≤ 10% increase in connected lighting power across the site			
Reballast / relamp existing luminaire where the wattage decreases.			
Change the configuration / layout of site components without altering lighting.		Lighting power and controls	As long as no changes to lighting are proposed, it should be permissible to convert a lawn to an "overflow parking area" or to convert part of a parking lot to a pedestrian plaza without demonstrating compliance with the lighting requirements in the code.
Alter or add to existing lighting control systems.	Lighting controls that are being added or altered	Lighting power + lighting controls which are not proposed to be altered	An alteration to an existing lighting control system could cause the system to become less efficient, so it is necessary to demonstrate compliance for those portions of the system which are being added or altered. There are also instances where experts could honestly disagree about whether a particular proposed alteration is more efficient or less efficient than the existing lighting controls. For all of these reasons, the simplest option is to always require compliance when control systems are being altered. However, it should be possible to upgrade the lighting control system without upgrading the luminaires, and it should also be possible to upgrade just a portion of the exterior lighting controls without being required to upgrade the entire exterior lighting control system. For example, if a high school wanted to add a timeswitch to shut off lights in their parking lot after midnight, they should be allowed to do this without also being required to upgrade the controls for the sports field lighting to meet current code.

Cost Impact: Will not increase the cost of construction
This proposal would have the effect of exempting some smaller alteration projects which are currently required to comply with the code (but which in truth are often not filed).

CE291-16 : C503.6-COLLINS11450

CE292-16

IECC: , C505.1, C505.2 (New), C505.2.1 (New), C505.2.2 (New), C505.3 (New), C505.3.1 (New), C505.3.2 (New), C505.3.3 (New).

Proponent : Jennifer Senick, Rutgers University, Center for Green Building, representing Rutgers University, Center for Green Building (jsenick@rutgers.edu)

2015 International Energy Conservation Code

Revise as follows:

C505.1 General. Spaces undergoing a change in occupancy ~~that would result in an increase in demand for either fossil fuel~~ from a F,H or ~~electrical energy~~ U occupancy to any other occupancy classification shall comply with this code. ~~Where the use in~~ Other spaces undergoing a ~~space changes from one use in Table C405.4.2(1) or C405.4.2(2) to another use in Table C405.4.2(1) or C405.4.2(2), the installed lighting wattage~~ change of occupancy shall comply with Sections C505.2 and C505.3. *Alterations* made concurrently with the change of occupancy shall be in accordance with Section ~~C405.4~~ C503.

Add new text as follows:

C505.2 Loads. Lighting loads and ventialtion shall comply with Sections C505.2.1 and C505.2.2.

C505.2.1 Lighting Wattage. Where the use in a space changes from one use in Table C405.4.2(1) or C405.4.2(2) to another use in Table C405.4.2(1) or C405.4.2(2), the installed lighting wattage shall comply with Section C405.4.

C505.2.2 Ventilation. Where the use in a space changes from one use to another as listed in Table 403.3.1.1 of the *International Mechanical Code* (IMC) the ventilation rate provided shall be as specified for the new occupancy in the IMC.

C505.3 Energy Intensities. Where a change of occupancy or use is made to an existing building that results in an increase in energy intensity classification as specified in Table C505.3.1, C505.3.2 or 505.3.3, the building or portion thereof shall comply with Sections C505.3.1 through C505.3.3 respectively that are applicable to the new occupancy and use. Where changes in occupancy and use are made to portions of an existing building only those portions of the building shall comply with Sections C505.3.1 through C505.3.3 as specified herein.

Exceptions:

1. Where it is demonstrated by analysis *approved* by the *code official* that the change will not increase usage of fossil fuel or electrical energy.
2. Where the occupancy or use change is less than 5,000 square feet in area.

C505.3.1 Space Heating, Cooling and Ventilation.
Where the change of occupancy or use results in an increase in energy intensity classification as specified in Table C505.3.1, the building or space undergoing the change shall comply with Section C402 and C403 applicable to the new occupancy and use. 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

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.

TABLE C505.3.1
Space Heating, Cooling and Ventilation.

Energy Intensity Classification	IBC Occupancy Classifcation and Use
1. High	A-2, B-Laboratories, I-2
2. Medium	A-1, A-3[a], A-4, B[b], E, I-1, I-3, M, R-4
3. Low	A-3-Places of Religious Worship, R-1, R-2, S-1, S-2

C505.3.2 Lighting Where the change of occupancy or use results in an increase in energy intensity classifcation as specified in Table C505.3.2, the building or space undergoing the change shall comply with Section C405 applicable to the new occupancy and use except for Section C405.5.
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TABLE C505.3.2
Lighting

Energy Intensity Classification	IBC Occupancy Classifcation and Use
1. High	A-2, B-Laboratories, I-2, M-Food Sales
2. Medium	A-3-Courtrooms, B[c], I-1, I-3, M[b], R-1, R-2, R-4, S-1, S-2
3. Low	A-1, A-3[a], A-4, E

C505.3.3 Service Water Heating. Where the change of occupancy or use results in an increase in energy intensity classification as specified in Table C505.3.3, the building or space undergoing the change shall comply with Section C404 applicable to the new

occupancy and use.

TABLE C505.3.3
Service Water Heating

Energy Intensity Classification	IBC Occupancy Classifcation and Use
1. High	A-2, I-1, I-2, R-1, R-4
2. Low	All other occupancies and uses

Reason: The IECC 2015 change of occupancy requirement states (C505.1):

> **"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 not widely enforced. Once 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. Another is that there is an inconsistency between the IECC Commentary on this requirement, which interprets energy demand as peak energy demand, and the intent of the IECC, C101.3 Intent: "This code shall regulate the design and construction of buildings for the use and conservation of energy over the life of each building" (emphasis added). Peak energy demand does not necessarily correlate with energy use. In our experience, building officials often require energy efficiency equipment upgrades, such as lighting or HVAC, in change of occupancy.

This proposal advances intensity per square foot 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) and the Building Performance Database (BPD), for residential buildings in the Residential Energy Consumption Survey (RECS), and for industrial buildings in the Manufacturers Energy Consumption Survey (MECS). These databases make it possible to rank building occupancies in the order of their energy intensities. Note that the ranking of occupancies to trigger specific code requirements has been a feature of the IEBC since its first edition (see IEBC 2015 Section 1012, Change of Occupancy Classification, Tables 1012.4, 1012.5 and 1012.6), and thus is familiar to building code officials.

Energy intensity data is further broken down by various end uses, as suggested by current enforcement practices: space conditioning, lighting, and water heating, which makes it possible to trigger code compliance of specific sections of the IECC by an increase in intensity for the use regulated by those sections. Only an increase in energy intensities in all three of the end uses triggers full compliance with the code.

There are ventilation requirements in the IMC and lighting wattage requirements in the IECC that are triggered by occupancy changes that do not correspond exactly to the energy intensity order of occupancies. The requirements are preserved by Section 505.2 of the proposed code change respectively.

There are two exceptions that apply to all three end uses:

C505.3 Exception 1 allows the applicant to demonstrate by analysis that the specific change will not increase energy intensity.

C505.3 Exception 2 provides an area limitation as a consideration of fairness to smaller applicants.

Three exceptions apply to specific end uses:

C505.3.1 Exceptions 1 and 2 address specific fenestration requirements.

C505.3.2 Exceptions excludes exterior lighting.

A matrix has been developed for each end use that displays a scale fo 2-3 groups in descending order from high to low energy intensities, measured in annual kBTU/ft2 (Tables 1-3). Within these scales are grouped CBECS building types and the corresponding International Building Code (IBC) occupancy classifications. Data sources for this analysis included primarily U.S. Department of Energy's CBECS 2003 and 2012 (aspects), BPD 2015, and RECS 2009. It was decided to include F, H and U occupancies in the code change proposal. An analysis of the 2010 Manufacturing Energy Consumption Survey (MECS) showed that many industries in these occupancy classifications could be classified in the low energy intensity categories, some were higher. However, since F, H and U buildings are not designed primarily for occupant comfort and safety, it was decided that a change from F, H and U to any other occupancy should comply withe code.

Table 1. Change of Occupancy Scale - Space Heating, Cooling, and Ventilation

	CBECS Building Type	EI Range kBTU/sq.ft.	IBC Occupancy Classification
1. High	Health Care (Inpatient), Food Service, Laboratories	Above 75	A-2, B-Laboratories, I-2
2. Medium	Public Assembly, Education, Public Order and Safety, Office, Service, Health Care (Outpatient), Retail, Residential Care/Assisted Living	34-75	A-1, A-3, A-4, B, E, I-1, I-3, M, R-4
3. Low	Religious Worship, Lodging, Apartments, Warehouse and Storage	0-33	A-3-Places of Religious Worship, R-1, R-2, S-1, S-2

Table 2. Change of Occupancy Scale - Lighting

	CBECS Building Type	EI Range kBTU/sq.ft.	IBC Classification
1. High	Health Care (Inpatient), Food Sales, Food Service, Laboratories	Above 31	A-2, B-Laboratories,I-2, M-Food Sales
2. Medium	Retail, Lodging, Office, Health Care (outpatient), Public Order and Safety, Service, Lodging,	13-31	A-3-Courtrooms, B, I-1, I-3, M, R-1, R-2, R-4,

	Apartments, Residential Care/Assisted Living,Warehouse and Storage		S-1, S-2
3. Low	Public Assembly, Religious Worship, Education	0-12	A-1, A-3, A-4, E

Table 3. Change of Occupancy Scale - Water Heating

	CBECS Building Type	EI Range kBTU/sq.ft.	IBC Occupancy Classification
1. High	Food Service, Health Care (Inpatient),Lodging,Residential Care/Assisted Living	Above 15	A-2, I-1, I-2, R-1, R-4
2. Low	All the rest	0-15	All the rest

The concept for this code change proposal was presented at the 2015 DOE Energy Code Conference in Nashville and at two annual codes conferences organized by NEEP. It has benefited from extensive reveiw and feedback from numerous building officials in multiple states, other stakeholders participating in SEHPCAC and from technical reviewers at CBEI.

This code change has been developed withe support from the Consortium for Building Energy Innovation (CBEI), a project of the U.S. Department of Energy.

Cost Impact: Will not increase the cost of construction
The current code requirement triggers full compliance with the code when there is an increase in energy demand. The proposed code change offers the metric of energy 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.

CE292-16 : C505.1-SENICK12379

CE293-16

IECC: CA101.1 (New).

Proponent : Kathleen Petrie, City of Seattle, Department of Construction and Inspections, representing City of Seattle, Department of Construction and Inspections (kathleen.petrie@seattle.gov)

2015 International Energy Conservation Code

Add new text as follows:

APPENDIX CA Renewable Energy

CA101.1 On-site renewable energy systems Each new commercial building or addition larger than 5,000 square feet of gross conditioned floor area shall include a renewable energy generation system consisting of not less than 70 Watts rated peak photovoltaic energy production, or 240 kBtu of annual solar water heating energy production, per 1,000 square feet of conditioned floor area or fraction thereof. For buildings over 5 stories in height, the conditioned area for this calculation shall be based on the conditioned area of the largest 5 above-grade stories in the building. Where the on-site renewable energy option in Section C406 is selected, the energy required this section shall be in addition to that required by Section C406.

Exception: Approved alternative approaches that achieve the on-site renewable energy requirements.

Reason: This proposal provides a new Appendix for the commercial portion of the International Energy Conservation Code which would be available to jurisdictions wanting to adopt renewable energy requirements for new commercial buildings and additions greater than 5,000 square feet. This proposal continues to move renewable energy into mainstream practice for the design and construction industries which helps to decrease the demand on utilities nationally. The benefit to the owner or tenant is lower utility bills. This language does not increase enforcement efforts because the review and inspection process for mechanical and renewable energy systems is currently standard practice.

The Washington State Building Code Council recently voted in favor of including this appendix in the 2015 Washington State Energy Code (to be confirmed by the Washington State Legislature). This requirement has been in the main body of the Seattle Energy Code since 2012.

Language has been added to ensure the requirements of the appendix do not conflict with Section C406. If the on-site renewable energy option in Section C406 is selected, both requirements are cumulative.

Cost Impact: Will increase the cost of construction
A report completed by Bloomberg (February 25, 2015: http://www.bloomberg.com/news/articles/2015-02-25/in-the-time-it-takes-to-read-this-story-another-solar-project-will-go-up), supports that the average installed cost is $3.50 per watt and expected to fall below $3.00 per watt during the 2015 code cycle (2016 - 2021). If you multiply $3.50 per watt times 70 watts rated peak photovoltaic energy production per 1,000 square feet of conditioned space, then the conservative resulting installation cost would be $245 per 1,000 square feet based on this proposal.
Rebates and subsidies will also reduce up-front costs. In 2016, the federal rebate for photovoltaic systems drops to 10% which will lower the effective cost from $245 to $220 per 1000 SF of floor area. There may also be state and local subsidies helping to offset costs.

In addition, there are also rates of return based on energy generation which will vary nationally. In Seattle, 1 watt of PV produces about 1 kWh of electricity per year, which provides an average return of 7 cents per year: $.07 X 70 Watts = $4.90 per 1000 SF.

CE293-16 : APPENDIX C (NEW)-PETRIE11953

CE294-16

IECC: (New), XA101 (New), XA101.1 (New), XA102 (New), XA103 (New), XA103.1 (New), XA103.2 (New), XA103.3 (New), XA103.4 (New), XA103.5 (New), XA103.6 (New), XA103.7 (New), XA103.8 (New).

Proponent : Joseph Cain, SunEdison, representing Solar Energy Industries Association (SEIA) (joecainpe@aol.com)

2015 International Energy Conservation Code

Add new text as follows:

APPENDIX (X) Solar Ready Zone - Commercial.

(The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.)

SECTION XA101 Scope.

XA101.1 General. These provisions shall be applicable for new construction where solar ready provisions are required.

Add new definition as follows:

SECTION XA102 GENERAL DEFINITIONS

SOLAR READY ZONE. A section or sections of the roof or building overhang designated and reserved for the future installation of a solar photovoltaic or solar thermal system.

Add new text as follows:

SECTION XA103 SOLAR READY ZONE

XA103.1 General. A solar ready zone shall be located on the roof of buildings that are five stories or less in height above grade plane, and are oriented between 110 degrees and 270 degrees of true north or have low-slope roofs. Solar ready zones shall comply with Sections XA103.2 through XA103.8.

Exceptions:

1. **A building with a permanently installed on-site renewable energy system.**
2. **A building with a solar ready zone that is shaded for more than 70 percent of daylight hours annually.**
3. **A building where the licensed design professional certifies that the incident solar radiation available to the building is not suitable for a solar ready zone**
4. **A building where the licensed design professional certifies that the solar zone area required by Section XA103.3 cannot be met because of extensive rooftop equipment, skylights, vegetative roof areas or other obstructions.**

XA103.2 Construction document requirements for solar ready zone. Construction documents shall indicate the *solar ready zone*.

XA103.3 Solar ready zone area. The total *solar ready zone* area shall be not less than 40% of the roof area calculated as the horizontally projected gross roof area less the area covered by skylights, occupied roof decks, vegetative roof areas and mandatory access or set back areas as required by the *International Fire Code*. The *solar ready zone* shall be a single area or smaller separated sub-zone areas. Each sub-zone shall be

not less than 5 feet in width in the narrowest dimension.

XA103.4 Obstructions. *Solar ready zones* shall be free from obstructions, including pipes, vents, ducts, HVAC equipment, skylights, and roof mounted equipment.

XA103.5 Roof loads and documentation. A collateral dead load of not less than 5 pounds per square foot (5 psf) shall be included in the gravity and lateral design calculations for the solar ready zone. The structural design loads for roof dead load and roof live load shall be indicated on the construction documents.

XA103.6 Interconnection pathway. Construction documents shall indicate pathways for routing of conduit or piping from the *solar ready zone* to the electrical service panel or service hot water system.

XA103.7 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 shall be labeled "For Future Solar Electric". The reserved space shall be positioned at the end of the panel that is opposite from the panel supply conductor connection.

XA103.8 Construction documentation certificate. A permanent certificate, indicating the *solar ready zone* and other requirements of this section, shall be posted near the electrical distribution panel, water heater or other conspicuous location by the builder or registered design professional.

Reason: This proposal adds a new non-mandatory Appendix to the IECC – Commercial Code.
Many building departments have been mandated by local regulations to accelerate permits and inspections for solar installations. Having important information and documentation available to the building department, solar contractor and building owner will assist in supporting the accelerated working environment many municipalities have mandated. It also provides uniform guidance for those jurisdictions where solar ready ordinances are under consideration.

This proposal is intended to identify the areas of a commercial building roof, called the solar ready zone, for potential future installation of renewable energy systems. This proposal requires documenting necessary solar ready zone information on the plans, some of which may already be required in permit construction requirements. This proposal also requires the builder to post specific information about the building for use by the building owners(s).

The proposed language follows similar language from the 2015 IRC Appendix U. This proposal does not require the installation of conduit, pre wiring, or pre-plumbing. It does not require any specific physical orientation of the commercial building. It does not require the redesign of plans.

Cost Impact: Will increase the cost of construction
The cost impact of this proposal is minimal, with increased cost due to the design professional's determination of the suitability of a solar ready zone on the building. The requirement for 5 psf collateral dead load in the solar ready zone could require a modest increase in strength of some bending members and some lateral design elements, resulting in some proportionately small incremental cost.

CE294-16 : APPENDIX X (NEW)-CAIN13525

CE295-16

IECC: C405.1.

Proponent : Marilyn Williams, National Electrical Manufacturers Association, representing National Electrical Manufacturers Association (mar_williams@nema.org)

2015 International Energy Conservation Code

Revise as follows:

C405.1 General (Mandatory). This section covers lighting system controls, the connection of ballasts, the maximum lighting power for interior ~~and exterior~~ applications~~ and~~ , electrical energy consumption, controls for electrical receptacles, and the minimum acceptable lighting equipment for exterior applications.

> **Exception:** Dwelling units within commercial buildings shall not be required to comply with Sections C405.2 through C405.5, provided that they comply with Section R404.1.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.2.15 or C403.2.16.

Reason: Harmonization with the requirements of ASHRAE 90.1, CA Title 24.

Cost Impact: Will not increase the cost of construction
This section is simply the charging text that introduces subsequent text and mandates nothing.

CE295-16 : C405.1-WILLIAMS13642

CE296-16

IECC: C405.7 (New).

Proponent : Marilyn Williams, National Electrical Manufacturers Association, representing National Electrical Manfuacturers Association (mar_williams@nema.org)

2015 International Energy Conservation Code

Add new text as follows:

C405.7 Controlled receptacles Automatic controls shall be provided for not less than 50% of all 125 volt 15- and 20-Ampere receptacles in private offices, conference rooms, printing and copying rooms, break rooms, classrooms and individual workstations in Group B and E occupancies and for not less than 25% of branch circuits installed to supply electrical power to modular furniture in Group B and E occupancies. Such controlled receptacles shall be uniformly distributed throughout each space. The automatic controls shall be one of the following:

1. An automatic control that is capable of operating on a scheduled basis using a time-of-day operated control device, or system, that will turn off receptacles at specific programmed times and that provides for an independent program schedule for control zones that do not exceed 5,000 ft^2 in area and do not include area on more than one story.

2. An automatic control that is an occupant sensor that is capable of turning off receptacles within 30 minutes of all occupants leaving a space.

3. An automatic control that utilizes an automated signal from another control or alarm system that is capable of turning off receptacles within 30 minutes after determining that the area served is unoccupied.

Exception: Automatic receptacle controls need not be provided in specific spaces where approved, based on the need for continuous power to receptacles for safety or security reasons associated with the space.

Reason: Harmonization with the requirements of ASHRAR 90.1, CA Title 24.

Cost Impact: Will increase the cost of construction

The requirement will increase cost due to the automatic control components that will be added to the controlled receptacle. However, this added cost will be recovered in the reduction of energy cost from automatically switching off electrical loads when they are not needed.

CE296-16 : C405.7 (NEW)-WILLIAMS13643

CE297-16

IECC: C302, C302.1.

Proponent : Marilyn Williams, representing National Electrical Manufacturers Association (mar_williams@nema.org)

2015 International Energy Conservation Code

SECTION C302 DESIGN CONDITIONS

C302.1 Interior design conditions. The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling. **<u>Where space heating in a dwelling unit is provided by not less than four independent zones, the interior design temperature used for heating load calculations shall be not less than 65F.</u>**

Reason: The IECC 2015 contains minimum design criteria (R302.1) based on all interior spaces maintaining an identical 72 degrees F. This design requirment fails to incentivize designers to consider zoning as an energy efficency strategy.
Ducted, central hearing, whether it be a deucted heat pump, electic furnace, gas furnace or other, is deisgned to serve large areas, most often an entire house. Non-ducted ERH, on the other hand, generally divides a house up into numerous independently controlled zones. The energy efficiency benefits of zoning are well documented as it allows users to heat only those areas that are occupanied, and to adjust their respective zone temperature individually, resulting in significant savings. On this basis, a reasonable person could conclude that, all other things being held constant, a zoned, non-ducted heating system would consume less energy than a ducted heating system using the same technology (gas, oil, electric resistance, etc.)

In addition, according to the U.S. Department of Energy - http://energy.gov/energysaver/articles/heat-distribution-systems

One way to save energy...is to provide separate zone control for different areas of large homes. Zone control is most effective when large areas of the home are not used often or are used on a different schedule than other parts of the home.

By forcing designers to use the same design conditions throughout a house takes away an incentive for installing multiple zones to achieve better efficiency and comfort, and tends to result in oversized heating systems.

Cost Impact: Will not increase the cost of construction

This proposal will not require the purchase of additional materials or the expenditure of additional labor. Therefore, it will have no cost impact.

CE297-16 : C302.1-
WILLIAMS11610