IECC - Commercial

2016 GROUP B PUBLIC COMMENT AGENDA

OCTOBER 19 - OCTOBER 25, 2016
KANSAS CITY CONVENTION CENTER
KANSAS CITY, MO

ICC
INTERNATIONAL CODE COUNCIL®

First Printing

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CE3-16 Part I
IECC: C202.

Proposed Change as Submitted

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

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.~~

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 Part I :
C202 BARRIER-
WESTON13663

Public Hearing Results

Part I

Committee Action: **Approved as Modified**

Modification:

AIR BARRIER.
~~Materials assembled and~~ One or more materials joined together in a continuous manner to restrict or prevent the passage of air through the building thermal envelope. ~~An air barrier can be a single material or a combination of materials.~~

Committee Reason: Approval is based on the proponent's published reason statements. The modification simplifies and cleans up the definition and adds the criterion for "continuous."

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Theresa Weston, DuPont Protective Solutions, representing DuPont Building Innovations (theresa.a.weston@dupont.com) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

SECTION 202 DEFINITIONS

AIR BARRIER. One or more materials joined together in a continuous manner to restrict or prevent the passage of air through the building thermal envelope and its assemblies..

Commenter's Reason: At the committee hearing a consensus modification was developed by the proponents of CE1, CE2 & CE3 (all proposed changes to the Air Barrier definition) and proposed to both Part I & Part II. Unfortunately, the words "and its assemblies" were inadvertently left out of the modification proposed for part I. This public comment corrects this omission and makes the definition the same as that approved as modified in Part II.

NOTE: PART II DID NOT RECEIVE A PUBLIC COMMENT AND IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY

CE3-16 Part II
R202 (IRC N1101.6)

Proposed Change as Submitted

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

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 Part II :
R202 BARRIER-
WESTON13664

Public Hearing Results

Part II

Committee Action: **Approved as Modified**

Modification:

AIR BARRIER. ~~Materials assembled and~~ One or more materials joined together in a continuous manner to restrict or prevent the passage of air through the building thermal envelope and its assemblies. ~~An air barrier can be a single material or a combination of materials.~~

Committee Reason: The modifcation brings clarity to the definition by eliminating an extraneous sentence.

The as-modfied proposal was approved because the committee agreed with the published reason statement.

Assembly Action: **None**

CE5-16 Part I
IECC: C202 (New).

Proposed Change as Submitted

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

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

CAVITY INSULATION. Insulating material located between framing members.

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 Part I :
C202
INSULATION-
CRANDELL13631

Public Hearing Results

Part I

Committee Action: **Approved as Submitted**

Committee Reason: The term is used in the code and the definition defines the term in the correct context as used in the code.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: CE5 came to the attention of SEHPCAC because of the inconsistency of action between the Commercial and Energy Code Development Committees. A key goal of the SEHPCAC is to minimize inconsistency between the two halves of the IECC where the same topic is being addressed. SEHPCAC also opposed this proposal at the Louisville hearings.

The definition is unneeded. As the Residential committee stated in its disapproval "the common meaning of cavity suffices'. Further the definition is flawed. It focuses on cavities being between framing members. This leaves out cavities such as those found in masonry units.

In this case the SEHPCAC feels the best way to achieve consistency between IECC code halves is to disapprove Part I of CE5.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

CE5-16 Part II
R202 (New) [IRC N1101.6 (New)]

Proposed Change as Submitted

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

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 Part II : R202 (N1106.1)-CAVITY-CRANDELL13632

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: The common meaning of cavity suffices. There is no need to define it.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Approve as Submitted.

Commenter's Reason: A cavity insulation definition is needed to bring clarity to differences in location of insulation products in various types of building envelope assemblies. Thus, it complements the definition of continuous insulation. Action taken on CE5-I was for approval and this PC will help to coordinate the residential and commercial energy codes. The commercial energy committee gave the following reason for approval: "The term is used in the code and the definition defines the term in the correct context as used in the code."

CE5-16 Part II

CE8-16 Part II

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

Proposed Change as Submitted

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

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. However there is no definition of what 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 within the preview of compliance documentation. A more distinct definition of compliance reports will help when further defining who can create such reports.

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

CE8-16 Part II : R202 (N1101.6)-COMPLIANCE-SCHWARZ13934

Public Hearing Results

Part II

Committee Action: **Approved as Submitted**

Committee Reason: Compliance documents are not necessarily technical documents. This revised deifnition allows such latitude.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: CE8 came to the attention of SEHPCAC because of the inconsistency of action between the Commercial and Energy Code Development Committees. A key goal of the SEHPCAC is to minimize inconsistency between the two halves of the IECC where the same topic is being addressed.
The term is only used once in the IECC-C provisions. It is a provision which clearly identifies what the compliance report has to address, therefore a definition seems unneeded. Similarly a compliance report is required in 4 provisions of the IECC-R. In each location, the code specifies what a compliance report contains and why it is being created. A definition does not improve understanding in any of these locations in a manner which will help the code user. The SEHPCAC is also agrees with the Commercial committee that the phrase in the definition 'intent of the code' is subjective and will make consistent application problematic. We can avoid the problem by simply reading what is required for each compliance report as already provided in the code.

In this case the SEHPCAC feels the best way to achieve consistency between IECC code halves is to disapprove Part II of CE8.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Disapprove.

Commenter's Reason: CE8 Part 2 should be disapproved because it adds a new definition that will cause inconsistency and confusion for code compliance and enforcement by defining a compliance report as demonstrating compliance with the "intent of the code" rather than compliance with the code itself. The definition is also unnecessary because the specific requirements for such a report are already spelled out in the code.

Although CE8 Part 2 was recommended for approval by the Residential IECC Code Development Committee, Part 1 was recommended for disapproval by the Commercial IECC Code Development Committee because it determined that the words "intent of the code" are subjective. We agree with the Commercial IECC Code Development Committee that the purpose of a compliance report would be to demonstrate compliance with specific code requirements, not the "intent of the code."

Moreover, we do not see a need for a generic definition of "compliance report" when the details of specific types of compliance reports are clearly spelled out in Sections R405.4.2.1, R405.4.2.2, and R406.6.2. These compliance reports list very specific requirements – not just the "intent of the code." We do not think a building code official should have to guess at the intent of the code, nor should compliance be approved based on "intent" when the requirements for compliance reports are clearly spelled out.

CE8-16 Part II

NOTE: PART I DID NOT RECEIVE A PUBLIC COMMENT AND IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY

CE8-16 Part I

IECC: C202 (New).

Proposed Change as Submitted

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

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.

Reason: Section R405 and section R406 reference compliance report. Section C407.4 require a compliance report. However there is no definition of what 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 within the preview of compliance documentation. A more distinct definition of compliance reports will help when further defining who can create such reports.

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

CE8-16 Part I :
C202 REPORT-SCHWARZ13933

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: The term is used only once in the code where the requirements are already spelled out. The words "intent of the code" are subjective.

Assembly Action: **None**

CE10-16 Part I

IECC: , (New), C202, C303.2.2 (New).

Proposed Change as Submitted

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)

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.

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]

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 will 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.

Analysis: A review of the standard(s) proposed for inclusion in the code, ASTM C1321, 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.

CE10-16 Part I : C202 (NEW)-LOVELL12313

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: Disapproval was based on the action taken on CE25-16. The proponent needs to make some corrections in a public comment submittal.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Amanda Hickman, InterCode Incorporated, representing Reflective Insulation Manufacturers Association International (amanda@intercodeinc.com) requests Approve as Submitted.

Commenter's Reason: This code change proposal was put forth by RIMA to address the following:

- Provide assistance to code officials by identifying the ASTM Practice for the methods of installation for these products which are used in the market place. However, this proposal ***does not require*** the installation of the product.
- Add important definitions to the code that clarify important information related to a product with widespread installation and use.

There were several misleading and incorrect statements by the opponents, at the Committee Action Hearings. Clarifications related to these items include the following:

- These products are installed in the same location as radiant barrier products – typically in a roof system, sprayed on the deck and structural members, facing an open ventilated air space.
- Air movement within the system is anticipated and does not detract from the product's thermal performance.
- ASTM C1371 was mentioned as the IRCC product "Standard". This is incorrect; it is a test method for determining emittance.
- This product has never been considered for inclusion in the Seal and Insulate Program for Energy Star. It provides thermal benefits outside the scope of the product requirements.

CE10-16 Part I

CE10-16 Part II

R202 (New) [IRC N1101.6 (New)], R303.2.2 (New) [IRC N110111.2 (New)]

Proposed Change as Submitted

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)

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: 1ASTM C 1321-15 Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCCS) in Building Construction, C 1321-15, ASTM, 2015.
2Thermal Performance Evaluation of Attic Radiant Barrier Systems Using the Large Scale Climate Simulator (LSCS), ASHRAE Transactions, Shrestha, Som, William Miller, Andre Desjarlais, 2010, Volume 116, Part 2.

Cost Impact: Will not increase the cost of construction
The code change proposal will not increase the cost of construction because the proposal only adds a standard reference.

Analysis: A review of the standard(s) proposed for inclusion in the code, ASTM C1321-15, with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 1, 2016.

CE10-16 Part II : R303.2.2(NEW)-HICKMAN12211

Public Hearing Results

Part II

Committee Action: **Approved as Submitted**

Committee Reason: The proposal was approved based on the published reason statement.

Assembly Motion: **Disapprove**
Online Vote Results: **Successful**
Support: 58.08% (115) Oppose: 41.92% (83)
Assembly Action: **Disapproved**

Individual Consideration Agenda

Proponent : Amanda Hickman, InterCode Incorporated, representing Reflective Insulation Manufacturers Association International (amanda@intercodeinc.com) requests Approve as Submitted.

Commenter's Reason: We support the IECC Residential Committee's action on this proposal for Approve as Submitted. The committee approved the proposal based on the key points outlined in the proposal's "reason statement."

This code change proposal was put forth by RIMA to address the following:

- Provide assistance to code officials by identifying the ASTM Practice for the methods of installation of the product. However, this proposal ***does not require*** the installation of the product.
- Add important definitions to the code that clarify important information related to a product with widespread installation and use.

There were several misleading and incorrect statements by the opponents at the Committee Action Hearings. Clarifications related to these items include the following:

- These products are installed in the same location as radiant barrier products – typically in a roof system, sprayed on the deck and structural members, facing an open ventilated air space.
- Air movement within the system is anticipated and does not detract from the product's thermal performance.

Proponent : Assembly Motion requests Disapprove.

Commenter's Reason: This code change proposal is on the agenda for individual consideration because the proposal received a successful assembly motion. The assembly action for Disapprove was Successful by a vote of 58.08% (115) to 41.92% (83) by eligible members online during the period of May 11 - May 26, 2016.

CE11-16 Part II
R202 (IRC N1101.6), R202

Proposed Change as Submitted

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee; Joseph Hetzel (Jhetzel@thomasamc.com)

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 (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: 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 Part II : R202-COLLINS13671

Public Hearing Results

Part II

Committee Action: **Approved as Submitted**

Committee Reason: There always seems to be an issue about whether the window is vertical fenestration or a skylight. This change makes it clear and makes the definitions consistent with the commercial side of the codes.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Hugo Aguilar, representing American Supply Association (haguilar@asa.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R202 (N1101.6) 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 ~~(~~ that are fixed or operable~~)~~, opaque doors, glazed doors, glazed block and combination opaque/glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of ~~at least~~ not less than 60 degrees (1.05 rad) from horizontal.

Commenter's Reason: The original proposal intended to correlate the skylights and vertical fenestration definitions between Section C202 and Section R202. However, the defintion for "vertical fenestration" in Section R202 does not correlate completely with the definition in Section C202 for "vertical fenestration" as the language "at least" in Section R202 was changed to "not less than." Furthermore, the language "that are" was not added to R202 either. This is required for correlation.

CE11-16 Part II

NOTE: PART I DID NOT RECEIVE A PUBLIC COMMENT AND IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY

CE11-16 Part I

IECC: 0.

Proposed Change as Submitted

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee; Joseph Hetzel (Jhetzel@thomasamc.com)

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 .

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 (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 Part I :
C202 DOOR-
COLLINS13670

Public Hearing Results

Part I

Committee Action: **Approved as Submitted**

Committee Reason: Approval was based on the proponent's published reason statements.

Assembly Action: **None**

CE18-16 Part II

R202 (New) [IRC N1101.6 (New)], R405.4 (New) [IRC N1105.4 (New)], IRC Appendix U102

Proposed Change as Submitted

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

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 provides more flexibility for the designer and builder to choose the most cost-effective solution for a project. It recognizes the contribution of renewable energy as a synergy with the rest of the building energy efficiencies. Just as credit is given for greater efficiency of furnaces, air conditioning systems, and water heating systems, this proposal would give credit to efficient use of available resources -- specifically renewable energy. Each of those appliances contribute to the energy efficiency of the building, but are not part of the building envelope. Each of those appliances have a service life that is expected to be less than the service life of the building envelope, and they are expected to be replaced with similar or better efficiencies in the future. Still, credit is given for improved performance over the baseline minimum efficiencies.

This proposal also establishes consistency with the Energy Rating Index (ERI) approach, where compliance credit for renewable energy is allowed. The contribution of renewable energy to the overall performance model will be self-limiting. For example, owing to net-metering programs, photovoltaic systems are typically sized to provide less power than is needed to meet overall annual electrical demand. In some cases, photovoltaic system size is constrained by the allowable space on a rooftop.

As states and localities move toward Zero Net Energy (ZNE) buildings, rapid deployment of renewable energy systems is integral to meet these goals. It is not possible to attain ZNE buildings without incorporating renewable energy systems. Therefore, renewable energy systems should obtain credit in the performance method to achieve the most cost-effective solutions and to give credit to builders for using renewables as a standard feature.

Cost Impact: Will not increase the cost of construction

This proposal will not increase the cost of construction, as it provides more flexibility to choose the most cost-effective solutions.

CE18-16 Part II :
R202
RENEWABLE-
CAIN13941

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: Hydro energy is missing from the list. The code does need to allow for and drive innovative methods for onsite power generation Language in R405.4 is clumsy as it really doesn't explain how one would "consider" that power in calculations. Is community-based solar farm considered to be on-site renewable energy? The Committee believes so.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Joseph Cain, representing Solar Energy Industries Association (SEIA) (JoeCainPE@gmail.com) requests Approve as Submitted.

Commenter's Reason: The Solar Energy Industries Association recommends approval of CE18-16 Part II as submitted, based on the original reason statement as follows:
This proposal provides more flexibility for the designer and builder to choose the most cost-effective solution for a project. It recognizes the contribution of renewable energy as a synergy with the rest of the building energy efficiencies. Just as credit is given for greater efficiency of furnaces, air conditioning systems, and water heating systems, this proposal would give credit to efficient use of available resources -- specifically renewable energy. Each of those appliances contribute to the energy efficiency of the building, but are not part of the building envelope. Each of those appliances have a service life that is expected to be less than the service life of the building envelope, and they are expected to be replaced with similar or better efficiencies in the future. Still, credit is given for improved performance over the baseline minimum efficiencies. This proposal also establishes consistency with the Energy Rating Index (ERI) approach, where compliance credit for renewable energy is allowed. The contribution of renewable energy to the overall performance model will be self-limiting. For example, owing to net-metering programs, photovoltaic systems are typically sized to provide less power than is needed to meet overall annual electrical demand. In some cases, photovoltaic system size is constrained by the allowable space on a rooftop. As states and localities move toward Zero Net Energy (ZNE) buildings, rapid deployment of renewable energy systems is integral to meet these goals. It is not possible to attain ZNE buildings without incorporating renewable energy systems. Therefore, renewable energy systems should obtain credit in the performance method to achieve the most cost-effective solutions and to give credit to builders for using renewables as a standard feature.

CE18-16 Part II

NOTE: PART I DID NOT RECEIVE A PUBLIC COMMENT AND IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY

CE18-16 Part I

IECC: 0, C202 (New).

Proposed Change as Submitted

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

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.

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 Part I : C202 RENEWABLE-CAIN13940

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: The proposal makes the definition unclear and eliminates some of the known options for renewable energy.

Assembly Action: **None**

CE19-16
IECC: C202, C202 (New).

Proposed Change as Submitted

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 Renewable Energy was created in the 2012 IECC when it was offered as one of the alternative compliance paths in Section C406. At the time, there was no precedent in the ICC codes about how to define renewable energy provisions for code purposes. This definition was split into two parts by the 2015 IgCC. This proposal introduces a definition of Renewable Energy Source that parallels the language of the IgCC,and modifies Onsite Renewable Energy System without having to redefine '*building site'* in the IECC. By enlarging the property scale on which renewable systems can be located, this definition matches the tendency to look at adjacent properties undergoing common development for the provision of onsite renewable energy
However, a much wider range of physical and financial renewable 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 renewable natural gas products. This proposal clarifies that if an on-site renewable energy system is used instead of an energy efficiency measure in Section C406, the renewable fuels must also be derived "onsite", now reconfigured in this definition to match the larger IgCC scale. This clarification will help code officials avoid the problem of enforcing the validity of claims made for renewable products that are shipped or transmitted to the building site - and also avoid the problem of enforcing that those same renewable products are going to be used for the life of the renewable 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, renewble energy systems are generally more expensive than the alternative packages in C406.

CE19-16 : C202
RENEWABLE-
EDELSON12682

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: There was no substantiation and no source for the changes to the definition. The proposal is subjective and the definition should not be changed until the proponents agree on what it should say.

Assembly Motion: **As Modified**
Online Vote Results: **Failed**
Support: 37.44% (79) Oppose: 62.56% (132)
Assembly Action: **None**

Online Floor Modification:

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

Individual Consideration Agenda

Public Comment 1:

Proponent : jim edelson, representing new building institute (jim@newbuildings.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 site* that sources~~*building*~~ *renewable energy*~~, 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 site.* ~~, the *building site*, or a combination of adjoining lots, that are being developed and maintained subject to the provisions of this code.~~

SECTION 202 DEFINITIONS

RENEWABLE ENERGY ~~SOURCE.~~ Energy derived from solar radiation, wind, waves, tides or biomass,~~ biomass~~ or ~~the internal heat of~~ that is extracted from hot fluid or steam heated within the earth.

Commenter's Reason: This comment defines the correct term as it is actually used in Section 406.6., rather than only a partial fragment of that term. In Section 406.6, it is a "renewable energy system", not renewable energy, that needs to be rated to provide sufficient power to meet the listed specification. This Comment is structured to define the correct full term of "renewable energy system", instead of the current partial term.
To increase clarity, the Comment also creates an independent definition of renewable energy. This reduces confusion and parallels the structure of similar defintions in the IgCC and 189.1. This corrected structure properly defines 'renewable energy' separately from the equipment that is the subject of the actual requirement in Section 406. The two resulting cogent definitions in the Comment are:

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

ON-SITE RENEWABLE ENERGY SYSTEM. An energy generation system located on the *building site* that sources *renewable energy* at the *building site.*

Finally, a new phrase correctly modifies the language regarding energy from the "heat of the earth" so it is consistent with the other sources listed in that sentence. Those other sources do not list the primary energy source (ie. the sun), but rather list the energy form tapped directly by the renewable energy system. Likewise, " hot fluid or steam heated within the earth" describes the energy form directly used by the project.

CE19-16

CE21-16 Part I

IECC: C301.1, C301.2, C301.3.

Proposed Change as Submitted

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

2015 International Energy Conservation Code

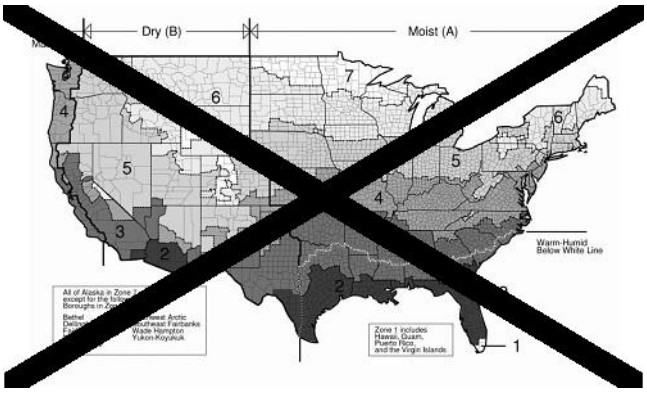
Revise as follows:

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 (2)~~

~~INTERNATIONAL CLIMATE ZONE DEFINITIONS~~

~~For SI: °C = [(°F)-32]/1.8.~~

~~TABLE C301.3 (1)~~

~~INTERNATIONAL CLIMATE ZONE DEFINITIONS~~

~~For SI: °C = [(°F)-32]/1.8.~~

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.
(https://www.ashrae.org/File%20Library/docLib/Bookstore/2013FCh14StnList_NamesIdsOnly.pdf)

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 Part I :
C301.1-
FERGUSON12403

Public Hearing Results

Part I

Committee Action: **Disapproved**

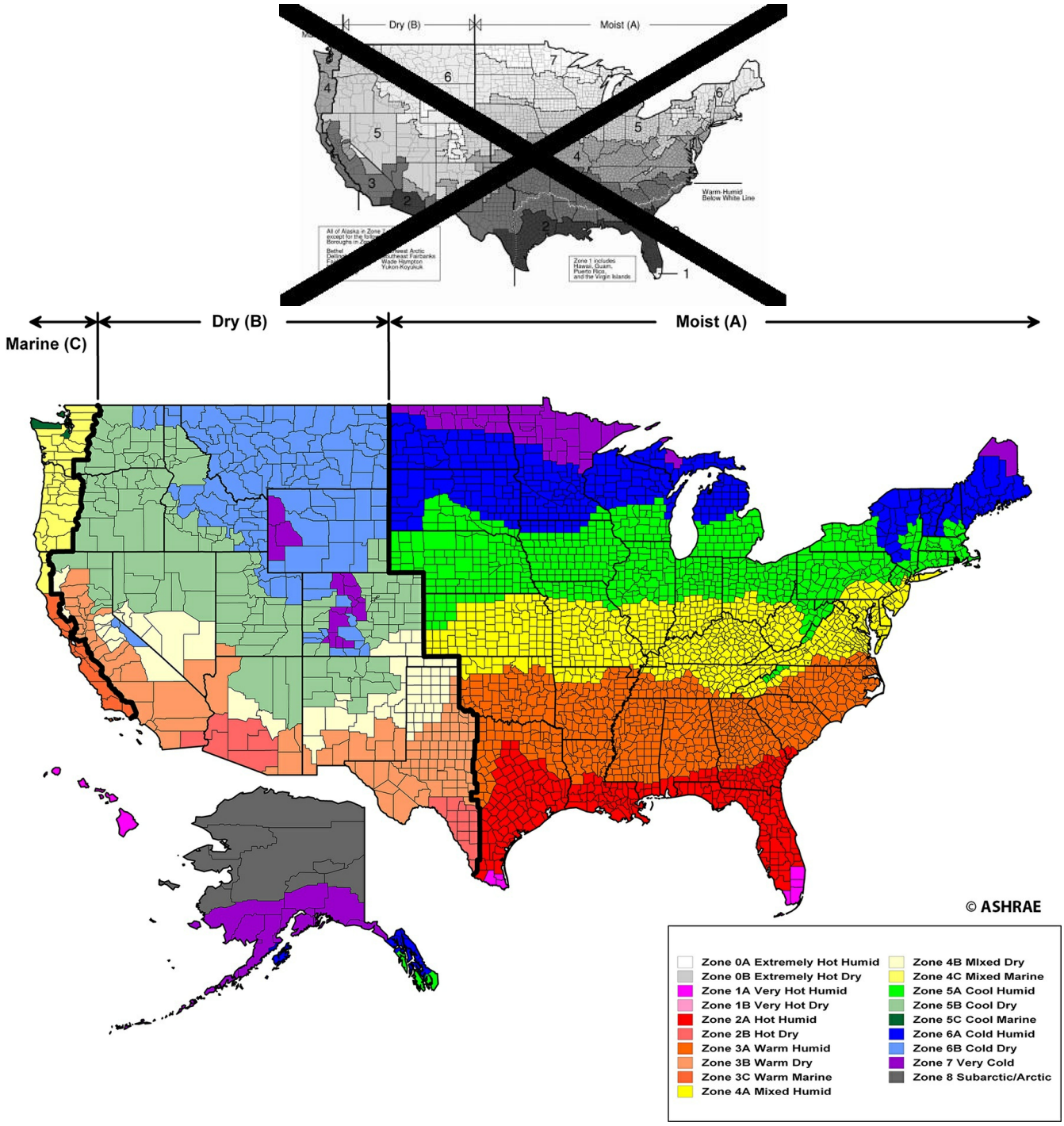
Committee Reason: The map and county tables need to be retained in the code. The IECC should not put such information under the control of another standards developing organization. The proposal should come back in a public comment to put the ASHRAE 169 information in the body of the IECC.

Assembly Motion: **As Modified**
Online Vote Results: **Failed**
Support: 26.95% (69) Oppose: 73.05% (187)
Assembly Action: **None**

Online Floor Modification:

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

FIGURE C301.1
United States Climate Zones



Individual Consideration Agenda

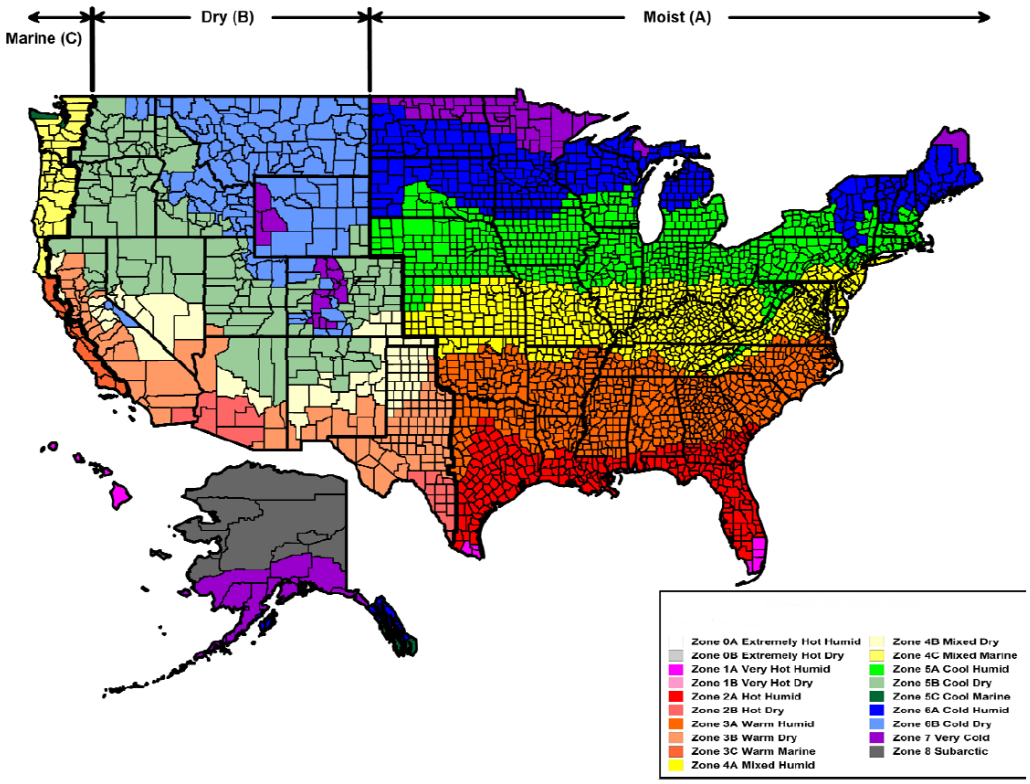
Public Comment 1:

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

FIGURE C301.1
United States Climate Zone Map



Commenter's Reason: This public comment ensures that all of the climate zone data in the IECC is consistent with ASHRAE Standards 90.1 and 169.
If future errata (editorial corrections) are found in ASHRAE Standard 169, this path (referencing to 169) is the only way to make sure the IECC Climate Zones are consistent with other national model energy requirements.

Public Comment 2:

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C301.1 General. *Climate zones* from Figure B-1 or Table B-1 of ASHRAE 169 shall be used in determining the applicable requirements from Chapter 4. Locations not in Table B-1 (outside the United States) shall be assigned a *climate zone* based on Table A-5,Table A-6, or Section A3 including Figure C-2 and Table A-3 of ASHRAE 169.

Table B-1, U.S. States by State and County
Figure B-1, Climate Zones for United States Counties
Table A-5, Canada Stations and Climate Zones
Table A-6, International Stations and Climate Zones
Section A3, Climate Zone Definitions
Table A-3, Thermal Climate Zone Definitions
Figure C-2, World Climate Zones Map

Commenter's Reason: The original propsoal CE21 deleted the existing tables and figures and only proposed to add a reference to ASHRAE 169-2013 for this information.
This public comment intends to modify the original proposal by extracting and reprinting the following Figures, Tables, and Sections from ASHRAE Standard 169-2013:

Table B-1, U.S. States by State and County
Figure B-1, Climate Zones for United States Counties
Table A-5, Canada Stations and Climate Zones
Table A-6, International Stations and Climate Zones
Section A3, Climate Zone Definitions
Table A-3, Thermal Climate Zone Definitions
Figure A-1, Thermal Climate Zones as a Function of Heating and Cooling Degree-Days
Figure C-2, World Climate Zones Map
Section 4, Climatic Design Data and Climate Zones

By extracting this information, we ensure that the climate zone information in the IECC is consistent with ASHRAE Standard 169-2013 and ASHRAE/IES Standard 90.1.

Analysis: This proposal is dependant upon an agreement between ASHRAE and ICC that would allow extraction of copy-righted material. Note that the Figure and Table numbering format is yet to be determined.

Public Comment 3:

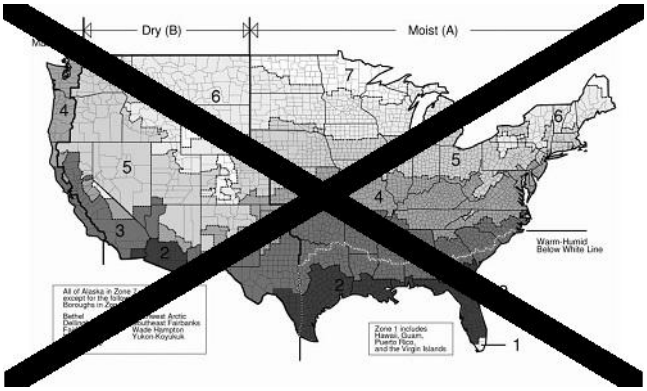
Proponent : Jay Johnson, Thomas Associates, Inc. representing Metal Building Manufacturers Association, representing Metal Building Manufacturers Association; Martha VanGeem, self, representing Masonry Alliance for Codes and Standards requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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

FIGURE C301.1
CLIMATE ZONES



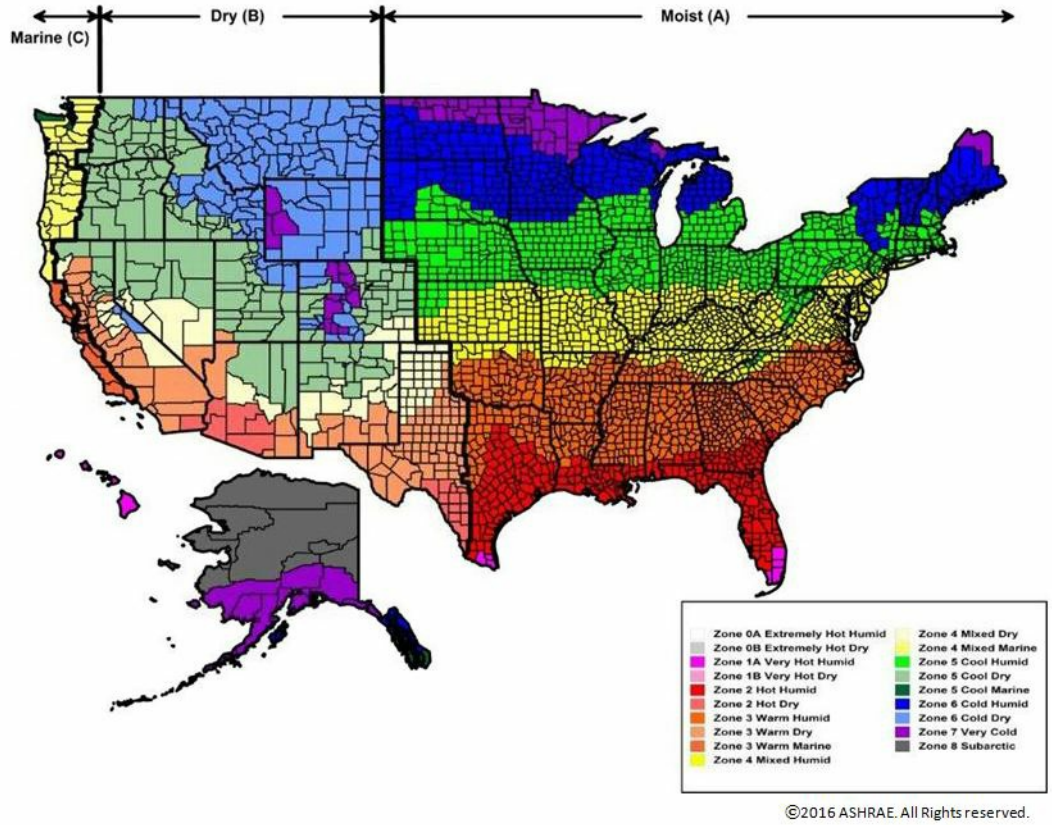


TABLE C301.1

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

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

ALABAMA	3A Lee	6A~~7~~ Kodiak Island	3A Calhoun	3A Monroe
	3A Limestone	7 Lake and Peninsu	4A Carroll	3A Montgomery
3A Autauga*	3A Lowndes*	7 Matanuska-Susitn	3A Chicot	3A Nevada
2A Baldwin*	3A Macon*	8 Nome	3A Clark	4A Newton
3A Barbour*	3A Madison	8 North Slope	3A Clay	3A Ouachita
3A Bibb	3A Marengo*	8 Northwest Arctic	3A Cleburne	3A Perry
3A Blount	3A Marion	5C~~7~~ Prince of Wales	3A Cleveland	3A Phillips
3A Bullock*	3A Marshall	Outer Ketchikan	3A Columbia*	3A Pike
3A Butler*	2A Mobile*	5C~~7~~ Sitka	3A Conway	3A Poinsett
3A Calhoun	3A Monroe*	7 Skagway-Hoonah-Angoon	3A Craighead	3A Polk
3A Chambers	3A Montgomery*		3A Crawford	3A Pope
3A Cherokee	3A Morgan	8 Southeast Fairbanks	3A Crittenden	3A Prairie
3A Chilton	3A Perry*	7 Valdez-Cordova	3A Cross	3A Pulaski
3A Choctaw*	3A Pickens	8 Wade Hampton	3A Dallas	3A Randolph
3A Clarke*	3A Pike*	6A~~7~~ Wrangell-Petersburg	3A Desha	3A Saline
3A Clay	3A Randolph	7 Yakutat	3A Drew	3A Scott
3A Cleburne	3A Russell*	8 Yukon-Koyukuk	3A Faulkner	4A Searcy
2~~3~~A Coffee*	3A Shelby	**ARIZONA**	3A Franklin	3A Sebastian

3A Colbert
3A Conecuh*
3A Coosa
2~~3~~A Covington*
3A Crenshaw*
3A Cullman
2~~3~~A Dale*
3A Dallas*
3A DeKalb
3A Elmore*
2~~3~~A Escambia*
3A Etowah
3A Fayette
3A Franklin
2~~3~~A Geneva*
3A Greene
3A Hale
2~~3~~A Henry*
2~~3~~A Houston*
3A Jackson
3A Jefferson
3A Lamar
3A Lauderdale
3A Lawrence
3A St. Clair
3A Sumter
3A Talladega
3A Tallapoosa
3A Tuscaloosa
3A Walker
3A Washington*
3A Wilcox*
3A Winston

ALASKA

7 Aleutians East
7 Aleutians West
7 Anchorage
7~~8~~ Bethel
7 Bristol Bay
8~~7~~ Denali
7~~8~~ Dillingham
8 Fairbanks North Star
7 Haines
6A~~7~~ Juneau
7 Kenai Peninsula
5C~~7~~ Ketchikan Gateway

ARIZONA

5B Apache
3B Cochise
5B Coconino
4B Gila
3B Graham
3B Greenlee
2B La Paz
2B Maricopa
3B Mohave
5B Navajo
2B Pima
2B Pinal
3B Santa Cruz
4B Yavapai
2B Yuma

ARKANSAS

3A Arkansas
3A Ashley
4A Baxter
4A Benton
4A Boone
3A Bradley
4A Fulton
3A Garland
3A Grant
3A Greene
3A Hempstead*
3A Hot Spring
3A Howard
3A Independence
4A Izard
3A Jackson
3A Jefferson
3A Johnson
3A Lafayette*
3A Lawrence
3A Lee
3A Lincoln
3A Little River*
3A Logan
3A Lonoke
4A Madison
4A Marion
3A Miller*
3A Mississippi
3A Sevier*
3A Sharp
3A St. Francis
4A Stone
3A Union*
3A Van Buren
4A Washington
3A White
3A Woodruff
3A Yell

CALIFORNIA

3C Alameda
6B Alpine
4B Amador
3B Butte
4B Calaveras
3B Colusa
3B Contra Costa
4C Del Norte
4B El Dorado
3B Fresno
3B Glenn
4C Humboldt
2B Imperial
4B Inyo
3B Kern
3B Kings
4B Lake
5B Lassen
3B Los Angeles
3B Madera
3C Marin
4B Mariposa
3C Mendocino
3B Merced
5B Modoc
6B Mono
3C Monterey
3C Napa
5B Nevada
3B Orange
3B Placer
5B Plumas
3B Riverside
3B Sacramento
3C San Benito
3B San Bernardino
3B San Diego
3C San Francisco
3B San Joaquin
3C San Luis Obispo
3C San Mateo
3C Santa Barbara
3C Santa Clara
3C Santa Cruz
3B Shasta
5B Sierra
3B Yuba

COLORADO

5B Adams
6B Alamosa
5B Arapahoe
6B Archuleta
4B Baca
4~~5~~B Bent
5B Boulder
5B Broomfield
6B Chaffee
5B Cheyenne
7 Clear Creek
6B Conejos
6B Costilla
5B Crowley
5~~6~~B Custer
5B Delta
5B Denver
6B Dolores
5B Douglas
6B Eagle
5B Elbert
5B El Paso
5B Fremont
5B Garfield
5B Gilpin
7 Grand
7 Gunnison
7 Hinsdale
5B Huerfano
7 Jackson
5B Jefferson
5B Kiowa
5B Montrose
5B Morgan
4B Otero
6B Ouray
7 Park
5B Phillips
7 Pitkin
4~~5~~B Prowers
5B Pueblo
6B Rio Blanco
7 Rio Grande
7 Routt
6B Saguache
7 San Juan
6B San Miguel
5B Sedgwick
7 Summit
5B Teller
5B Washington
5B Weld
5B Yuma

CONNECTICUT

5A (all)

DELAWARE

4A (all)

DISTRICT OF COLUMBIA

4A (all)

FLORIDA

2A Alachua*
2A Baker*
2A Duval*
2A Escambia*
2A Flagler*
2A Franklin*
2A Gadsden*
2A Gilchrist*
2A Glades*
2A Gulf*
2A Hamilton*
2A Hardee*
2A Hendry*
2A Hernando*
2A Highlands*
2A Hillsborough*
2A Holmes*
2A Indian River*
2A Jackson*
2A Jefferson*
2A Lafayette*
2A Lake*
2A Lee*
2A Leon*
2A Levy*
2A Liberty*
2A Madison*
2A Manatee*
2A Marion*
2A Martin*
1A Miami-Dade*
1A Monroe*
2A Nassau*
2A Okaloosa*
2A Okeechobee*
2A Orange*
2A Osceola*
2A Suwannee*
2A Taylor*
2A Union*
2A Volusia*
2A Wakulla*
2A Walton*
2A Washington*

GEORGIA

2A Appling*
2A Atkinson*
2A Bacon*
2A Baker*
3A Baldwin
3~~4~~A Banks
3A Barrow
3A Bartow
3A Ben Hill*
2A Berrien*
3A Bibb
3A Bleckley*
2A Brantley*
2A Brooks*
2A Bryan*
3A Bulloch*
3A Burke
3A Butts
2~~3~~A Calhoun*
2A Camden*
3A Candler*
3A Carroll
3~~4~~A Catoosa
2A Charlton*
2A Chatham*
3A Chattahoochee*

5B Siskiyou
3B Solano
3C Sonoma
3B Stanislaus
3B Sutter
3B Tehama
4B Trinity
3B Tulare
4B Tuolumne
3C Ventura
3B Yolo

5B Kit Carson
7 Lake
5B La Plata
5B Larimer
4B Las Animas
5B Lincoln
5B Logan
5B Mesa
7 Mineral
6B Moffat
5B Montezuma

2A Bay*
2A Bradford*
2A Brevard*
1A Broward*
2A Calhoun*
2A Charlotte*
2A Citrus*
2A Clay*
2A Collier*
2A Columbia*
2A DeSoto*
2A Dixie*

12A Palm Beach*
2A Pasco*
2A Pinellas*
2A Polk*
2A Putnam*
2A Santa Rosa*
2A Sarasota*
2A Seminole*
2A St. Johns*
2A St. Lucie*
2A Sumter*

34A Chattooga
3A Cherokee
3A Clarke
3A Clay*
3A Clayton
2A Clinch*
3A Cobb
23A Coffee*
2A Colquitt*
3A Columbia
2A Cook*
3A Coweta*

3A Crawford
3A Crisp*
34A Dade
34A Dawson
2A Decatur*
3A DeKalb
3A Dodge*
3A Dooly*
23A Dougherty*
3A Douglas
23A Early*
2A Echols*
2A Effingham*
3A Elbert
3A Emanuel*
2A Evans*
34A Fannin
3A Fayette
34A Floyd
3A Forsyth
34A Franklin
3A Fulton
34A Gilmer
3A Glascock
2A Glynn*
34A Gordon
2A Grady*
3A Greene
3A Gwinnett
34A Habersham
34A Hall
3A Hancock
3A Haralson
3A Harris
3A Hart
3A Heard
3A Henry
3A Houston*
23A 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*
34A Lumpkin
3A Macon*
3A Madison
3A Marion*
3A McDuffie
2A McIntosh*
3A Meriwether
2A Miller*
2A Mitchell*
3A Monroe
3A Montgomery*
3A Morgan
34A Murray
3A Muscogee
3A Newton
3A Oconee
3A Oglethorpe
3A Paulding
3A Peach*
34A Pickens
2A Pierce*
3A Pike
3A Polk
3A Pulaski*
3A Putnam
3A Quitman*
34A Rabun
3A Randolph*
3A Richmond
3A Rockdale
3A Schley*
3A Screven*
2A Seminole*
3A Spalding
34A Stephens
3A Stewart*
3A Sumter*
3A Talbot
3A Taliaferro
2A Tattnall*

3A Taylor*
3A Telfair*
3A Terrell*
2A Thomas*
23A Tift*
2A Toombs*
34A Towns
3A Treutlen*
3A Troup
3A Turner*
3A Twiggs*
34A Union
3A Upson
34A Walker
3A Walton
2A Ware*
3A Warren
3A Washington
2A Wayne*
3A Webster*
3A Wheeler*
34A White
34A Whitfield
3A Wilcox*
3A Wilkes
3A Wilkinson
23A Worth*

HAWAII

1A (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
45A Calhoun
5A Carroll
5A Cass
5A Champaign
4A Christian
45A Clark
4A Clay
4A Clinton
45A Coles
5A Cook

4A Crawford
45A 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
45A Greene
5A Grundy
4A Hamilton
5A Hancock
4A Hardin
5A Henderson
5A Henry
5A Iroquois
4A Jackson
4A Jasper
4A Jefferson
45A 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

5A McLean
5A Boone
5A Miami
5A Appanoose
5A Jasper

5A Menard
5A Mercer
4A Monroe
4A Montgomery
5A Morgan
5A Moultrie
5A Ogle
5A Peoria
4A Perry
5A Piatt
5A Pike
4A Pope
4A Pulaski
5A Putnam
4A Randolph
4A Richland
5A Rock Island
4A Saline
5A Sangamon
5A Schuyler
5A Scott
4A Shelby
5A Stark
4A St. Clair
5A Stephenson
5A Tazewell
4A Union
5A Vermilion
4A Wabash
5A Warren
4A Washington
4A Wayne
4A White
5A Whiteside
5A Will
4A Williamson
5A Winnebago
5A Woodford

INDIANA

5A Adams
5A Allen
~~4~~5A Bartholomew
5A Benton
5A Blackford

4A Brown
5A Carroll
5A Cass
4A Clark
~~4~~5A Clay
5A Clinton
4A Crawford
4A Daviess
4A Dearborn
~~4~~5A Decatur
5A De Kalb
5A Delaware
4A Dubois
5A Elkhart
~~4~~5A Fayette
4A Floyd
5A Fountain
~~4~~5A Franklin
5A Fulton
4A Gibson
5A Grant
4A Greene
5A Hamilton
5A Hancock
4A Harrison
~~4~~5A Hendricks
5A Henry
5A Howard
5A Huntington
4A Jackson
5A Jasper
5A Jay
4A Jefferson
4A Jennings
~~4~~5A Johnson
4A Knox
5A Kosciusko
5A LaGrange
5A Lake
5A LaPorte
4A Lawrence
5A Madison
~~4~~5A Marion
5A Marshall
4A Martin

4A Monroe
5A Montgomery
~~4~~5A Morgan
5A Newton
5A Noble
4A Ohio
4A Orange
~~4~~5A Owen
5A Parke
4A Perry
4A Pike
5A Porter
4A Posey
5A Pulaski
~~4~~5A Putnam
5A Randolph
4A Ripley
~~4~~5A Rush
4A Scott
~~4~~5A Shelby
4A Spencer
5A Starke
5A Steuben
5A St. Joseph
4A Sullivan
4A Switzerland
5A Tippecanoe
5A Tipton
~~4~~5A Union
4A Vanderburgh
5A Vermillion
~~4~~5A Vigo
5A Wabash
5A Warren
4A Warrick
4A Washington
5A Wayne
5A Wells
5A White
5A Whitley

IOWA

5A Adair
5A Adams
~~5~~6A Allamakee

5A Audubon
5A Benton
~~5~~6A Black Hawk
5A Boone
~~5~~6A Bremer
~~5~~6A Buchanan
~~5~~6A Buena Vista
~~5~~6A Butler
~~5~~6A Calhoun
5A Carroll
5A Cass
5A Cedar
6A Cerro Gordo
~~5~~6A Cherokee
~~5~~6A Chickasaw
5A Clarke
6A Clay
~~5~~6A Clayton
5A Clinton
5A Crawford
5A Dallas
5A Davis
5A Decatur
~~5~~6A Delaware
5A Des Moines
6A Dickinson
5A Dubuque
6A Emmet
~~5~~6A Fayette
~~5~~6A Floyd
~~5~~6A Franklin
5A Fremont
5A Greene
~~5~~6A Grundy
5A Guthrie
~~5~~6A Hamilton
6A Hancock
~~5~~6A Hardin
5A Harrison
5A Henry
~~5~~6A Howard
~~5~~6A Humboldt
~~5~~6A Ida
5A Iowa
5A Jackson

5A Jefferson
5A Johnson
5A Jones
5A Keokuk
6A Kossuth
5A Lee
5A Linn
5A Louisa
5A Lucas
6A Lyon
5A Madison
5A Mahaska
5A Marion
5A Marshall
5A Mills
6A Mitchell
5A Monona
5A Monroe
5A Montgomery
5A Muscatine
6A O'Brien
6A Osceola
5A Page
6A Palo Alto
~~5~~6A Plymouth
~~5~~6A Pocahontas
5A Polk
5A Pottawattamie
5A Poweshiek
5A Ringgold
~~5~~6A Sac
5A Scott
5A Shelby
6A Sioux
5A Story
5A Tama
5A Taylor
5A Union
5A Van Buren
5A Wapello
5A Warren
5A Washington
5A Wayne
~~5~~6A Webster
6A Winnebago

~~5~~6A Winneshiek
5A Woodbury
6A Worth
~~5~~6A Wright

KANSAS

4A Allen
4A Anderson
4A Atchison
4A Barber
4A Barton
4A Bourbon
4A Brown
4A Butler

4A Haskell
4A Hodgeman
4A Jackson
4A Jefferson
5A Jewell
4A Johnson
4A Kearny
4A Kingman
4A Kiowa
4A Labette
~~4~~5A Lane
4A Leavenworth
4A Lincoln
4A Linn

4A Sedgwick
4A Seward
4A Shawnee
5A Sheridan
5A Sherman
5A Smith
4A Stafford
4A Stanton
4A Stevens
4A Sumner
5A Thomas
~~4~~5A Trego
4A Wabaunsee
5A Wallace

2A Iberville*
3A Jackson*
2A Jefferson*
2A Jefferson Davis*
2A Lafayette*
2A Lafourche*
3A La Salle*
3A Lincoln*
2A Livingston*
3A Madison*
3A Morehouse
3A Natchitoches*
2A Orleans*
3A Ouachita*

6A Cumberland
6A Franklin
6A Hancock
6A Kennebec
6A Knox
6A Lincoln
6A Oxford
6A Penobscot
6A Piscataquis
6A Sagadahoc
6A Somerset
6A Waldo
6A Washington
6A York

4A Chase
4A Chautauqua
4A Cherokee
5A Cheyenne
4A Clark
4A Clay
~~4~~5A Cloud
4A Coffey
4A Comanche
4A Cowley
4A Crawford
5A Decatur
4A Dickinson
4A Doniphan
4A Douglas
4A Edwards
4A Elk
~~4~~5A Ellis
4A Ellsworth
4A Finney
4A Ford
4A Franklin
4A Geary
5A Gove
~~4~~5A Graham
4A Grant
4A Gray
5A Greeley
4A Greenwood
~~4~~5AHamilton
4A Harper
4A Harvey

5A Logan
4A Lyon
4A Marion
4A Marshall
4A McPherson
4A Meade
4A Miami
~~4~~5A Mitchell
4A Montgomery
4A Morris
4A Morton
4A Nemaha
4A Neosho
~~4~~5A Ness
5A Norton
4A Osage
~~4~~5A Osborne
4A Ottawa
4A Pawnee
5A Phillips
4A Pottawatomie
4A Pratt
5A Rawlins
4A Reno
5A Republic
4A Rice
4A Riley
~~4~~5A Rooks
4A Rush
4A Russell
4A Saline
5A Scott

4A Washington
5A Wichita
4A Wilson
4A Woodson
4A Wyandotte

KENTUCKY

4A (all)

LOUISIANA

2A Acadia*
2A Allen*
2A Ascension*
2A Assumption*
2A Avoyelles*
2A Beauregard*
3A Bienville*
3A Bossier*
3A Caddo*
2A Calcasieu*
3A Caldwell*
2A Cameron*
3A Catahoula*
3A Claiborne*
3A Concordia*
3A De Soto*
2A East Baton Rouge*
3A East Carroll
2A East Feliciana*
2A Evangeline*
3A Franklin*
3A Grant*
2A Iberia*

2A Plaquemines*
2A Pointe Coupee*
2A Rapides*
3A Red River*
3A Richland*
3A Sabine*
2A St. Bernard*
2A St. Charles*
2A St. Helena*
2A St. James*
2A St. John the Baptist*
2A St. Landry*
2A St. Martin*
2A St. Mary*
2A St. Tammany*
2A Tangipahoa*
3A Tensas*
2A Terrebonne*
3A Union*
2A Vermilion*
3A Vernon*
2A Washington*
3A Webster*
2A West Baton Rouge
3A West Carroll
2A West Feliciana*
3A Winn*

MAINE

6A Androscoggin
7 Aroostook

MARYLAND

~~4~~5A Allegany
4A Anne Arundel
4A Baltimore
4A Baltimore (city)
4A Calvert
4A Caroline
4A Carroll
4A Cecil
4A Charles
4A Dorchester
4A Frederick
5A Garrett
4A Harford
4A Howard
4A Kent
4A Montgomery
4A Prince George's
4A Queen Anne's
4A Somerset
4A St. Mary's
4A Talbot
4A Washington
4A Wicomico
4A Worcester

MASSACHSETTS

5A (all)

MICHIGAN

6A Alcona
6A Alger

5A Allegan
6A Alpena
6A Antrim
6A Arenac
~~6A~~7 Baraga
5A Barry
5A Bay
6A Benzie
5A Berrien
5A Branch
5A Calhoun
5A Cass
6A Charlevoix
6A Cheboygan
~~6A~~7 Chippewa
6A Clare

~~6A~~7 Mackinac
5A Macomb
6A Manistee
~~7~~6A Marquette
6A Mason
6A Mecosta
6A Menominee
5A Midland
6A Missaukee
5A Monroe
5A Montcalm
6A Montmorency
5A Muskegon
6A Newaygo
5A Oakland
6A Oceana

6A Carver
7 Cass
6A Chippewa
6A Chisago
~~6A~~7 Clay
7 Clearwater
7 Cook
6A Cottonwood
7 Crow Wing
6A Dakota
6A Dodge
6A Douglas
6A Faribault
~~5~~6A Fillmore
6A Freeborn
6A Goodhue

~~6A~~7 Otter Tail
7 Pennington
7 Pine
6A Pipestone
7 Polk
6A Pope
6A Ramsey
7 Red Lake
6A Redwood
6A Renville
6A Rice
6A Rock
7 Roseau
6A Scott
6A Sherburne
6A Sibley

3A Clarke
3A Clay
3A Coahoma
3A Copiah*
3A Covington*
3A DeSoto
3A Forrest*
3A Franklin*
~~2~~3A George*
3A Greene*
3A Grenada
2A Hancock*
2A Harrison*
3A Hinds*
3A Holmes
3A Humphreys

5A Clinton
6A Crawford
6A Delta
6A Dickinson
5A Eaton
6A Emmet
5A Genesee
6A Gladwin
6A~~7~~ Gogebic
6A Grand Traverse
5A Gratiot
5A Hillsdale
6A~~7~~ Houghton
5~~6~~A Huron
5A Ingham
5A Ionia
6A Iosco
6A~~7~~ Iron
6A Isabella
5A Jackson
5A Kalamazoo
6A Kalkaska
5A Kent
7 Keweenaw
6A Lake
5A Lapeer
6A Leelanau
5A Lenawee
5A Livingston
6A~~7~~ Luce
6A Ogemaw
6A~~7~~ Ontonagon
6A Osceola
6A Oscoda
6A Otsego
5A Ottawa
6A Presque Isle
6A Roscommon
5A Saginaw
5A~~6A~~ Sanilac
6A~~7~~ Schoolcraft
5A Shiawassee
5A St. Clair
5A St. Joseph
5A Tuscola
5A Van Buren
5A Washtenaw
5A Wayne
6A Wexford

MINNESOTA

7 Aitkin
6A Anoka
6A~~7~~ Becker
7 Beltrami
6A Benton
6A Big Stone
6A Blue Earth
6A Brown
7 Carlton
6A~~7~~ Grant
6A Hennepin
~~5~~6A Houston
7 Hubbard
6A Isanti
7 Itasca
6A Jackson
6A~~7~~ Kanabec
6A Kandiyohi
7 Kittson
7 Koochiching
6A Lac qui Parle
7 Lake
7 Lake of the Woods
6A Le Sueur
6A Lincoln
6A Lyon
7 Mahnomen
7 Marshall
6A Martin
6A McLeod
6A Meeker
6A~~7~~ Mille Lacs
6A Morrison
6A Mower
6A Murray
6A Nicollet
6A Nobles
7 Norman
6A Olmsted
6A Stearns
6A Steele
6A Stevens
7 St. Louis
6A Swift
6A Todd
6A Traverse
6A Wabasha
7 Wadena
6A Waseca
6A Washington
6A Watonwan
6A~~7~~ Wilkin
5~~6~~A Winona
6A Wright
6A Yellow Medicine

MISSISSIPPI

3A Adams*
3A Alcorn
3A Amite*
3A Attala
3A Benton
3A Bolivar
3A Calhoun
3A Carroll
3A Chickasaw
3A Choctaw
3A Claiborne*
3A Issaquena
3A Itawamba
2A Jackson*
3A Jasper
3A Jefferson*
3A Jefferson Davis*
3A Jones*
3A Kemper
3A Lafayette
3A Lamar*
3A Lauderdale
3A Lawrence*
3A Leake
3A Lee
3A Leflore
3A Lincoln*
3A Lowndes
3A Madison
3A Marion*
3A Marshall
3A Monroe
3A Montgomery
3A Neshoba
3A Newton
3A Noxubee
3A Oktibbeha
3A Panola
2A Pearl River*
3A Perry*
3A Pike*
3A Pontotoc
3A Prentiss
3A Quitman
3A Rankin*
3A Scott
3A Sharkey
3A Simpson*
3A Smith*
2A Stone*
3A Sunflower
3A Tallahatchie
3A Tate
3A Tippah
3A Tishomingo
3A Tunica
3A Union
3A Walthall*
3A Warren*
3A Washington
3A Wayne*
3A Webster
3A Wilkinson*
3A Winston
3A Yalobusha
3A Yazoo

MISSOURI

5A Adair
5A Andrew
5A Atchison
4A Audrain
4A Barry
4A Barton
4A Bates
4A Benton
4A Bollinger
4A Boone
4~~5~~A Chariton
4A Christian
5A Clark
4A Clay
4~~5~~A Clinton
4A Cole
4A Cooper
4A Crawford
4A Dade
4A Dallas
5A Daviess
5A DeKalb
4A Dent
4A Douglas
3~~4~~A Dunklin
4A Franklin
4A Gasconade
5A Gentry
4A Greene
5A Grundy
5A Harrison
4A Henry
4A Hickory
5A Holt
4A Howard
4A Howell
4A Iron
4A Jackson
4A Jasper
4A Jefferson
4A Johnson
5A Knox
4A Laclede
4A Lafayette
4A Lawrence
5A Lewis
4A Lincoln
4A Mississippi
4A Moniteau
4A Monroe
4A Montgomery
4A Morgan
4A New Madrid
4A Newton
5A Nodaway
4A Oregon
4A Osage
4A Ozark
3~~4~~A Pemiscot
4A Perry
4A Pettis
4A Phelps
5A Pike
4A Platte
4A Polk
4A Pulaski
5A Putnam
5A Ralls
4A Randolph
4A Ray
4A Reynolds
4A Ripley
4A Saline
5A Schuyler
5A Scotland
4A Scott
4A Shannon
5A Shelby
4A St. Charles
4A St. Clair
4A St. Francois
4A St. Louis
4A St. Louis (city)
4A Ste. Genevieve
4A Webster
5A Worth
4A Wright

MONTANA

6B (all)

NEBRASKA

5A (all)

NEVADA

4~~5~~B Carson City (city)
5B Churchill
3B Clark
4~~5~~B Douglas
5B Elko
4~~5~~B Esmeralda
5B Eureka
5B Humboldt
5B Lander
4~~5~~B Lincoln
4~~5~~B Lyon
4~~5~~B Mineral
4~~5~~B Nye
5B Pershing
5B Storey
5B Washoe
5B White Pine

NEW HAMPSHIRE

6A Belknap
6A Carroll
6~~5~~A Cheshire
6A Coos
6A Grafton
5A Hillsborough
4A Cumberland
4A Essex
4A Gloucester
4A Hudson
5A Hunterdon
4~~5~~A Mercer
4A Middlesex
4A Monmouth
5A Morris
4A Ocean
5A Passaic
4A Salem
5A Somerset
5A Sussex
4A Union
5A Warren

NEW MEXICO

4B Bernalillo
4~~5~~B Catron
3B Chaves
5~~4~~B Cibola
5B Colfax
4B Curry
4B DeBaca
3B Dona Ana
3B Eddy
4B Grant
4B Guadalupe
5B Harding
3B Hidalgo
3B Lea
4B Lincoln
5B Los Alamos
3B Luna
5B McKinley
5B Mora

4~~5~~A Buchanan
4A Butler
4~~5~~A Caldwell
4A Callaway
4A Camden
4A Cape Girardeau
4A Carroll
4A Carter
4A Cass
4A Cedar
5A Linn
5A Livingston
5A Macon
4A Madison
4A Maries
5A Marion
4A McDonald
5A Mercer
4A Miller
4A Stoddard
4A Stone
5A Sullivan
4A Taney
4A Texas
4A Vernon
4A Warren
4A Washington
4A Wayne
5~~6~~A Merrimack
5A Rockingham
5A Strafford
6A Sullivan

NEW JERSEY

4A Atlantic
5A Bergen
4A Burlington
4A Camden
4A Cape May
3B Otero
4B Quay
5B Rio Arriba
4B Roosevelt
5B Sandoval
5B San Juan
5B San Miguel
5B Santa Fe
3~~4~~B Sierra
4B Socorro

5B Taos
5B Torrance
4B Union
4B Valencia

NEW YORK

5A Albany
5~~6~~A Allegany
4A Bronx
5~~6~~A Broome
5~~6~~ACattaraugus
5A Cayuga
5A Chautauqua
5A Chemung
6A Chenango
6A Clinton
5A Columbia
5A Cortland
6A Delaware
5A Dutchess
5A Erie
6A Essex
6A Franklin
6A Fulton
5A Genesee
5A Greene
6A Hamilton
6A Herkimer
6A Jefferson
4A Kings
6A Lewis
5A Livingston
6A Madison
5A Monroe
6A Montgomery
4A Nassau
4A New York
5A Niagara
6A Oneida
5A Onondaga
5A Ontario
5A Orange
5A Orleans
5A Oswego
6A Otsego
5A Putnam
4A Queens
5A Rensselaer
4A Richmond
5A Rockland
5A Saratoga
5A Schenectady
5~~6~~A Schoharie
5~~6~~A Schuyler
5A Seneca
5~~6~~A Steuben
6A St. Lawrence
4A Suffolk
6A Sullivan
5A Tioga
5~~6~~A Tompkins
6A Ulster
6A Warren
5A Washington
5A Wayne
5~~4~~A Westchester
5~~6~~A Wyoming
5A Yates

NORTH CAROLINA

3~~4~~A Alamance
3~~4~~A Alexander
5A Alleghany
3A Anson
5A Ashe
5A Avery
3A Beaufort
3~~4~~A Bertie
3A Bladen
3A Brunswick*
4A Buncombe
4A Burke
3A Cabarrus
4A Caldwell
3A Camden
3A Carteret*
3~~4~~A Caswell
3~~4~~A Catawba
4A Chatham
3~~4~~A Cherokee
3A Chowan
3~~4~~A Clay
3~~4~~A Cleveland
3A Columbus*
3A Craven
3A Cumberland
3A Currituck
3A Dare
3A Davidson
3~~4~~A Davie
3A Duplin
3~~4~~A Durham
3A Edgecombe
3~~4~~A Forsyth
3~~4~~A Franklin
3A Gaston
3~~4~~A Gates
4A Graham
3~~4~~A Granville
3A Greene
3~~4~~A Guilford
3~~4~~A Halifax
3~~4~~A Harnett
4A Haywood
4A Henderson
3~~4~~A Hertford
3A Hoke
3A Hyde
3~~4~~A Iredell
4A Jackson
3A Johnston
3A Jones
3~~4~~A Lee
3A Lenoir
3~~4~~A Lincoln
4A Macon
4A Madison
3A Martin
4A McDowell
3A Mecklenburg
4~~5~~A Mitchell
3A Montgomery
3A Moore
3~~4~~A Nash
3A New Hanover*
3~~4~~A Northampton
3A Onslow*
3~~4~~A Orange
3A Pamlico
3A Pasquotank
3A Pender*
3A Perquimans
3~~4~~A Person
3A Pitt
3~~4~~A Polk
3A Randolph
3A Richmond
3A Robeson
3~~4~~A Rockingham
3A Rowan
3~~4~~A Rutherford
3A Sampson
3A Scotland
3A Stanly
4A Stokes
4A Surry
4A Swain
4A Transylvania
3A Tyrrell
3A Union
3~~4~~A Vance
3~~4~~A Wake
3~~4~~A Warren
3A Washington
5A Watauga
3A Wayne
5~~4~~A Wilkes
3A Wilson
4A Yadkin
5A Yancey

NORTH DAKOTA

6A Adams
6A~~7~~ Barnes
7 Benson
6A Billings
7 Bottineau
6A Bowman
7 Burke
6A Burleigh
6A~~7~~ Cass
7 Cavalier
6A Dickey
7 Divide
6A Dunn
6A~~7~~ Eddy
6A Emmons
6A~~7~~ Foster
6A Golden Valley
7 Grand Forks
6A Grant
6A~~7~~ Griggs
6A Hettinger
6A~~7~~ Kidder
6A LaMoure
6A Logan
7 McHenry
6A McIntosh
6A McKenzie
6A~~7~~ McLean
6A Mercer
6A Morton
6A~~7~~ Mountrail
7 Nelson
6A Oliver
7 Pembina
7 Pierce
7 Ramsey
6A Ransom
7 Renville
6A Richland
7 Rolette
6A Sargent
6A~~7~~ Sheridan
6A Sioux
6A Slope
6A Stark
6A~~7~~ Steele
6A~~7~~ Stutsman
7 Towner
6A~~7~~ Traill
7 Walsh
7 Ward
6A~~7~~ Wells
6A~~7~~ Williams

OHIO

4A Adams
5A Allen
5A Ashland
5A Ashtabula
4~~5~~A Athens
5A Auglaize
5A Belmont
4A Brown
4~~5~~A Butler
5A Mahoning
5A Marion
5A Medina
4~~5~~A Meigs
5A Mercer
5A Miami
5A Monroe
3A Bryan
3A Caddo
3A Canadian
3A Carter
3A Cherokee
3A Choctaw
4B Cimarron
3A Okfuskee
3A Oklahoma
3A Okmulgee
4~~3~~A Osage
4~~3~~A Ottawa
3A Pawnee
3A Payne
4C Linn
5B Malheur
4C Marion
5B Morrow
4C Multnomah
4C Polk
5B Sherman

5A Carroll
5A Champaign
5A Clark
4A Clermont
~~5~~4A Clinton
5A Columbiana
5A Coshocton
5A Crawford
5A Cuyahoga
5A Darke
5A Defiance
5A Delaware
5A Erie
5A Fairfield
~~5~~4A Fayette
~~5~~4A Franklin
5A Fulton
4A Gallia
5A Geauga
~~5~~4A Greene
5A Guernsey
4A Hamilton
5A Hancock
5A Hardin
5A Harrison
5A Henry
~~5~~4A Highland
~~5~~4A Hocking
5A Holmes
5A Huron
~~5~~4A Jackson
5A Jefferson
5A Knox
5A Lake
4A Lawrence
5A Licking
5A Logan
5A Lorain
5A Lucas
~~5~~4A Madison

5A Montgomery
5A Morgan
5A Morrow
5A Muskingum
5A Noble
5A Ottawa
5A Paulding
5A Perry
5A Pickaway
4A Pike
5A Portage
5A Preble
5A Putnam
5A Richland
~~5~~4A Ross
5A Sandusky
4A Scioto
5A Seneca
5A Shelby
5A Stark
5A Summit
5A Trumbull
5A Tuscarawas
5A Union
5A Van Wert
~~5~~4A Vinton
~~5~~4A Warren
4A Washington
5A Wayne
5A Williams
5A Wood
5A Wyandot

OKLAHOMA

3A Adair
~~3~~4A Alfalfa
3A Atoka
4B Beaver
3A Beckham
3A Blaine

3A Cleveland
3A Coal
3A Comanche
3A Cotton
~~3~~4A Craig
3A Creek
3A Custer
~~3~~4A Delaware
3A Dewey
~~3~~4A Ellis
~~3~~4A Garfield
3A Garvin
3A Grady
~~3~~4A Grant
3A Greer
3A Harmon
~~3~~4A Harper
3A Haskell
3A Hughes
3A Jackson
3A Jefferson
3A Johnston
~~3~~4A Kay
3A Kingfisher
3A Kiowa
3A Latimer
3A Le Flore
3A Lincoln
3A Logan
3A Love
~~3~~4A Major
3A Marshall
3A Mayes
3A McClain
3A McCurtain
3A McIntosh
3A Murray
3A Muskogee
3A Noble
~~3~~4A Nowata

3A Pittsburg
3A Pontotoc
3A Pottawatomie
3A Pushmataha
3A Roger Mills
3A Rogers
3A Seminole
3A Sequoyah
3A Stephens
3A Tillman
3A Tulsa
3A Wagoner
~~3~~4A Washington
3A Washita
~~3~~4A Woods
~~3~~4A Woodward

OREGON

5B Baker
4C Benton
4C Clackamas
4C Clatsop
4C Columbia
4C Coos
5B Crook
4C Curry
5B Deschutes
4C Douglas
5B Gilliam
5B Grant
5B Harney
5B Hood River
4C Jackson
5B Jefferson
4C Josephine
5B Klamath
5B Lake
4C Lane
4C Lincoln

4C Tillamook
5B Umatilla
5B Union
5B Wallowa
5B Wasco
4C Washington
5B Wheeler
4C Yamhill

PENNSYLVANIA

~~5~~4A Adams
5A Allegheny
5A Armstrong
5A Beaver
5A Bedford
~~5~~4A Berks
5A Blair
5A Bradford
4A Bucks
5A Butler
5A Cambria
~~6~~5A Cameron
5A Carbon
5A Centre
4A Chester
5A Clarion
~~6~~5A Clearfield
5A Clinton
5A Columbia
5A Crawford
~~5~~4A Cumberland
~~5~~4A Dauphin
4A Delaware
~~6~~5A Elk
5A Erie
5A Fayette
5A Forest
~~5~~4A Franklin
5A Fulton
5A Greene

5A Huntingdon
5A Indiana
5A Jefferson
5A Juniata
5A Lackawanna
~~5~~4A Lancaster
5A Lawrence
~~5~~4A Lebanon
5A Lehigh
5A Luzerne
5A Lycoming

3A Bamberg*
3A Barnwell*
~~2~~3A Beaufort*
3A Berkeley*
3A Calhoun
3A Charleston*
3A Cherokee
3A Chester
3A Chesterfield
3A Clarendon
3A Colleton*

5A Bennett
5A Bon Homme
6A Brookings
6A Brown
~~5~~6A Brule
6A Buffalo
6A Butte
6A Campbell
5A Charles Mix
6A Clark
5A Clay

6A Minnehaha
6A Moody
6A Pennington
6A Perkins
6A Potter
6A Roberts
6A Sanborn
6A Shannon
6A Spink
~~5~~6A Stanley
6A Sully

~~3~~4A Gibson
~~3~~4A Giles
4A Grainger
4A Greene
~~3~~4A Grundy
4A Hamblen
~~3~~4A Hamilton
4A Hancock
3A Hardeman
3A Hardin
4A Hawkins

5~~6~~A McKean
5A Mercer
5A Mifflin
5A Monroe
4A Montgomery
5A Montour
5A Northampton
5A Northumberland
4~~5~~A Perry
4A Philadelphia
5A Pike
5~~6~~A Potter
5A Schuylkill
5A Snyder
5A Somerset
5A Sullivan
5~~6~~A Susquehanna
5~~6~~A Tioga
5A Union
5A Venango
5A Warren
5A Washington
5~~6~~A Wayne
5A Westmoreland
5A Wyoming
4A York

RHODE ISLAND

5A (all)

SOUTH CAROLINA

3A Abbeville
3A Aiken
3A Allendale*
3A Anderson
3A Darlington
3A Dillon
3A Dorchester*
3A Edgefield
3A Fairfield
3A Florence
3A Georgetown*
3A Greenville
3A Greenwood
3A Hampton*
3A Horry*
2~~3~~A Jasper*
3A Kershaw
3A Lancaster
3A Laurens
3A Lee
3A Lexington
3A Marion
3A Marlboro
3A McCormick
3A Newberry
3A Oconee
3A Orangeburg
3A Pickens
3A Richland
3A Saluda
3A Spartanburg
3A Sumter
3A Union
3A Williamsburg
3A York

SOUTH DAKOTA

6A Aurora
6A Beadle
6A Codington
6A Corson
6A Custer
6A Davison
6A Day
6A Deuel
6A Dewey
5A Douglas
6A Edmunds
6A Fall River
6A Faulk
6A Grant
5A Gregory
5~~6~~A Haakon
6A Hamlin
6A Hand
6A Hanson
6A Harding
6A Hughes
5A Hutchinson
6A Hyde
5A Jackson
6A Jerauld
5~~6~~A Jones
6A Kingsbury
6A Lake
6A Lawrence
6A Lincoln
5~~6~~A Lyman
6A Marshall
6A McCook
6A McPherson
6A Meade
5A Mellette
6A Miner
5A Todd
5A Tripp
5A Turner
5A Union
6A Walworth
5A Yankton
6A Ziebach

TENNESSEE

4A Anderson
3~~4~~A Bedford
4A Benton
4A Bledsoe
4A Blount
4A Bradley
4A Campbell
4A Cannon
4A Carroll
4A Carter
4A Cheatham
3A Chester
4A Claiborne
4A Clay
4A Cocke
4A Coffee
3A Crockett
4A Cumberland
3~~4~~A Davidson
3~~4~~A Decatur
4A DeKalb
4A Dickson
3A Dyer
3A Fayette
4A Fentress
3~~4~~A Franklin
3A Haywood
3A Henderson
4A Henry
3~~4~~A Hickman
4A Houston
4A Humphreys
4A Jackson
4A Jefferson
4A Johnson
4A Knox
4~~3~~A Lake
3A Lauderdale
3~~4~~A Lawrence
3~~4~~A Lewis
3~~4~~ALincoln
4A Loudon
4A Macon
3A Madison
3~~4~~A Marion
3~~4~~A Marshall
3~~4~~A Maury
4A McMinn
3A McNairy
4A Meigs
4A Monroe
4A Montgomery
3~~4~~A Moore
4A Morgan
4A Obion
4A Overton
3~~4~~A Perry
4A Pickett
4A Polk
4A Putnam
4A Rhea
4A Roane
4A Robertson
3~~4~~A Rutherford
4A Scott
4A Sequatchie
4A Sevier
3A Shelby
4A Smith
4A Stewart
4A Sullivan
4A Sumner
3A Tipton
4A Trousdale
4A Unicoi
3B Brewster
4B Briscoe
2A Brooks*
3A Brown*
2A Burleson*
3A Burnet*
2A Caldwell*
2A Calhoun*
3B Callahan
1~~2~~A Cameron*
3A Camp*
4B Carson
3A Cass*
4B Castro
3B Ector
2B Edwards
2~~3~~A Ellis*
3B El Paso
3A Erath*
2A Falls*
3A Fannin
2A Fayette*
3B Fisher
4B Floyd
3B Foard
2A Fort Bend*
3A Franklin*
2A Freestone*
3B Howard
3B Hudspeth
3A Hunt*
4B Hutchinson
3B Irion
3A Jack
2A Jackson*
2A Jasper*
3B Jeff Davis
2A Jefferson*
2A Jim Hogg*
2A Jim Wells*
2~~3~~A Johnson*
3B Jones
3B McCulloch
2A McLennan*
2A McMullen*
2B Medina
3B Menard
3B Midland
2A Milam*
3A Mills*
3B Mitchell
3A Montague
2A Montgomery*
4B Moore
3A Morris*
3B Motley

4A Union	2A Chambers*	2B Frio	2A Karnes*	3A Nacogdoches*
4A Van Buren	2A Cherokee*	3B Gaines	3A Kaufman*	2~~3~~A Navarro*
4A Warren	3B Childress	2A Galveston*	3A Kendall*	2A Newton*
4A Washington	3A Clay	3B Garza	2A Kenedy*	3B Nolan
3~~4~~A Wayne	4B Cochran	3A Gillespie*	3B Kent	2A Nueces*
4A Weakley	3B Coke	3B Glasscock	3B Kerr	4B Ochiltree
4A White	3B Coleman	2A Goliad*	3B Kimble	4B Oldham
3~~4~~A Williamson	3A Collin*	2A Gonzales*	3B King	2A Orange*
4A Wilson	3B Collingsworth	4B Gray	2B Kinney	3A Palo Pinto*
TEXAS	2A Colorado*	3A Grayson	2A Kleberg*	3A Panola*
	2A Comal*	3A Gregg*	3B Knox	3A Parker*
2A Anderson*	3A Comanche*	2A Grimes*	3A Lamar*	4B Parmer
3B Andrews	3B Concho	2A Guadalupe*	4B Lamb	3B Pecos
2A Angelina*	3A Cooke	4B Hale	3A Lampasas*	2A Polk*
2A Aransas*	2A Coryell*	3B Hall	2B La Salle	4B Potter
3A Archer	3B Cottle	3A Hamilton*	2A Lavaca*	3B Presidio
4B Armstrong	3B Crane	4B Hansford	2A Lee*	3A Rains*
2A Atascosa*	3B Crockett	3B Hardeman	2A Leon*	4B Randall
2A Austin*	3B Crosby	2A Hardin*	2A Liberty*	3B Reagan
4B Bailey	3B Culberson	2A Harris*	2A Limestone*	2B Real
2B Bandera	4B Dallam	3A Harrison*	4B Lipscomb	3A Red River*
2A Bastrop*	2~~3~~A Dallas*	4B Hartley	2A Live Oak*	3B Reeves
3B Baylor	3B Dawson	3B Haskell	3A Llano*	2A Refugio*
2A Bee*	4B Deaf Smith	2A Hays*	3B Loving	4B Roberts
2A Bell*	3A Delta	3B Hemphill	3B Lubbock	2A Robertson*
2A Bexar*	3A Denton*	3A Henderson*	3B Lynn	3A Rockwall*
3A Blanco*	2A DeWitt*	1~~2~~A Hidalgo*	2A Madison*	3B Runnels
3B Borden	3B Dickens	2A Hill*	3A Marion*	3A Rusk*
2A Bosque*	2B Dimmit	4B Hockley	3B Martin	3A Sabine*
3A Bowie*	4B Donley	3A Hood*	3B Mason	3A San Augustine*
2A Brazoria*	2A Duval*	3A Hopkins*	2A Matagorda*	2A San Jacinto*
2A Brazos*	3A Eastland	2A Houston*	2B Maverick	2A San Patricio*

3A San Saba*	3A Young	4C Clark	4A Gilmer	**WISCONSIN**
3B Schleicher	2B Zapata	5B Columbia	5A Grant	
3B Scurry	2B Zavala	4C Cowlitz	4~~5~~A Greenbrier	5~~6~~A Adams
3B Shackelford	**UTAH**	5B Douglas	5A Hampshire	6A~~7~~ Ashland
3A Shelby*		6B Ferry	5A Hancock	6A Barron
4B Sherman	5B Beaver	5B Franklin	5A Hardy	6A~~7~~ Bayfield
3A Smith*	5~~6~~B Box Elder	5B Garfield	5A Harrison	6A Brown
3A Somervell*	5~~6~~B Cache	5B Grant	4A Jackson	6A Buffalo
2A Starr*	5~~6~~B Carbon	4C Grays Harbor	4A Jefferson	6A~~7~~ Burnett
3A Stephens	6B Daggett	5~~4~~C Island	4A Kanawha	5~~6~~A Calumet
3B Sterling	5B Davis	4C Jefferson	4~~5~~A Lewis	6A Chippewa
3B Stonewall	6B Duchesne	5~~4~~C King	4A Lincoln	6A Clark
3B Sutton	5B Emery	4C Kitsap	4A Logan	5~~6~~A Columbia
4B Swisher	5B Garfield	5B Kittitas	5A Marion	5~~6~~A Crawford
2~~3~~A Tarrant*	5B Grand	5B Klickitat	5A Marshall	5~~6~~A Dane

3B Taylor
3B Terrell
3B Terry
3B Throckmorton
3A Titus*
3B Tom Green
2A Travis*
2A Trinity*
2A Tyler*
3A Upshur*
3B Upton
2B Uvalde
2B Val Verde
3A Van Zandt*
2A Victoria*
2A Walker*
2A Waller*
3B Ward
2A Washington*
2B Webb
2A Wharton*
3B Wheeler
3A Wichita
3B Wilbarger
1~~2~~A Willacy*
2A Williamson*
2A Wilson*
3B Winkler
3A Wise
3A Wood*
4B Yoakum

5B Iron
5B Juab
5B Kane
5B Millard
6B Morgan
5B Piute
6B Rich
5B Salt Lake
5B San Juan
5B Sanpete
5B Sevier
6B Summit
5B Tooele
6B Uintah
5B Utah
6B Wasatch
3B Washington
5B Wayne
5B Weber

VERMONT

6A (all)

VIRGINIA

4A (all)

WASHINGTON

5B Adams
5B Asotin
5B Benton
5B Chelan
5~~4~~C Clallam

4C Lewis
5B Lincoln
4C Mason
6B Okanogan
4C Pacific
6B Pend Oreille
4C Pierce
5~~4~~C San Juan
4C Skagit
5B Skamania
4C Snohomish
5B Spokane
6B Stevens
4C Thurston
4C Wahkiakum
5B Walla Walla
4C Whatcom
5B Whitman
5B Yakima

WEST VIRGINIA

5A Barbour
4A Berkeley
4A Boone
4A Braxton
5A Brooke
4A Cabell
4A Calhoun
4A Clay
4~~5~~A Doddridge
4~~5~~A Fayette

4A Mason
4A McDowell
4A Mercer
5A Mineral
4A Mingo
5A Monongalia
4A Monroe
4A Morgan
4~~5~~A Nicholas
5A Ohio
5A Pendleton
4A Pleasants
5A Pocahontas
5A Preston
4A Putnam
4~~5~~A Raleigh
5A Randolph
4A Ritchie
4A Roane
4~~5~~A Summers
5A Taylor
5A Tucker
4A Tyler
4~~5~~A Upshur
4A Wayne
4~~5~~A Webster
5A Wetzel
4A Wirt
4A Wood
4A Wyoming

5~~6~~A Dodge
6A Door
6A~~7~~ Douglas
6A Dunn
6A Eau Claire
6A~~7~~ Florence
5~~6~~A Fond du Lac
6A~~7~~ Forest
5~~6~~A Grant
5~~6~~A Green
5~~6~~A Green Lake
5~~6~~A Iowa
6A~~7~~ Iron
6A Jackson
5~~6~~A Jefferson
5~~6~~A Juneau
5~~6~~A Kenosha
6A Kewaunee
5~~6~~A La Crosse
5~~6~~A Lafayette
6A~~7~~ Langlade
6A~~7~~ Lincoln
6A Manitowoc
6A Marathon
6A Marinette
6A Marquette
6A Menominee
5~~6~~A Milwaukee
5~~6~~A Monroe
6A Oconto
6A~~7~~ Oneida
5~~6~~A Outagamie

5~~6~~AOzaukee
6A Pepin
6A Pierce
6A Polk
6A Portage
6A~~7~~ Price
5~~6~~A Racine
6A Richland
5~~6~~A Rock
6A Rusk
5~~6~~ASauk
6A~~7~~ Sawyer
6A Shawano
6A Sheboygan
6A St. Croix

6A~~7~~ Taylor
6A Trempealeau
5~~6~~A Vernon
6A~~7~~ Vilas
5~~6~~A Walworth
6A~~7~~ Washburn
5~~6~~A Washington
5~~6~~A Waukesha
6A Waupaca
5~~6~~A Waushara
5~~6~~A 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
5~~6~~B 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 (all)*

GUAM

1A (all)*

NORTHERN MARIANA ISLANDS

1A (all)*

PUERTO RICO

1A except~~(all)~~*
2B Barraquitas*
2B Cayey*

VIRGIN ISLANDS

1A (all)*

Commenter's Reason: This modification includes the U.S. map as Figure C301.1 and U.S. county tables as Table C301.1 to be used in determining the climate zone for locations within the U.S. These were requested during testimony and from the committee at the hearings. Additional information is contained in the original reason statement.

Clarifications were made on using ASHRAE 169 for international locations. Simple tables no longer exist for determining climate zone by weather data for a particular location, so the procedure in ASHRAE 169 has been referenced.

The county tables are in a format of "replace proposal as follows". It shows the changes to the Climate Zones in Table C301.1 compared to the 2015 IECC rather than showing the changes relative to the public comment, which deleted Table C301.1. We did this with permission of IECC staff for clarification purposes.

CE21-16 Part I

CE21-16 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)]

Proposed Change as Submitted

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

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.

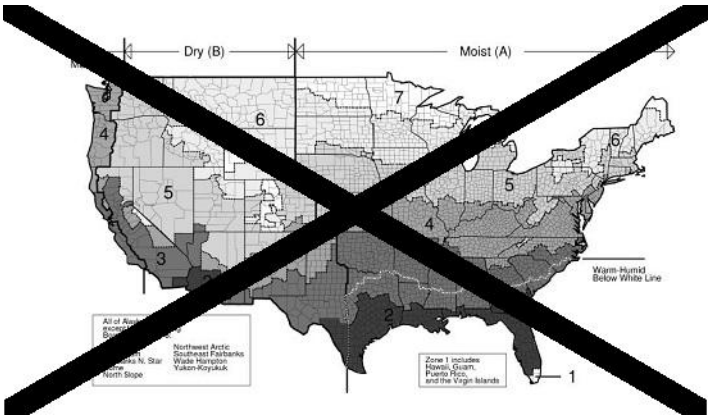
Delete without substitution:

~~**TABLE R301.1 (N1101.7)**~~

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

~~**R301.1**~~

~~**CLIMATE ZONES**~~



~~**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 w ith 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 allow s 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 entries 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, w et-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 w as 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 w as 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 w ill 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 169-2013, with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 1, 2016.

CE21-16 Part II :
R301.1-
FERGUSON12999

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: Without the climate information in the code, no one will be able to see what they will be held to. Coordination with the Department of Energy in the future will be very critical for having control of this information. This is not broken and there is no need to change.

Assembly Action: **None**

Individual Consideration Agenda

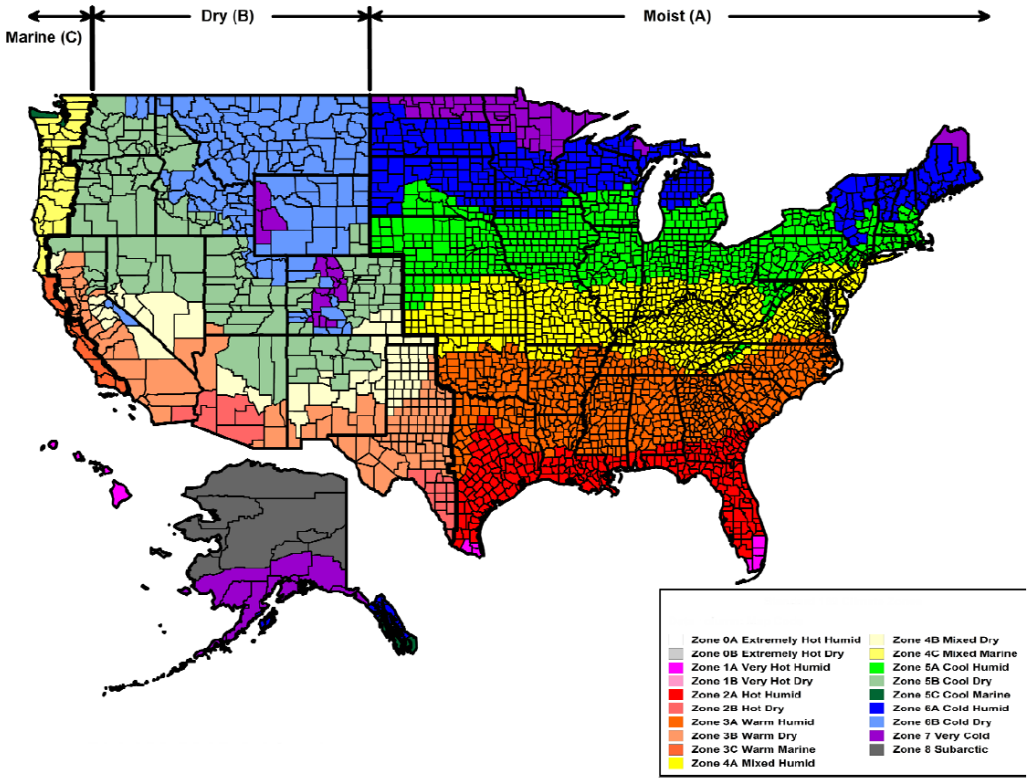
Public Comment 1:

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

FIGURE R301.1
United States Climate Zone Map



Commenter's Reason: This public comment ensures that all of the climate zone data in the IECC is consistent with ASHRAE Standards 90.1 and 169.
If future errata (editorial corrections) are found in ASHRAE Standard 169, this path (referencing to 169) is the only way to make sure the IECC Climate Zones are consistent with other national model energy requirements.

Public Comment 2:

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R301.1 (N1107.1) General. *Climate zones* from Figure B-1 or Table B-1 in ASHRAE 169 shall be used in determining the applicable requirements from Chapter 4. Locations not in Table B-1 shall be assigned a *climate zone* based on Table A-5, Table A-6, or Section A3, including Figure C-2 and Table A-3, in ASHRAE 169.

Table B-1, U.S. States by State and County
Figure B-1, Climate Zones for United States Counties
Table A-5, Canada Stations and Climate Zones
Table A-6, International Stations and Climate Zones

Section A3, Climate Zone Definitions
Table A-3, Thermal Climate Zone Definitions
Figure C-2, World Climate Zones Map

Commenter's Reason: The original propsoal CE21 deleted the existing tables and figures and only proposed to add a reference to ASHRAE 169-2013 for this information.
This public comment intends to modify the original proposal by extracting and reprinting the following Figures, Tables, and Sections from ASHRAE Standard 169-2013:

Table B-1, U.S. States by State and County
Figure B-1, Climate Zones for United States Counties
Table A-5, Canada Stations and Climate Zones
Table A-6, International Stations and Climate Zones
Section A3, Climate Zone Definitions
Table A-3, Thermal Climate Zone Definitions
Figure A-1, Thermal Climate Zones as a Function of Heating and Cooling Degree-Days
Figure C-2, World Climate Zones Map
Section 4, Climatic Design Data and Climate Zones

By extracting this information, we ensure that the climate zone information in the IECC is consistent with ASHRAE Standard 169-2013 and ASHRAE/IES Standard 90.1.

Analysis: This proposal is dependant upon an agreement between ASHRAE and ICC that would allow extraction of copy-righted material. Note that figure and table numbering format is yet to be determined.

Public Comment 3:

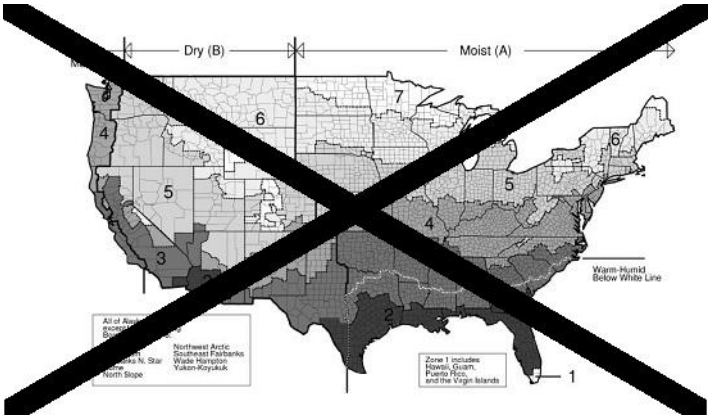
Proponent : Jay Johnson, Thomas Associates, Inc. representing Metal Building Manufacturers Assocation; Martha VanGeem, self, representing Masonry Alliance for Codes and Standards requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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

FIGURE R301.1(N1101.7)
CLIMATE ZONES



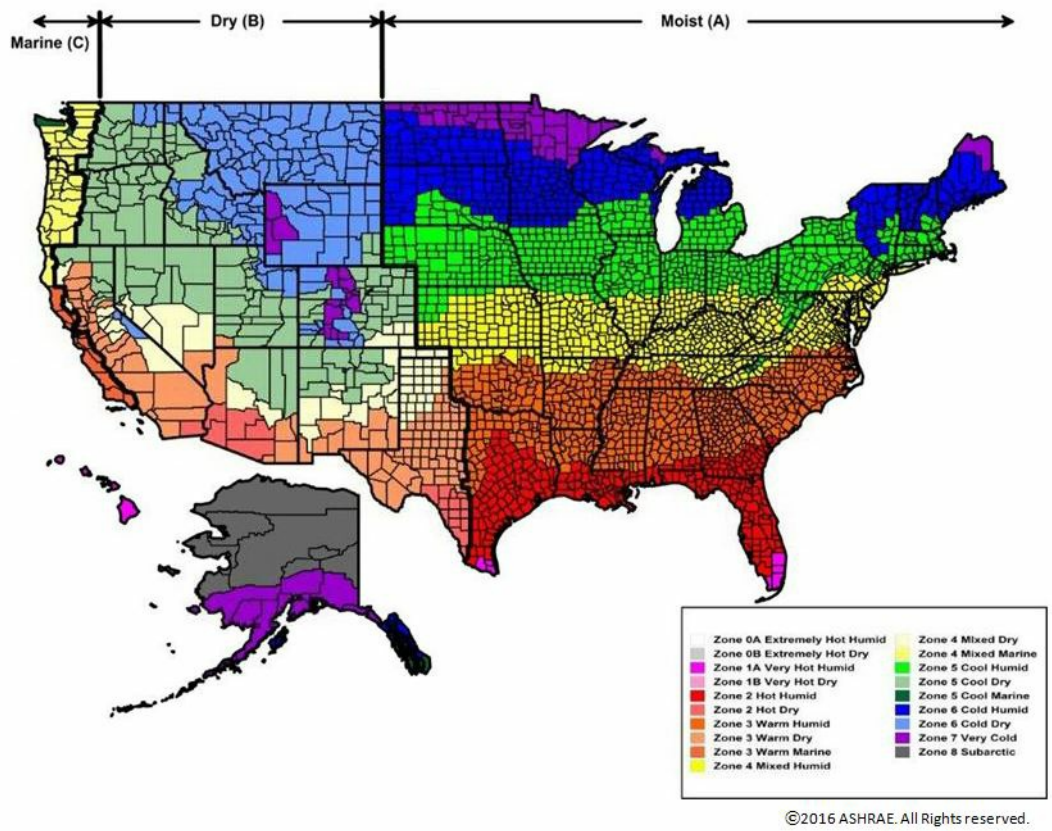


TABLE R301.1 (N1101.7)
CLIMATE ZONES, MOISTURE REGIMES, AND WARM-HUMID DESIGNATIONS BY STATE, COUNTY AND TERRITORY

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

ALABAMA

3A Autauga*
2A Baldwin*
3A Barbour*
3A Bibb
3A Blount
3A Bullock*
3A Butler*
3A Calhoun
3A Chambers
3A Cherokee
3A Chilton
3A Choctaw*
3A Clarke*
3A Clay
3A Cleburne
2~~3~~A Coffee*
3A Colbert
3A Conecuh*
3A Coosa
2~~3~~ACovington*
3A Crenshaw*
3A Cullman
2~~3~~A Dale*
3A Dallas*
3A DeKalb
3A Elmore*
2~~3~~A Escambia*
3A Etowah
3A Lee
3A Limestone
3A Lowndes*
3A Macon*
3A Madison
3A Marengo*
3A Marion
3A Marshall
2A Mobile*
3A Monroe*
3A Montgomery*
3A Morgan
3A Perry*
3A Pickens
3A Pike*
3A Randolph
3A Russell*
3A Shelby
3A St. Clair
3A Sumter
3A Talladega
3A Tallapoosa
3A Tuscaloosa
3A Walker
3A Washington*
3A Wilcox*
3A Winston

ALASKA

7 Aleutians East
6A~~7~~ Kodiak Island
7 Lake and Peninsu
7 Matanuska-Susitn
8 Nome
8 North Slope
8 Northwest Arctic
5C~~7~~ Prince of Wales Outer Ketchikan
5C~~7~~ Sitka
7 Skagway-Hoonah-Angoon
8 Southeast Fairban
7 Valdez-Cordova
8 Wade Hampton
6A~~7~~ Wrangell-Petersb
7 Yakutat
8 Yukon-Koyukuk

ARIZONA

5B Apache
3B Cochise
5B Coconino
4B Gila
3B Graham
3B Greenlee
2B La Paz
2B Maricopa
3B Mohave
5B Navajo
2B Pima
3A Calhoun
4A Carroll
3A Chicot
3A Clark
3A Clay
3A Cleburne
3A Cleveland
3A Columbia*
3A Conway
3A Craighead
3A Crawford
3A Crittenden
3A Cross
3A Dallas
3A Desha
3A Drew
3A Faulkner
3A Franklin
4A Fulton
3A Garland
3A Grant
3A Greene
3A Hempstead*
3A Hot Spring
3A Howard
3A Independence
4A Izard
3A Jackson
3A Jefferson
3A Johnson
3A Monroe
3A Montgomery
3A Nevada
4A Newton
3A Ouachita
3A Perry
3A Phillips
3A Pike
3A Poinsett
3A Polk
3A Pope
3A Prairie
3A Pulaski
3A Randolph
3A Saline
3A Scott
4A Searcy
3A Sebastian
3A Sevier*
3A Sharp
3A St. Francis
4A Stone
3A Union*
3A Van Buren
4A Washington
3A White
3A Woodruff
3A Yell

CALIFORNIA

3A Fayette
3A Franklin
23A Geneva*
3A Greene
3A Hale
23A Henry*
23A Houston*
3A Jackson
3A Jefferson
3A Lamar
3A Lauderdale
3A Lawrence

7 Aleutians West
7 Anchorage
78 Bethel
7 Bristol Bay
87 Denali
78 Dillingham
8 Fairbanks North Sta
7 Haines
6A7 Juneau
7 Kenai Peninsula
5C7 Ketchikan Gateway

2B Pinal
3B Santa Cruz
4B Yavapai
2B Yuma

ARKANSAS

3A Arkansas
3A Ashley
4A Baxter
4A Benton
4A Boone
3A Bradley

3A Lafayette*
3A Lawrence
3A Lee
3A Lincoln
3A Little River*
3A Logan
3A Lonoke
4A Madison
4A Marion
3A Miller*
3A Mississippi

3C Alameda
6B Alpine
4B Amador
3B Butte
4B Calaveras
3B Colusa
3B Contra Costa
4C Del Norte
4B El Dorado
3B Fresno
3B Glenn

4C Humboldt
2B Imperial
4B Inyo
3B Kern
3B Kings
4B Lake
5B Lassen
3B Los Angeles
3B Madera
3C Marin
4B Mariposa
3C Mendocino
3B Merced
5B Modoc
6B Mono
3C Monterey
3C Napa
5B Nevada
3B Orange
3B Placer
5B Plumas
3B Riverside
3B Sacramento
3C San Benito
3B San Bernardino
3B San Diego
3C San Francisco
3B San Joaquin
3C San Luis Obispo
3C San Mateo
3C Santa Barbara
3C Santa Clara
3C Santa Cruz
3B Shasta
5B Sierra
5B Siskiyou
3B Solano
3C Sonoma
3B Stanislaus
3B Sutter
3B Tehama
4B Trinity
3B Tulare
4B Tuolumne
3C Ventura
3B Yolo

3B Yuba

COLORADO

5B Adams
6B Alamosa
5B Arapahoe
6B Archuleta
4B Baca
45B Bent
5B Boulder
5B Broomfield
6B Chaffee
5B Cheyenne
7 Clear Creek
6B Conejos
6B Costilla
5B Crowley
56B Custer
5B Delta
5B Denver
6B Dolores
5B Douglas
6B Eagle
5B Elbert
5B El Paso
5B Fremont
5B Garfield
5B Gilpin
7 Grand
7 Gunnison
7 Hinsdale
5B Huerfano
7 Jackson
5B Jefferson
5B Kiowa
5B Kit Carson
7 Lake
5B La Plata
5B Larimer
4B Las Animas
5B Lincoln
5B Logan
5B Mesa
7 Mineral
6B Moffat
5B Montezuma

5B Montrose
5B Morgan
4B Otero
6B Ouray
7 Park
5B Phillips
7 Pitkin
45B Prowers
5B Pueblo
6B Rio Blanco
7 Rio Grande
7 Routt
6B Saguache
7 San Juan
6B San Miguel
5B Sedgwick
7 Summit
5B Teller
5B Washington
5B Weld
5B Yuma

CONNECTICUT

5A (all)

DELAWARE

4A (all)

DISTRICT OF COLUMBIA

4A (all)

FLORIDA

2A Alachua*
2A Baker*
2A Bay*
2A Bradford*
2A Brevard*
1A Broward*
2A Calhoun*
2A Charlotte*
2A Citrus*
2A Clay*
2A Collier*
2A Columbia*
2A DeSoto*
2A Dixie*
2A Duval*

2A Escambia*
2A Flagler*
2A Franklin*
2A Gadsden*
2A Gilchrist*
2A Glades*
2A Gulf*
2A Hamilton*
2A Hardee*
2A Hendry*
2A Hernando*
2A Highlands*
2A Hillsborough*
2A Holmes*
2A Indian River*
2A Jackson*
2A Jefferson*
2A Lafayette*
2A Lake*
2A Lee*
2A Leon*
2A Levy*
2A Liberty*
2A Madison*
2A Manatee*
2A Marion*
2A Martin*
1A Miami-Dade*
1A Monroe*
2A Nassau*
2A Okaloosa*
2A Okeechobee*
2A Orange*
2A Osceola*
12A Palm Beach*
2A Pasco*
2A Pinellas*
2A Polk*
2A Putnam*
2A Santa Rosa*
2A Sarasota*
2A Seminole*
2A St. Johns*
2A St. Lucie*
2A Sumter*
2A Suwannee*

2A Taylor*
2A Union*
2A Volusia*
2A Wakulla*
2A Walton*
2A Washington*

GEORGIA

2A Appling*
2A Atkinson*
2A Bacon*
2A Baker*
3A Baldwin
34A Banks
3A Barrow
3A Bartow
3A Ben Hill*
2A Berrien*
3A Bibb
3A Bleckley*
2A Brantley*
2A Brooks*
2A Bryan*
3A Bulloch*
3A Burke
3A Butts
23A Calhoun*
2A Camden*
3A Candler*
3A Carroll
34A Catoosa
2A Charlton*
2A Chatham*
3A Chattahoochee*
34A Chattooga
3A Cherokee
3A Clarke
3A Clay*
3A Clayton
2A Clinch*
3A Cobb
23A Coffee*
2A Colquitt*
3A Columbia
2A Cook*
3A Coweta

3A Crawford
3A Crisp*
34A Dade

2A Lanier*
3A Laurens*
3A Lee*

3A Taylor*
3A Telfair*
3A Terrell*

5B Cassia
6B Clark
5B Clearwater

4A Crawford
45A Cumberland
5A DeKalb

34A Dawson
2A Decatur*
3A DeKalb
3A Dodge*
3A Dooly*
23A Dougherty*
3A Douglas
23A Early*
2A Echols*
2A Effingham*
3A Elbert
3A Emanuel*
2A Evans*
34A Fannin
3A Fayette
34A Floyd
3A Forsyth
34A Franklin
3A Fulton
34A Gilmer
3A Glascock
2A Glynn*
34A Gordon
2A Grady*
3A Greene
3A Gwinnett
34A Habersham
34A Hall
3A Hancock
3A Haralson
3A Harris
3A Hart
3A Heard
3A Henry
3A Houston*
23A Irwin*
3A Jackson
3A Jasper
2A Jeff Davis*
3A Jefferson
3A Jenkins*
3A Johnson*
3A Jones
3A Lamar

2A Liberty*
3A Lincoln
2A Long*
2A Lowndes*
34A Lumpkin
3A Macon*
3A Madison
3A Marion*
3A McDuffie
2A McIntosh*
3A Meriwether
2A Miller*
2A Mitchell*
3A Monroe
3A Montgomery*
3A Morgan
34A Murray
3A Muscogee
3A Newton
3A Oconee
3A Oglethorpe
3A Paulding
3A Peach*
34A Pickens
2A Pierce*
3A Pike
3A Polk
3A Pulaski*
3A Putnam
3A Quitman*
34A Rabun
3A Randolph*
3A Richmond
3A Rockdale
3A Schley*
3A Screven*
2A Seminole*
3A Spalding
34A Stephens
3A Stewart*
3A Sumter*
3A Talbot
3A Taliaferro
2A Tattnall*

2A Thomas*
23A Tift*
2A Toombs*
34A Towns
3A Treutlen*
3A Troup
3A Turner*
3A Twiggs*
34A Union
3A Upson
34A Walker
3A Walton
2A Ware*
3A Warren
3A Washington
2A Wayne*
3A Webster*
3A Wheeler*
34A White
34A Whitfield
3A Wilcox*
3A Wilkes
3A Wilkinson
23A Worth*

HAWAII

1A (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 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
45A Calhoun
5A Carroll
5A Cass
4A Christian
45A Clark
5A Clay
4A Clinton
45A Coles
5A Cook

5A De Witt
5A Douglas
5A DuPage
5A Edgar
4A Edwards
4A Effingham
4A Fayette
5A Ford
4A Franklin
5A Fulton
4A Gallatin
45A Greene
5A Grundy
4A Hamilton
5A Hancock
4A Hardin
5A Henderson
5A Henry
5A Iroquois
4A Jackson
4A Jasper
4A Jefferson
45A 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

5A McLean
5A Menard
5A Mercer
4A Monroe
4A Montgomery
5A Morgan
5A Moultrie
5A Ogle
5A Peoria
4A Perry
5A Piatt
5A Pike
4A Pope

5A Boone
4A Brown
5A Carroll
5A Cass
4A Clark
45A Clay
5A Clinton
4A Crawford
4A Daviess
4A Dearborn
45A Decatur
5A De Kalb
5A Delaware

5A Miami
4A Monroe
5A Montgomery
45A Morgan
5A Newton
5A Noble
4A Ohio
4A Orange
45A Owen
5A Parke
4A Perry
4A Pike
5A Porter

5A Appanoose
5A Audubon
5A Benton
56A Black Hawk
5A Boone
5A Bremer
56A Buchanan
56A Buena Vista
56A Butler
56A Calhoun
5A Carroll
5A Cass
5A Cedar

5A Jasper
5A Jefferson
5A Johnson
5A Jones
5A Keokuk
6A Kossuth
5A Lee
5A Linn
5A Louisa
5A Lucas
6A Lyon
5A Madison
5A Mahaska

4A Pulaski
5A Putnam
4A Randolph
4A Richland
5A Rock Island
4A Saline
5A Sangamon
5A Schuyler
5A Scott
4A Shelby
5A Stark
4A St. Clair
5A Stephenson
5A Tazewell
4A Union
5A Vermilion
4A Wabash
5A Warren
4A Washington
4A Wayne
4A White
5A Whiteside
5A Will
4A Williamson
5A Winnebago
5A Woodford

INDIANA

5A Adams
5A Allen
4~~5~~A Bartholomew
5A Benton
5A Blackford

4A Dubois
5A Elkhart
4~~5~~A Fayette
4A Floyd
5A Fountain
4~~5~~A Franklin
5A Fulton
4A Gibson
5A Grant
4A Greene
5A Hamilton
5A Hancock
4A Harrison
4~~5~~A Hendricks
5A Henry
5A Howard
5A Huntington
4A Jackson
5A Jasper
5A Jay
4A Jefferson
4A Jennings
4~~5~~A Johnson
4A Knox
5A Kosciusko
5A LaGrange
5A Lake
5A LaPorte
4A Lawrence
5A Madison
4~~5~~A Marion
5A Marshall
4A Martin

4A Posey
5A Pulaski
4~~5~~A Putnam
5A Randolph
4A Ripley
4~~5~~A Rush
4A Scott
4A Shelby
4A Spencer
5A Starke
5A Steuben
5A St. Joseph
4A Sullivan
4A Switzerland
5A Tippecanoe
5A Tipton
4~~5~~A Union
4A Vanderburgh
5A Vermillion
4~~5~~A Vigo
5A Wabash
5A Warren
4A Warrick
4A Washington
5A Wayne
5A Wells
5A White
5A Whitley

IOWA

5A Adair
5A Adams
5~~6~~A Allamakee

6A Cerro Gordo
5~~6~~A Cherokee
5~~6~~A Chickasaw
5A Clarke
6A Clay
5~~6~~A Clayton
5A Clinton
5A Crawford
5A Dallas
5A Davis
5A Decatur
5~~6~~A Delaware
5A Des Moines
6A Dickinson
5A Dubuque
6A Emmet
5~~6~~A Fayette
5~~6~~A Floyd
5~~6~~A Franklin
5A Fremont
5A Greene
5~~6~~A Grundy
5A Guthrie
5~~6~~A Hamilton
6A Hancock
5~~6~~A Hardin
5A Harrison
5A Henry
5~~6~~A Howard
5~~6~~A Humboldt
5~~6~~A Ida
5A Iowa
5A Jackson

5A Marion
5A Marshall
5A Mills
6A Mitchell
5A Monona
5A Monroe
5A Montgomery
5A Muscatine
6A O'Brien
6A Osceola
5A Page
6A Palo Alto
5~~6~~A Plymouth
5~~6~~A Pocahontas
5A Polk
5A Pottawattamie
5A Poweshiek
5A Ringgold
5~~6~~A Sac
5A Scott
5A Shelby
6A Sioux
5A Story
5A Tama
5A Taylor
5A Union
5A Van Buren
5A Wapello
5A Warren
5A Washington
5A Wayne
5~~6~~A Webster
6A Winnebago

5~~6~~A Winneshiek
5A Woodbury
6A Worth
5~~6~~A Wright

KANSAS

4A Allen
4A Anderson
4A Atchison
4A Barber
4A Barton
4A Bourbon
4A Brown
4A Butler
4A Chase
4A Chautauqua

4A Haskell
4A Hodgeman
4A Jackson
4A Jefferson
5A Jewell
4A Johnson
4A Kearny
4A Kingman
4A Kiowa
4A Labette
4~~5~~A Lane
4A Leavenworth
4A Lincoln
4A Linn
5A Logan
4A Lyon

4A Sedgwick
4A Seward
4A Shawnee
5A Sheridan
5A Sherman
5A Smith
4A Stafford
4A Stanton
4A Stevens
4A Sumner
5A Thomas
4~~5~~A Trego
4A Wabaunsee
5A Wallace
4A Washington
5A Wichita

2A Iberville*
3A Jackson*
2A Jefferson*
2A Jefferson Davis*
2A Lafayette*
2A Lafourche*
3A La Salle*
3A Lincoln*
2A Livingston*
3A Madison*
3A Morehouse
3A Natchitoches*
2A Orleans*
3A Ouachita*
2A Plaquemines*
2A Pointe Coupee*

6A Cumberland
6A Franklin
6A Hancock
6A Kennebec
6A Knox
6A Lincoln
6A Oxford
6A Penobscot
6A Piscataquis
6A Sagadahoc
6A Somerset
6A Waldo
6A Washington
6A York

MARYLAND

4A Cherokee
5A Cheyenne
4A Clark
4A Clay
~~4~~5A Cloud
4A Coffey
4A Comanche
4A Cowley
4A Crawford
5A Decatur
4A Dickinson
4A Doniphan
4A Edwards
4A Elk
~~4~~5A Ellis
4A Ellsworth
4A Finney
4A Ford
4A Franklin
4A Geary
5A Gove
~~4~~5A Graham
4A Grant
4A Gray
5A Greeley
4A Greenwood
~~4~~5A Hamilton
4A Harper
4A Harvey

4A Marion
4A Marshall
4A McPherson
4A Meade
4A Miami
~~4~~5A Mitchell
4A Montgomery
4A Morris
4A Morton
4A Nemaha
4A Neosho
~~4~~5A Ness
5A Norton
4A Osage
~~4~~5A Osborne
4A Ottawa
4A Pawnee
5A Phillips
4A Pottawatomie
4A Pratt
5A Rawlins
4A Reno
5A Republic
4A Rice
4A Riley
~~4~~5A Rooks
4A Rush
4A Russell
4A Saline
5A Scott

4A Wilson
4A Woodson
4A Wyandotte

KENTUCKY

4A (all)

LOUISIANA

2A Acadia*
2A Allen*
2A Ascension*
2A Assumption*
2A Avoyelles*
2A Beauregard*
3A Bienville*
3A Bossier*
3A Caddo*
2A Calcasieu*
3A Caldwell*
2A Cameron*
3A Catahoula*
3A Claiborne*
3A Concordia*
3A De Soto*
2A East Baton Rouge*
3A East Carroll
2A East Feliciana*
2A Evangeline*
3A Franklin*
3A Grant*
2A Iberia*

2A Rapides*
3A Red River*
3A Richland*
3A Sabine*
2A St. Bernard*
2A St. Charles*
2A St. Helena*
2A St. James*
2A St. John the Baptist*
2A St. Landry*
2A St. Martin*
2A St. Mary*
2A St. Tammany*
2A Tangipahoa*
3A Tensas*
2A Terrebonne*
3A Union*
2A Vermilion*
3A Vernon*
2A Washington*
3A Webster*
2A West Baton Rouge
3A West Carroll
2A West Feliciana*
3A Winn*

MAINE

6A Androscoggin
7 Aroostook

~~5~~4A Allegany
4A Anne Arundel
4A Baltimore
4A Baltimore (city)
4A Calvert
4A Caroline
4A Carroll
4A Cecil
4A Charles
4A Dorchester
4A Frederick
5A Garrett
4A Harford
4A Howard
4A Kent
4A Montgomery
4A Prince George's
4A Queen Anne's
4A Somerset
4A St. Mary's
4A Talbot
4A Washington
4A Wicomico
4A Worcester

MASSACHSETTS

5A (all)

MICHIGAN

6A Alcona
6A Alger

5A Allegan
6A Alpena
6A Antrim
6A Arenac
~~6A7~~ Baraga
5A Barry
5A Bay
6A Benzie
5A Berrien
5A Branch
5A Calhoun
5A Cass
6A Charlevoix
6A Cheboygan
~~6A7~~ Chippewa
6A Clare
5A Clinton
6A Crawford
6A Delta
6A Dickinson

~~6A7~~ Mackinac
5A Macomb
6A Manistee
~~7~~6A Marquette
6A Mason
6A Mecosta
6A Menominee
5A Midland
6A Missaukee
5A Monroe
5A Montcalm
6A Montmorency
5A Muskegon
6A Newaygo
5A Oakland
6A Oceana
6A Ogemaw
~~6A7~~ Ontonagon
6A Osceola
6A Oscoda

6A Carver
7 Cass
6A Chippewa
6A Chisago
~~6A7~~ Clay
7 Clearwater
7 Cook
6A Cottonwood
7 Crow Wing
6A Dakota
6A Dodge
6A Douglas
6A Faribault
~~5~~6A Fillmore
6A Freeborn
6A Goodhue
~~6A7~~ Grant
6A Hennepin
~~5~~6A Houston
7 Hubbard

~~6A7~~ Otter Tail
7 Pennington
7 Pine
6A Pipestone
7Polk
6A Pope
6A Ramsey
7 Red Lake
6A Redwood
6A Renville
6A Rice
6A Rock
7 Roseau
6A Scott
6A Sherburne
6A Sibley
6A Stearns
6A Steele
6A Stevens
7 St. Louis

3A Clarke
3A Clay
3A Coahoma
3A Copiah*
3A Covington*
3A DeSoto
3A Forrest*
3A Franklin*
~~2~~3A George*
3A Greene*
3A Grenada
2A Hancock*
2A Harrison*
3A Hinds*
3A Holmes
3A Humphreys
3A Issaquena
3A Itawamba
2A Jackson*
3A Jasper

5A Eaton
6A Emmet
5A Genesee
6A Gladwin
6A~~7~~ Gogebic
6A Grand Traverse
5A Gratiot
5A Hillsdale
6A~~7~~ Houghton
5~~6~~A Huron
5A Ingham
5A Ionia
6A Iosco
6A~~7~~ Iron
6A Isabella
5A Jackson
5A Kalamazoo
6A Kalkaska
5A Kent
7 Keweenaw
6A Lake
5A Lapeer
6A Leelanau
5A Lenawee
5A Livingston
6A~~7~~ Luce
6A Otsego
5A Ottawa
6A Presque Isle
6A Roscommon
5A Saginaw
5~~6~~A Sanilac
6A~~7~~ Schoolcraft
5A Shiawassee
5A St. Clair
5A St. Joseph
5A Tuscola
5A Van Buren
5A Washtenaw
5A Wayne
6A Wexford

MINNESOTA

7 Aitkin
6A Anoka
6A~~7~~ Becker
7 Beltrami
6A Benton
6A Big Stone
6A Blue Earth
6A Brown
7 Carlton
6A Isanti
7 Itasca
6A Jackson
6A~~7~~ Kanabec
6A Kandiyohi
7 Kittson
7 Koochiching
6A Lac qui Parle
7 Lake
7 Lake of the Woods
6A Le Sueur
6A Lincoln
6A Lyon
7 Mahnomen
7 Marshall
6A Martin
6A McLeod
6A Meeker
6A~~7~~ Mille Lacs
6A Morrison
6A Mower
6A Murray
6A Nicollet
6A Nobles
7 Norman
6A Olmsted
6A Swift
6A Todd
6A Traverse
6A Wabasha
7 Wadena
6A Waseca
6A Washington
6A Watonwan
6A~~7~~ Wilkin
5~~6~~A Winona
6A Wright
6A Yellow Medicine

MISSISSIPPI

3A Adams*
3A Alcorn
3A Amite*
3A Attala
3A Benton
3A Bolivar
3A Calhoun
3A Carroll
3A Chickasaw
3A Choctaw
3A Claiborne*
3A Jefferson*
3A Jefferson Davis*
3A Jones*
3A Kemper
3A Lafayette
3A Lamar*
3A Lauderdale
3A Lawrence*
3A Leake
3A Lee
3A Leflore
3A Lincoln*
3A Lowndes
3A Madison
3A Marion*
3A Marshall
3A Monroe
3A Montgomery
3A Neshoba
3A Newton
3A Noxubee
3A Oktibbeha
3A Panola
2A Pearl River*
3A Perry*
3A Pike*
3A Pontotoc
3A Prentiss
3A Quitman
3A Rankin*
3A Scott
3A Sharkey
3A Simpson*
3A Smith*
2A Stone*
3A Sunflower
3A Tallahatchie
3A Tate
3A Tippah
3A Tishomingo
3A Tunica
3A Union
3A Walthall*
3A Warren*
3A Washington
3A Wayne*
3A Webster
3A Wilkinson*
3A Winston
3A Yalobusha
3A Yazoo

MISSOURI

5A Adair
5A Andrew
5A Atchison
4A Audrain
4A Barry
4A Barton
4A Bates
4A Benton
4A Bollinger
4A Boone
4~~5~~A Buchanan
4A Butler
4~~5~~A Caldwell
4A Callaway
4~~5~~A Chariton
4A Christian
5A Clark
4A Clay
4~~5~~A Clinton
4A Cole
4A Cooper
4A Crawford
4A Dade
4A Dallas
5A Daviess
5A DeKalb
4A Dent
4A Douglas
3~~4~~A Dunklin
4A Franklin
4A Gasconade
5A Gentry
4A Greene
5A Grundy
5A Harrison
4A Henry
4A Hickory
5A Holt
4A Howard
4A Howell
4A Iron
4A Jackson
4A Jasper
4A Jefferson
4A Johnson
5A Knox
4A Laclede
4A Lafayette
4A Lawrence
5A Lewis
4A Lincoln
5A Linn
5A Livingston
5A Macon
4A Madison
4A Mississippi
4A Moniteau
4A Monroe
4A Montgomery
4A Morgan
4A New Madrid
4A Newton
5A Nodaway
4A Oregon
4A Osage
4A Ozark
3~~4~~A Pemiscot
4A Perry
4A Pettis
4A Phelps
5A Pike
4A Platte
4A Polk
4A Pulaski
5A Putnam
5A Ralls
4A Randolph
4A Ray
4A Reynolds
4A Ripley
4A Saline
5A Schuyler
5A Scotland
4A Scott
4A Shannon
5A Shelby
4A St. Charles
4A St. Clair
4A St. Francois
4A St. Louis
4A St. Louis (city)
4A Ste. Genevieve
4A Stoddard
4A Stone
5A Sullivan
4A Taney
4A Webster
5A Worth
4A Wright

MONTANA

6B (all)

NEBRASKA

5A (all)

NEVADA

4~~5~~B Carson City (city)
5B Churchill
3B Clark
4~~5~~B Douglas
5B Elko
4~~5~~B Esmeralda
5B Eureka
5B Humboldt
5B Lander
4~~5~~B Lincoln
4~~5~~B Lyon
4~~5~~B Mineral
4~~5~~B Nye
5B Pershing
5B Storey
5B Washoe
5B White Pine

NEW HAMPSHIRE

6A Belknap
6A Carroll
6~~5~~A Cheshire
6A Coos
6A Grafton
5A Hillsborough
5~~6~~A Merrimack
5A Rockingham
5A Strafford
6A Sullivan
4A Cumberland
4A Essex
4A Gloucester
4A Hudson
5A Hunterdon
4~~5~~A Mercer
4A Middlesex
4A Monmouth
5A Morris
4A Ocean
5A Passaic
4A Salem
5A Somerset
5A Sussex
4A Union
5A Warren

NEW MEXICO

4B Bernalillo
4~~5~~B Catron
3B Chaves
5~~4~~B Cibola
5B Colfax
4B Curry
4B DeBaca
3B Dona Ana
3B Eddy
4B Grant
4B Guadalupe
5B Harding
3B Hidalgo
3B Lea
4B Lincoln
5B Los Alamos
3B Luna
5B McKinley
5B Mora
3B Otero
4B Quay
5B Rio Arriba
4B Roosevelt

4A Camden
4A Cape Girardeau
4A Carroll
4A Carter
4A Cass
4A Cedar
4A Maries
5A Marion
4A McDonald
5A Mercer
4A Miller
4A Texas
4A Vernon
4A Warren
4A Washington
4A Wayne

NEW JERSEY

4A Atlantic
5A Bergen
4A Burlington
4A Camden
4A Cape May
5B Sandoval
5B San Juan
5B San Miguel
5B Santa Fe
34B Sierra
4B Socorro

5B Taos
5B Torrance
4B Union
4B Valencia

NEW YORK

5A Albany
56A Allegany
4A Bronx
56A Broome
56A Cattaraugus
5A Cayuga
5A Chautauqua
5A Chemung
6A Chenango
6A Clinton
5A Columbia
5A Cortland
6A Delaware
5A Dutchess
5A Erie
6A Essex
6A Franklin
6A Fulton
5A Genesee
5A Greene
6A Hamilton
6A Herkimer
6A Jefferson
4A Kings
6A Lewis
5A Livingston
6A Madison
5A Monroe
6A Montgomery
4A Nassau
4A New York
5A Niagara
6A Oneida
5A Onondaga
5A Ontario
5A Orange
5A Orleans
5A Oswego
6A Otsego
5A Putnam
4A Queens
5A Rensselaer
4A Richmond
5A Rockland
5A Saratoga
5A Schenectady
56A Schoharie
56A Schuyler
5A Seneca
56A Steuben
6A St. Lawrence
4A Suffolk
6A Sullivan
5A Tioga
56A Tompkins
6A Ulster
6A Warren
5A Washington
5A Wayne
54A Westchester
56A Wyoming
5A Yates

NORTH CAROLINA

34A Alamance
34A Alexander
5A Alleghany
3A Anson
5A Ashe
5A Avery
3A Beaufort
34A Bertie
3A Bladen
3A Brunswick*
4A Buncombe
4A Burke
3A Cabarrus
4A Caldwell
3A Camden
3A Carteret*
34A Caswell
34ACatawba
4A Chatham
34A Cherokee
3A Chowan
34A Clay
34A Cleveland
3A Columbus*
3A Craven
3A Cumberland
3A Currituck
3A Dare
3A Davidson
34A Davie
3A Duplin
34A Durham
3A Edgecombe
34A Forsyth
34A Franklin
3A Gaston
34A Gates
4A Graham
34AGranville
3A Greene
34A Guilford
34A Halifax
34A Harnett
4A Haywood
4A Henderson
34A Hertford
3A Hoke
3A Hyde
34A Iredell
4A Jackson
3A Johnston
3A Jones
34A Lee
3A Lenoir
34A Lincoln
4A Macon
4A Madison
3A Martin
4A McDowell
3A Mecklenburg
45A Mitchell
3A Montgomery
3A Moore
34A Nash
3A New Hanover*
34A Northampton
3A Onslow*
34A Orange
3A Pamlico
3A Pasquotank
3A Pender*
3A Perquimans
34A Person
3A Pitt
34A Polk
3A Randolph
3A Richmond
3A Robeson
34A Rockingham
3A Rowan
34A Rutherford
3A Sampson
3A Scotland
3A Stanly
4A Stokes
4A Surry
4A Swain
4A Transylvania
3A Tyrrell
3A Union
34A Vance
34A Wake
34A Warren
3A Washington
5A Watauga
3A Wayne
54A Wilkes
3A Wilson
4A Yadkin
5A Yancey

NORTH DAKOTA

6A Adams
6A7 Barnes
7Benson
6A Billings
7 Bottineau
6A Bowman
7 Burke
6A Burleigh
6A7 Cass
7 Cavalier
6A Dickey
7 Divide
6A Dunn
6A7 Eddy
6A Emmons
6A7 Foster
6A Golden Valley
7 Grand Forks
6A Grant
6A7 Griggs
6A Hettinger
6A7 Kidder
6A LaMoure
6A Logan
7 McHenry
6A McIntosh
6A McKenzie
6A7 McLean
6A Mercer
6A Morton
6A7 Mountrail
7 Nelson
6A Oliver
7 Pembina
7 Pierce
7 Ramsey
6A Ransom
7 Renville
6A Richland
7Rolette
6A Sargent
6A7 Sheridan
6A Sioux
6A Slope
6A Stark
6A7 Steele
6A7 Stutsman
7 Towner
6A7 Traill
7 Walsh
7 Ward
6A7 Wells
6A7 Williams

OHIO

4A Adams
5A Allen
5A Ashland
5A Ashtabula
45A Athens
5A Auglaize
5A Belmont
4A Brown
45A Butler
5A Carroll
5A Champaign
5A Mahoning
5A Marion
5A Medina
45A Meigs
5A Mercer
5A Miami
5A Monroe
5A Montgomery
5A Morgan
3A Bryan
3A Caddo
3A Canadian
3A Carter
3A Cherokee
3A Choctaw
4B Cimarron
3A Cleveland
3A Coal
3A Okfuskee
3A Oklahoma
3A Okmulgee
43A Osage
43A Ottawa
3A Pawnee
3A Payne
3A Pittsburg
3A Pontotoc
4C Linn
5B Malheur
4C Marion
5B Morrow
4C Multnomah
4C Polk
5B Sherman
4C Tillamook
5B Umatilla

5A Clark
4A Clermont
~~4~~5A Clinton
5A Columbiana
5A Coshocton
5A Crawford
5A Cuyahoga
5A Darke
5A Defiance
5A Delaware
5A Erie
5A Fairfield
~~4~~5A Fayette
~~4~~5A Franklin
5A Fulton
4A Gallia
5A Geauga
~~4~~5A Greene
5A Guernsey
4A Hamilton
5A Hancock
5A Hardin
5A Harrison
5A Henry
~~4~~5A Highland
~~4~~5A Hocking
5A Holmes
5A Huron
~~4~~5A Jackson
5A Jefferson
5A Knox
5A Lake
4A Lawrence
5A Licking
5A Logan
5A Lorain
5A Lucas
~~4~~5A Madison

5A Morrow
5A Muskingum
5A Noble
5A Ottawa
5A Paulding
5A Perry
~~4~~5A Pickaway
4A Pike
5A Portage
5A Preble
5A Putnam
5A Richland
~~4~~5A Ross
5A Sandusky
4A Scioto
5A Seneca
5A Shelby
5A Stark
5A Summit
5A Trumbull
5A Tuscarawas
5A Union
5A Van Wert
~~4~~5A Vinton
~~4~~5A Warren
4A Washington
5A Wayne
5A Williams
5A Wood
5A Wyandot

OKLAHOMA

3A Adair
~~4~~3A Alfalfa
3A Atoka
4B Beaver
3A Beckham
3A Blaine

3A Comanche
3A Cotton
~~4~~3A Craig
3A Creek
3A Custer
~~4~~3A Delaware
3A Dewey
~~4~~3A Ellis
~~4~~3A Garfield
3A Garvin
3A Grady
~~4~~3A Grant
3A Greer
3A Harmon
~~4~~3A Harper
3A Haskell
3A Hughes
3A Jackson
3A Jefferson
3A Johnston
~~4~~3A Kay
3A Kingfisher
3A Kiowa
3A Latimer
3A Le Flore
3A Lincoln
3A Logan
3A Love
~~4~~3A Major
3A Marshall
3A Mayes
3A McClain
3A McCurtain
3A McIntosh
3A Murray
3A Muskogee
3A Noble
~~4~~3A Nowata

3A Pottawatomie
3A Pushmataha
3A Roger Mills
3A Rogers
3A Seminole
3A Sequoyah
3A Stephens
4B Texas
3A Tillman
3A Tulsa
3A Wagoner
~~4~~3A Washington
3A Washita
~~4~~3A Woods
~~4~~3A Woodward

OREGON

5B Baker
4C Benton
4C Clackamas
4C Clatsop
4C Columbia
4C Coos
5B Crook
4C Curry
5B Deschutes
4C Douglas
5B Gilliam
5B Grant
5B Harney
5B Hood River
4C Jackson
5B Jefferson
4C Josephine
5B Klamath
5B Lake
4C Lane
4C Lincoln

5B Union
5B Wallowa
5B Wasco
4C Washington
5B Wheeler
4C Yamhill

PENNSYLVANIA

~~4~~5A Adams
5A Allegheny
5A Armstrong
5A Beaver
5A Bedford
~~4~~5A Berks
5A Blair
5A Bradford
4A Bucks
5A Butler
5A Cambria
~~5~~6A Cameron
5A Carbon
5A Centre
4A Chester
5A Clarion
~~4~~5A Clearfield
5A Clinton
5A Columbia
5A Crawford
~~4~~5A Cumberland
~~4~~5A Dauphin
4A Delaware
~~5~~6A Elk
5A Erie
5A Fayette
5A Forest
~~4~~5A Franklin
5A Fulton
5A Greene

5A Huntingdon
5A Indiana
5A Jefferson
5A Juniata
5A Lackawanna
~~4~~5A Lancaster
5A Lawrence
~~4~~5A Lebanon
5A Lehigh
5A Luzerne
5A Lycoming
~~5~~6A McKean
5A Mercer
5A Mifflin

3A Bamberg*
3A Barnwell*
~~2~~3A Beaufort*
3A Berkeley*
3A Calhoun
3A Charleston*
3A Cherokee
3A Chester
3A Chesterfield
3A Clarendon
3A Colleton*
3A Darlington
3A Dillon
3A Dorchester*

5A Bennett
5A Bon Homme
6A Brookings
6A Brown
~~5~~6A Brule
6A Buffalo
6A Butte
6A Campbell
5A Charles Mix
6A Clark
5A Clay
6A Codington
6A Corson
6A Custer

6A Minnehaha
6A Moody
6A Pennington
6A Perkins
6A Potter
6A Roberts
6A Sanborn
6A Shannon
6A Spink
~~5~~6A Stanley
6A Sully
5A Todd
5A Tripp
6A Turner

~~3~~4A Gibson
~~3~~4A Giles
4A Grainger
4A Greene
~~3~~4A Grundy
4A Hamblen
~~3~~4A Hamilton
4A Hancock
3A Hardeman
3A Hardin
4A Hawkins
3A Haywood
3A Henderson
4A Henry

5A Monroe
4A Montgomery
5A Montour
5A Northampton
5A Northumberland
~~5~~4A Perry
4A Philadelphia
5A Pike
~~6~~5A Potter
5A Schuylkill
5A Snyder
5A Somerset
5A Sullivan
~~6~~5A Susquehanna
~~6~~5A Tioga
5A Union
5A Venango
5A Warren
5A Washington
~~6~~5A Wayne
5A Westmoreland
5A Wyoming
4A York

RHODE ISLAND

5A (all)

SOUTH CAROLINA

3A Abbeville
3A Aiken
3A Allendale*
3A Anderson
3A Edgefield
3A Fairfield
3A Florence
3A Georgetown*
3A Greenville
3A Greenwood
3A Hampton*
3A Horry*
~~3~~2A Jasper*
3A Kershaw
3A Lancaster
3A Laurens
3A Lee
3A Lexington
3A Marion
3A Marlboro
3A McCormick
3A Newberry
3A Oconee
3A Orangeburg
3A Pickens
3A Richland
3A Saluda
3A Spartanburg
3A Sumter
3A Union
3A Williamsburg
3A York

SOUTH DAKOTA

6A Aurora
6A Beadle
6A Davison
6A Day
6A Deuel
6A Dewey
5A Douglas
6A Edmunds
6A Fall River
6A Faulk
6A Grant
5A Gregory
~~6~~5A Haakon
6A Hamlin
6A Hand
6A Hanson
6A Harding
6A Hughes
5A Hutchinson
6A Hyde
5A Jackson
6A Jerauld
~~6~~5A Jones
6A Kingsbury
6A Lake
6A Lawrence
6A Lincoln
~~6~~5A Lyman
6A Marshall
6A McCook
6A McPherson
6A Meade
5A Mellette
6A Miner
5A Union
6A Walworth
5A Yankton
6A Ziebach

TENNESSEE

4A Anderson
~~4~~3A Bedford
4A Benton
4A Bledsoe
4A Blount
4A Bradley
4A Campbell
4A Cannon
4A Carroll
4A Carter
4A Cheatham
3A Chester
4A Claiborne
4A Clay
4A Cocke
~~4~~3A Coffee
3A Crockett
4A Cumberland
~~4~~3A Davidson
~~4~~3A Decatur
4A DeKalb
4A Dickson
3A Dyer
3A Fayette
4A Fentress
~~4~~3A Franklin
~~4~~3A Hickman
4A Houston
4A Humphreys
4A Jackson
4A Jefferson
4A Johnson
4A Knox
~~3~~4A Lake
3A Lauderdale
~~4~~3A Lawrence
~~4~~3A Lewis
~~4~~3A Lincoln
4A Loudon
4A Macon
3A Madison
~~4~~3A Marion
~~4~~3A Marshall
~~4~~3A Maury
4A McMinn
3A McNairy
4A Meigs
4A Monroe
4A Montgomery
~~4~~3A Moore
4A Morgan
4A Obion
4A Overton
~~4~~3A Perry
4A Pickett
4A Polk
4A Putnam
4A Rhea
4A Roane
4A Robertson
~~4~~3A Rutherford
4A Scott
4A Sequatchie
4A Sevier
3A Shelby
4A Smith
4A Stewart
4A Sullivan
4A Sumner
3A Tipton
4A Trousdale
4A Unicoi
4A Union
4A Van Buren
4A Warren
4A Washington
~~4~~3A Wayne
4A Weakley
4A White
~~4~~3A Williamson
4A Wilson

TEXAS

3B Brewster
4B Briscoe
2A Brooks*
3A Brown*
2A Burleson*
3A Burnet*
2A Caldwell*
2A Calhoun*
3B Callahan
~~1~~2A Cameron*
3A Camp*
4B Carson
3A Cass*
4B Castro
2A Chambers*
2A Cherokee*
3B Childress
3A Clay
4B Cochran
3B Coke
3B Coleman
3A Collin*
3B Collingsworth
2A Colorado*
3B Ector
2B Edwards
~~2~~3A Ellis*
3B El Paso
3A Erath*
2A Falls*
3A Fannin
2A Fayette*
3B Fisher
4B Floyd
3B Foard
2A Fort Bend*
3A Franklin*
2A Freestone*
2B Frio
3B Gaines
2A Galveston*
3B Garza
3A Gillespie*
3B Glasscock
2A Goliad*
2A Gonzales*
4B Gray
3A Grayson
3B Howard
3B Hudspeth
3A Hunt*
4B Hutchinson
3B Irion
3A Jack
2A Jackson*
2A Jasper*
3B Jeff Davis
2A Jefferson*
2A Jim Hogg*
2A Jim Wells*
~~2~~3A Johnson*
3B Jones
2A Karnes*
3A Kaufman*
3A Kendall*
2A Kenedy*
3B Kent
3B Kerr
3B Kimble
3B King
2B Kinney
2A Kleberg*
3B McCulloch
2A McLennan*
2A McMullen*
2B Medina
3B Menard
3B Midland
2A Milam*
3A Mills*
3B Mitchell
3A Montague
2A Montgomery*
4B Moore
3A Morris*
3B Motley
3A Nacogdoches*
~~2~~3A Navarro*
2A Newton*
3B Nolan
2A Nueces*
4B Ochiltree
4B Oldham
2A Orange*
3A Palo Pinto*
3A Panola*

2A Anderson*
3B Andrews
2A Angelina*
2A Aransas*
3A Archer
4B Armstrong
2A Atascosa*
2A Austin*
4B Bailey
2B Bandera
2A Bastrop*
3B Baylor
2A Bee*
2A Bell*
2A Bexar*
3A Blanco*
3B Borden
2A Bosque*
3A Bowie*
2A Brazoria*
2A Brazos*

2A Comal*
3A Comanche*
3B Concho
3A Cooke
2A Coryell*
3B Cottle
3B Crane
3B Crockett
3B Crosby
3B Culberson
4B Dallam
23A Dallas*
3B Dawson
4B Deaf Smith
3A Delta
3A Denton*
2A DeWitt*
3B Dickens
2B Dimmit
4B Donley
2A Duval*
3A Eastland

3A Gregg*
2A Grimes*
2A Guadalupe*
4B Hale
3B Hall
3A Hamilton*
4B Hansford
3B Hardeman
2A Hardin*
2A Harris*
3A Harrison*
4B Hartley
3B Haskell
2A Hays*
3B Hemphill
3A Henderson*
12A Hidalgo*
2A Hill*
4B Hockley
3A Hood*
3A Hopkins*
2A Houston*

3B Knox
3A Lamar*
4B Lamb
3A Lampasas*
2B La Salle
2A Lavaca*
2A Lee*
2A Leon*
2A Liberty*
2A Limestone*
4B Lipscomb
2A Live Oak*
3A Llano*
3B Loving
3B Lubbock
3B Lynn
2A Madison*
3A Marion*
3B Martin
3B Mason
2A Matagorda*
2B Maverick

3A Parker*
4B Parmer
3B Pecos
2A Polk*
4B Potter
3B Presidio
3A Rains*
4B Randall
3B Reagan
2B Real
3A Red River*
3B Reeves
2A Refugio*
4B Roberts
2A Robertson*
3A Rockwall*
3B Runnels
3A Rusk*
3A Sabine*
3A San Augustine*
2A San Jacinto*
2A San Patricio*

3A San Saba*
3B Schleicher
3B Scurry
3B Shackelford
3A Shelby*
4B Sherman
3A Smith*
3A Somervell*
2A Starr*
3A Stephens
3B Sterling
3B Stonewall
3B Sutton
4B Swisher
23A Tarrant*
3B Taylor
3B Terrell
3B Terry
3B Throckmorton
3A Titus*
3B Tom Green
2A Travis*
2A Trinity*
2A Tyler*
3A Upshur*
3B Upton
2B Uvalde
2 B Val Verde
3A Van Zandt*
2A Victoria*
2A Walker*
2A Waller*
3B Ward
2A Washington*

3A Young
2B Zapata
2B Zavala

UTAH

5B Beaver
56B Box Elder
56B Cache
56B Carbon
6B Daggett
5B Davis
6B Duchesne
5B Emery
5B Garfield
5B Grand
5B Iron
5B Juab
5B Kane
5B Millard
6B Morgan
5B Piute
6B Rich
5B Salt Lake
5B San Juan
5B Sanpete
5B Sevier
6B Summit
5B Tooele
6B Uintah
5B Utah
6B Wasatch
3B Washington
5B Wayne
5B Weber

4C Clark
5B Columbia
4C Cowlitz
5B Douglas
6B Ferry
5B Franklin
5B Garfield
5B Grant
4C Grays Harbor
54C Island
4C Jefferson
4C King
4C Kitsap
54C Kittitas
5B Klickitat
4C Lewis
5B Lincoln
4C Mason
6B Okanogan
4C Pacific
6B Pend Oreille
4C Pierce
54C San Juan
4C Skagit
5B Skamania
4C Snohomish
5B Spokane
6B Stevens
4C Thurston
4C Wahkiakum
5B Walla Walla
4C Whatcom
5B Whitman
5B Yakima

4A Gilmer
5A Grant
45A Greenbrier
5A Hampshire
5A Hancock
5A Hardy
5A Harrison
4A Jackson
4A Jefferson
4A Kanawha
45A Lewis
4A Lincoln
4A Logan
5A Marion
5A Marshall
4A Mason
4A McDowell
4A Mercer
5A Mineral
4A Mingo
5A Monongalia
4A Monroe
4A Morgan
45A Nicholas
5A Ohio
5A Pendleton
4A Pleasants
5A Pocahontas
5A Preston
4A Putnam
45A Raleigh
5A Randolph
4A Ritchie
4A Roane

WISCONSIN

56A Adams
6A7 Ashland
6A Barron
6A7 Bayfield
6A Brown
6A Buffalo
6A7 Burnett
56A Calumet
6A Chippewa
6A Clark
56A Columbia
56A Crawford
56A Dane
56A Dodge
6A Door
6A7 Douglas
6A Dunn
6A Eau Claire
6A7 Florence
56A Fond du Lac
6A7 Forest
56A Grant
56A Green
56A Green Lake
56A Iowa
6A7 Iron
6A Jackson
56A Jefferson
56A Juneau
56A Kenosha
6A Kewaunee
56A La Crosse

2B Webb
2A Wharton*
3B Wheeler
3A Wichita
3B Wilbarger
1~~2~~A Willacy*
2A Williamson*
2A Wilson*
3B Winkler
3A Wise
3A Wood*
4B Yoakum

VERMONT

6A (all)

VIRGINIA

4A (all)

WASHINGTON

5B Adams
5B Asotin
5B Benton
5B Chelan
5~~4~~C Clallam

WEST VIRGINIA

5A Barbour
4A Berkeley
4A Boone
4A Braxton
5A Brooke
4A Cabell
4A Calhoun
4A Clay
4~~5~~A Doddridge
4~~5~~A Fayette
4~~5~~A Summers
5A Taylor
5A Tucker
4A Tyler
4~~5~~A Upshur
4A Wayne
4~~5~~A Webster
5A Wetzel
4A Wirt
4A Wood
4A Wyoming

5~~6~~A Lafayette
6A~~7~~ Langlade
6A~~7~~ Lincoln
6A Manitowoc
6A Marathon
6A Marinette
6A Marquette
6A Menominee
5~~6~~A Milwaukee
5~~6~~A Monroe
6A Oconto
6A~~7~~ Oneida
5~~6~~A Outagamie
5~~6~~A Ozaukee
6A Pepin
6A Pierce
6A Polk
6A Portage
6A~~7~~ Price
5~~6~~A Racine
6A Richland
5~~6~~A Rock
6A Rusk
5~~6~~A Sauk
6A~~7~~ Sawyer
6A Shawano
6A Sheboygan
6A St. Croix
6A~~7~~ Taylor
6A Trempealeau
5~~6~~A Vernon
6A~~7~~ Vilas
5~~6~~A Walworth
6A~~7~~ Washburn
5~~6~~A Washington
5~~6~~A Waukesha
6A Waupaca
5~~6~~A Waushara
5~~6~~A 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
5~~6~~B 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 (all)*

GUAM

1A (all)*

NORTHERN MARIANA ISLANDS

1A (all)*

PUERTO RICO

1A except...~~(all)~~*
2B Barraquitas*
2B Cayey*

VIRGIN ISLANDS

1A (all)*

Commenter's Reason: This modification includes the U.S. map as Figure R301.1 and U.S. county table as Table R301.1 to be used in determining the climate zone for locations within the U.S. These were requested during testimony and from the committee at the hearings. Additional information is contained in the original reason statement.
Clarifications were made on using ASHRAE 169 for international locations. Simple tables no longer exist for determining climate zone by weather data for a particular location, so the procedure in ASHRAE 169 has been referenced.

The county tables are in a format of "replace proposal as follows". It shows the changes to the Climate Zones in Table R301.1 compared to the 2015 IECC rather than showing the changes relative to the public comment, which deleted Table R301.1. We did this with permission of IECC staff for clarification purposes.

CE21-16 Part II

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).

Proposed Change as Submitted

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

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. 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.~~

1. *Low energy buildings*.
2. *Conditioned passive buildings*.
3. Those that do not contain ~~*conditioned*~~ *semi-heated*~~space~~ or *conditioned space*.
4. ~~Greenhouses~~*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]	Occupancy Group	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)							
		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* unit[3]	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 Load[7]	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
	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):	Total annual glazed opening solar radiation gains
	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 type[a]:	
	Efficiency (AFUE, HSPF, EER, COP):	
	Capacity:	
Cooling system(s)	Fuel type:	Total annual active space cooling (and dehumidification) demand
	Equipment type[b]:	
	Efficiency (EER, SEER, COP):	
	Capacity:	
	Economizer:	
Auxiliary electric system(s)	Pumps, fans, charging stations for systems:	Total annual auxiliary system(s) demand
Service water heating[c]	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

Reason: 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.

Bibliography: 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 (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 (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 (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 (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 (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 (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 (http://ec.gc.ca/dd-sd/default.asp?lang=En&n=D39CB7AC-1#ftn2a)

Cost Impact: 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 world including within the US have been designed and constructed to meet the original single set of performance benchmark values without a construction cost premium. As passive building design strategies associated with the building envelope reduce space conditioning loads up to 90%, the increased costs associated with 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 allows building designers, builders and owners to elect to meet performance benchmark criteria through benchmark performance based energy modeling software, without requiring added energy modeling or documentation required to demonstrate compliance with 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 where desigers, builders and owners elect to seek more rigorous performance criteria, allowing this added compliance methodology will reduce project costs by eliminating added energy modeling and/or documentation that does not improve the project building's performance.

CE23-16 Part I : C302.1-ZIMMER11857

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: The proposal is too complex and complicated for the enforcement and plan review processes. Disapproval is consistent with the action taken on Part II of the proposal.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Marc Nard, representing Portland Cement Association (mnard@cement.org) requests Approve as Submitted.

Commenter's Reason: This code change proposal adds a new compliance alternative which would allow building designers, builders and owners for conditioned passive buildings. It specifically allows them to meet benchmark criteria through benchmark performance based energy modeling software without requiring additional energy modeling or the associated documentation associated with current compliance pathways. By allowing this new compliance methodology it will reduce project costs and eliminate building evaluation and testing that fails to improve overall building performance. This new method introduces a more sophisticated compliance option which should not be rejected based simply on it not currently being as familiar a process.

CE23-16 Part I

CE23-16 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)]

Proposed Change as Submitted

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

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 provisions of Sections R401 through R404 labeled "Mandatory."~~
2. Section R405 and the mandatory provisions of 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.
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. 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.~~

1. *Low-energy buildings.*
2. *Conditioned passive residences.*
3. Those that do not contain ~~*conditioned*~~ *semi-heated space* or *conditioned space*.
4. *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 zone	-	-	**1**	**2**	**3**	**4 except Marine**	**5 and 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)							
		R-4	155 kWh/m^2 (49.05 kWh/m^2 If all source energy is mixed grid electricity and source enrgy factor is 3.16)							
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*):	
	Orientation:	Total annual glazed opening solar radiation gains
	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 tool*, use the following equation: kWh/yr = 0.03942 x CFA + 29.565 x (N_{br} + 1)	Total annual mechanical ventilation fan operation demand
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: 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 CO2e 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 CO2 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: 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 (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 (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 (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 (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 (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 (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 (http://ec.gc.ca/dd-sd/default.asp?lang=En&n=D39CB7AC-1#ftn2a)

Cost Impact: 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 world including within the US have been constructed without a construction cost premium. As passive building design strategies associated with the building envelope reduce space conditioning loads, often substantially, the increased costs associated with 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 ownership. Passive building design measures often do not result in any construction cost increase, simply making informed decisions during the design process.

CE23-16 Part II : R401.2-ZIMMER11958

Public Hearing Results

Part II

Committee Action: Disapproved

Committee Reason: This code language is much too confusing. The code already provides options so there is a path availble for passive solar.

Assembly Action: None

Individual Consideration Agenda

Proponent : Marc Nard, representing Portland Cement Association (mnard@cement.org) requests Approve as Submitted.

Commenter's Reason: This code change proposal adds a new compliance alternative which would allow building designers, builders and owners for conditioned passive buildings. It specifically allows them to meet benchmark criteria through benchmark performance based energy modeling software without requiring additional energy modeling or the associated documentation associated with current compliance pathways. By allowing this new compliance methodology it will reduce project costs and eliminate building evaluation and testing that fails to improve overall building performance. This new method introduces a more sophisticated compliance option which should not be rejected based simply on it not currently being as familiar a process.

CE23-16 Part II

CE24-16 Part I
IECC: C303.1.2.

Proposed Change as Submitted

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

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.

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 Part I :
C303.1.2-
SCHWARZ13815

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: This text belongs in Section 303.1.1. Depth markers and packaging markings are sufficient. There was concern for the term "certificate" which has legal ramifications and the code would be requiring contractors to certify something. Disapproval is consistent with the action taken on Part II of the proposal. The certificate might not remain in place during the construction process.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

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

C303.1.1 Building thermal envelope insulation. ~~An *R*-value identification mark~~
Insulating materials shall be ~~applied by~~ manufactured with R-value identification marks and installed such that the manufacturer ~~to each piece of~~ '~~s~~~~*building thermal envelope*~~ *R*-value mark is readily observable upon inspection. For insulation ~~12 inches (305 mm)~~ materials that are installed without an observable manufacturer's R-value mark, such as blown, draped, sprayed, layered or ~~greater in width. Alternately~~ insulated siding products, the insulation ~~installers~~ installer shall ~~provide a certification~~ create an insulation certificate immediately after installing the insulation listing the, location, type, manufacturer, installed density, installed thickness, and *R*-value ~~of insulation installed in~~ for each ~~element~~ insulated component of the *building thermal envelope*. ~~For blown or sprayed~~ The insulation ~~(fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed~~ certificate shall ~~be *listed* on the certification. For sprayed polyurethane foam (SPF) insulation,~~ certify the installed ~~thickness~~ R-value 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~~ insulation material and shall be ~~listed on~~ signed, and dated by the ~~certification. The~~ insulation installer ~~shall sign, date~~ and ~~post~~ left for the ~~certification~~ code official in a conspicuous location ~~on the job site~~ for review and documentation.

C303.1.1.1 Blown or sprayed roof/ceiling insulation. The thickness of blown-in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 square feet (28 m^2) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers not less than 1 inch (25 mm) in height. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed *R*-value shall be *listed* on certification provided by the insulation installer.

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.~~

Commenter's Reason:

- Section R301.1.1, and section R303.1.2 already overlap and are confusing and section R303.1.1.1 addresses attic blown insulation which can be confused with R301.1.1 a blown insulation description that better describes attic blown rather than wall or floor blown insulation. The committee suggested that this proposal belonged in R303.1.1 code, so I believe that this revision of the proposal should be allowed to clean up these section of the code.

- Only one trade partner can accurately determine the R-value of installed loose fill insulation. Asking that trade partner to certify the R-value of the material they installed is important quality control and conforms with the federal trade commission's 16CFR part 460 R-value rules. Accurate R-value representation is needed for the development of the HERS index (ERI score) and is now more often needed for mortgage loans and appraisals. Lastly, the code already askes for a certificate and specifically uses the term certification so this is not a new concept with unknown legal ramifications. Rather this proposal clarifies what is needed.

- The updated proposal is looking for the certification to be placed in a conspicuous location specifically for the code official or third party review. It is not meant to be permanently adhered to the home. Section R401.3 Certificate addresses a certificate that is permanently installed in the home.

CE24-16 Part I

NOTE: PART II DID NOT RECEIVE A PUBLIC COMMENT AND IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY

CE24-16 Part II
R303.1.2 (IRC N1101.10.2)

Proposed Change as Submitted

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

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 Part II : R303.1.2-SCHWARZ13816

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: This is redundant with the requirements for Section R303.1.1.1. Some code officials do not what this information posted on the electrical panel.

Assembly Action: **None**

CE25-16 Part I
IECC: , C202 (New), C303.1.1.

Proposed Change as Submitted

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

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

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.

SECTION C202 DEFINITIONS

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:

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 *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: 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.

Cost Impact: 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 Part I :

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: More information is needed on air space requirements and installation. The proposal does not address the air movement issue. Product test standards need to be introduced into the code. The proposed text does not fit in Section C303.1.1 and should be in a separate subsection. The definition fails to provide intent for this product.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Amanda Hickman, InterCode Incorporated, representing Reflective Insulation Manufacturers Association International (amanda@intercodeinc.com) requests Approve as Submitted.

Commenter's Reason: RIMA-I strongly disagrees with the "Commercial Committee's Reason" for disapproval of this proposal.

The purpose of this code change proposal was put forth by RIMA for the following reasons:

- Clarify the primary "identifying" characteristic of reflective insulation.
- Add important definitions to the code that clarify important information related to an established product in the market place.

We strongly disagree with the Commercial Committee's disapproval of this proposal. The Residential Committee approved the language since they recognized the usefulness of this language and they stated, "...This language provides good information for identification of these products". Unfortunately, the opposition put forth a number of inaccurate and highly misleading statements in order to confuse the discussion.

The Commercial Committee's "Reason Statement" and disapproval of this proposal, is evidence that there was, and is, much confusion regarding these widely used products, which is precisely why the proposed language is needed in the code.

- "Installation" is not included in the scope of this section; installation is addressed in Section C303.2
- Section 303.1 is titled "Identification" which is the primary intent of the proposed language.
- There is continued misunderstanding about the difference between radiant barriers and reflective insulation: radiant barriers are installed in open air spaces that are ventilated; reflective insulation products are installed in enclosed air spaces that are not ventilated.
- Typical construction methods are utilized for assemblies that are tested per C1363 (hot box), no special sealing or gasketing is incorporated into the design and building of these tested assemblies.
- ASTM consensus test methods are utilized for testing reflective insulation, foam and fiberglass.
- Air flow in these systems, due to their location adjacent to the air barrier, is insignificant.
- There is an ICC-ES Acceptance Criteria, AC02, that is current and was originally published in 2004.

CE25-16 Part II

R202 (New) [IRC N1101.6 (New)], R303.1.1 (IRC N1101.10.1)

Proposed Change as Submitted

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

2015 International Energy Conservation Code

Add new definition as follows:

R202 (N1101.6) 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.

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: 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.

Cost Impact: 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 Part II :
R202 (NEW)-
LOVELL12295

Public Hearing Results

Part II

Committee Action: **Approved as Submitted**

Committee Reason: Although there are unresolved issues about the insulating value when installed, this language provides good information for identification of these products.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Amanda Hickman, InterCode Incorporated, representing Reflective Insulation Manufacturers Association International (amanda@intercodeinc.com) requests Approve as Submitted.

Commenter's Reason: We support the IECC Residential Committee's action on this proposal for Approve as Submitted. The committee reasoned that this language is needed in the code because "...this language provides good information for identification of these products." This proposal ***does not mandate*** the use of a reflective insulation.

The purpose of this code change proposal was put forth by RIMA for the following reasons:

- Clarify the primary "identifying" characteristic of reflective insulation.
- Add important definitions to the code that clarify important information related to an established product in the market place for the code official.
- There is continued misunderstanding about the difference between radiant barriers and reflective insulation; radiant barriers are installed in open air spaces that are ventilated; reflective insulation products are installed in enclosed air spaces that are not ventilated.
- Typical construction methods are utilized for assemblies that are tested per C1363 (hot box), no special sealing or gasketing is incorporated into the design and building of these tested assemblies.
- Air flow in these systems, due to their location adjacent to the air barrier, is insignificant.
- There is an ICC-ES Acceptance Criteria, AC02, that is current and was originally published in 2004.

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Disapprove.

Commenter's Reason: This PC coordinates the IECC-C and IECC-R a manner consistent with the commercial energy committee decision to disapprove. It was recognized by both committees that the proposal has "unresolved issues" and that "more information is needed" to support appropriate use and application of the product. It is not appropriate to bring a material into the code with only partial information, particularly when the missing information deals with its primary function, in this case thermal performance under varying conditions of use, including appropriate limitations of use. For these and other reasons, warnings have been issued by EPA EnergyStar and others regarding the application of these materials for energy conservation purposes.

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

Commenter's Reason: The definition of Emmittance seems fine but the reflective insulation portion is defining the application installation requirements that don't belong in a definition. Also, adding this to C303.1.1 makes it sound like reflective insulation is already permitted to be installed by code but it hasn't been approved anywhere within the code yet. Air and thermal insulation are different, we are not able to create another formula for R-value. How will Raters and others assess the value? The Colorado Chapter of ICC agrees with the Commercial Energy Committee's reasons for disapproval.

CE25-16 Part II

CE27-16 Part I

IECC: C202, C202 (New), C303.1.1.

Proposed Change as Submitted

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

SECTION C202 DEFINITIONS

GENERAL DEFINITIONS

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

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~~*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 Part I :
C303.1.1-WILEN
AIA CDT
RRO13595

Public Hearing Results

Part I

Committee Action: **Approved as Modified**

Modification:

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~~ certificate of compliance 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~~*certificate of compliance*. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be *listed* on the *certificate of compliance*. For insulated siding, the R-value shall be labeled on the product's package and shall be listed on the ~~certification~~*certificate of compliance*. The insulation installer shall sign, date and post the ~~certification~~ *certificate of compliance* in a conspicuous location on the job site.

Committee Reason: Approval is based on the proponent's published reason statements. The modification completes what the proposal intended to do in Section 303.1.1.

Assembly Action: **None**

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

Commenter's Reason: CE27 came to the attention of SEHPCAC because of the inconsistency of action between the Commercial and Energy Code Development Committees. A key goal of the SEHPCAC is to minimize inconsistency between the two halves of the IECC where the same topic is being addressed. SEHPCAC also opposed this proposal at the Louisville hearings.

This seems to be a solution looking for a problem – and if adopted – will create a new set of problems. The Residential committee called out the confusion between certificates and certificate of conformance. This change has the potential of being applied to other materials. We know that wasn't the intent of the proponent, but the language could lead to such a misapplication. We are not convinced this change is needed.

In this case the SEHPCAC feels the best way to achieve consistency between IECC code halves is to disapprove Part I of CE27.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

CE27-16 Part I

NOTE: PART II DID NOT RECEIVE A PUBLIC COMMENT AND IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY

CE27-16 Part II

R202 (New) [IRC N1101.6 (New)], R303.1.1 (IRC N1101.10)

Proposed Change as Submitted

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

R202 (N1101.6) GENERAL DEFINITIONS

Add new definition as follows:

CERTIFICATE OF COMPLIANCE.

A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents.

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~~*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 Part II :
R202-WILEN AIA
CDT RRO13596

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: This creates too much confusion between "certificates" and "certificate of conformance".

Assembly Action: **None**

CE28-16 Part I

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

Proposed Change as Submitted

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)

2015 International Energy Conservation Code

Add new definition as follows:

SECTION C202 DEFINITIONS

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.

SECTION C202 DEFINITIONS

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

Add new text as follows:

C303.1.5 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.

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

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

Radiant barriers follow two ASTM Standards – ASTM C1313/C1313M, "Standard Specification for Sheet Radiant Barriers for Building Construction Applications," and ASTM C1744, "Standard Practice for Installation and Use of Radiant Barrier Systems (RBS) in Commercial/Industrial Building Construction".

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

Radiant barrier products include a surface with an emittance of 0.1 or less that is installed in roof assemblies or attics with the low-emittance surface facing an open or ventilated air space.[1] The low emittance material can be bonded to plastic film, woven fabric, reinforced paper, OSB or plywood. The thermal performance of radiant barriers depends on emittance and location in the attic, wall or roof assembly. Radiant barriers are predominantly installed in attic spaces below the roof deck. The low-emittance surface of radiant barrier products dramatically reduces the heat gain by radiation into the structure and attic HVAC ducts. For this reason, radiant barriers are especially effective in warm sunny climates where they provide reduced use of air conditioning. Radiant barrier products that are available include single-sheet material, multi-layer assemblies and wood sheathing with attached aluminum film or foil. The single sheet material is installed in roof assemblies by attaching directly to the roof deck, in between the rafters or trusses or to the underside of the rafters or trusses. The foil-faced sheathing is installed with the low-emittance side of the sheathing or panel facing toward the attic space to create a radiant barrier.

Attic radiant barriers are in extensive use. These products have been on the market for several decades and are used by 87 of the top 100 US Builders. They have an established history and have been accepted into several regional code requirements. Over 800 million square feet of the product is being installed annually.

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

- IBC 2015 – Section 1509, Radiant Barriers Installed Above Roof Deck
- HI – Chapter 181 of Title 3, 2015, Section 407.2, Table 407.1
- TX - Austin, Chapter 25-12-263, Article 12, 2013. Energy Code, Section 402.7
- FL – 2010 Florida Building Code, Section 405.6.1, Figure 405.6.1 & Table 303.2 (ASTM Standards C1313 & C1158)
- FL – 2015 Florida Building Code, Section 405.7.1, Figure 405.7.1 & Table 303.2.1 (ASTM Standards C1313 & C1158) & Performance Section 6.5.4.1
- CA – Title 24, 2013, Part 6, Subsection 8, Section (c), Subsection 2; Table 150.1-A; Reference Residential Appendix RA4

Bibliography: [1] 2014 Annual Book of ASTM Standards, ASTM C1313, ASTM, 2014, Vol 04.06 pp 758-761.

Cost Impact: Will not increase the cost of construction
This proposal will not increase the cost of construction because it only adds informational language regarding radiant barriers.

Analysis: A review of the standard(s) proposed for inclusion in the code, ASTM C1313M, 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.

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

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: There is no charging text to explain what to do with these products. The proposed text does not belong in Section 303 which is about identification. The definition of radiant barrier and Section C303.1.5 are redundant, both referring to an emittance of 0.1. The code user needs to know where these products are to be installed. Are they installed in a ventilated system or in an assembly? The code should provide guidance on the installation of such products. Without a code requirement, the proposed text serves no purpose.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Amanda Hickman, InterCode Incorporated, representing Reflective Insulation Manufacturers Association International (amanda@intercodeinc.com) requests Approve as Submitted.

Commenter's Reason: The purpose of this code change proposal was put forth by RIMA for the following reasons:

- Clarify the primary "identifying" characteristic of radiant barriers.
- Provide assistance to code officials by identifying the ASTM Standard for additional product characteristics of the product. However, this proposal ***does not require*** the use of the product.
- Add important definitions to the code that clarify important information related to a very prominent product in the market place.

We strongly disagree with the Commercial Committee's disapproval of this proposal. The Residential Committee approved the language since they recognized the usefulness of this language and they stated, "This will be valuable for product inspection." Unfortunately, the opposition put forth a number of inaccurate and highly misleading statements in order to confuse the discussion.

The Commercial Committee's "Reason Statement" and disapproval of this proposal is evidence that there was and is, much confusion about these widely used products, which is precisely why the proposed language is needed in the code.

- This section references "Identification" and is exactly what this proposal addresses – please refer to the other products within this section and notice that the intent of this language parallels the language of products already listed.
- The key identifying characteristic is "emittance" and this is the reason for its inclusion.
- ASTM C1313 is the material standard for radiant barriers and it contains all the additional identifying characteristics.
- Additionally, the Committee refers to "installation" – this section does not pertain to installation – Section C303.2 addresses installation.
- Due to the fact "emittance" had been deemed appropriate to include in the definition which was previously approved into the IBC, by the IECC Residential Committee, and in order to maintain consistency, the original proposed language should be approved.
- There is continued misunderstanding about the difference between radiant barriers and reflective insulation: radiant barriers are installed in open air spaces that are ventilated; reflective insulation products are installed in enclosed air spaces that are not ventilated.
- Radiant barriers reduce radiant heat transfer by 90% or more. These products provide benefit by dramatically reducing the heat flow through the roof assembly into the building; as much as a 35º F reduction in attic **air space temperatures** can result.
- There is also an ICC-ES Acceptance Criteria, AC220 (published 2003), issued by ICC for radiant barriers.

CE28-16 Part I

CE28-16 Part II

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

Proposed Change as Submitted

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

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.

RADIANT BARRIER.

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

Add new text as follows:

R303.1.5 (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.

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

Radiant barriers follow two ASTM Standards – ASTM C 1313/C 1313M, "Standard Specification for Sheet Radiant Barriers for Building Construction Applications," and ASTM C 1743, "Standard Practice for Installation and Use of Radiant Barrier Systems (RBS) in Residential Construction".

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

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

Radiant barrier products include a surface with an emittance of 0.1 or less that is installed in roof assemblies or attics with the low-emittance surface facing an open or ventilated air space.[1] The low emittance material can be bonded to plastic film, woven fabric, reinforced paper, OSB or plywood. The thermal performance of radiant barriers depends on emittance and location in the attic, wall or roof assembly. Radiant barriers are predominantly installed in attic spaces below the roof deck. The low-emittance surface of radiant barrier products dramatically reduces the heat gain by radiation into the structure and attic HVAC ducts. For this reason, radiant barriers are especially effective in warm sunny climates where they provide reduced use of air conditioning. Radiant barrier products that are available include single-sheet material, multi-layer assemblies and wood sheathing with attached aluminum film or foil. The single sheet material is installed in roof assemblies by attaching directly to the roof deck, in between the rafters or trusses or to the underside of the rafters or trusses. The foil-faced sheathing is installed with the low-emittance side of the sheathing or panel facing toward the attic space to create a radiant barrier.

Attic radiant barriers are in extensive use. These products have been on the market for several decades and are used by 87 of the top 100 US Builders. They have an established history and have been accepted into several regional code requirements. Over 800 million square feet of the product is being installed annually.

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

- IBC 2015 – Section 1509, Radiant Barriers Installed Above Roof Deck
- HI – Chapter 181 of Title 3, 2015, Section 407.2, Table 407.1
- TX - Austin, Chapter 25-12-263, Article 12, 2013. Energy Code, Section 402.7
- FL – 2010 Florida Building Code, Section 405.6.1, Figure 405.6.1 & Table 303.2 (ASTM Standards C1313 & C1158)
- FL – 2015 Florida Building Code, Section 405.7.1, Figure 405.7.1 & Table 303.2.1 (ASTM Standards C1313 & C1158) & Performance Section 6.5.4.1
- CA – Title 24, 2013, Part 6, Subsection 8, Section (c), Subsection 2; Table 150.1-A; Reference Residential Appendix RA4

Bibliography: [1]2014 Annual Book of ASTM Standards, ASTM C1313, ASTM, 2014, Vol 04.06 pp 758-761.

Cost Impact: Will not increase the cost of construction
This proposal will not increase the cost of construction because it only adds informational language regarding radiant barriers.

Analysis: The standard proposed for inclusion in this code, ASTM C11313-12, is referenced in the 2015 *International Building Code*.

CE28-16 Part II :
R202 (NEW)-
LOVELL12308

Public Hearing Results

Part II

Committee Action: **Approved as Submitted**

Committee Reason: The new definition provides for identification of a product. This will be valuable for product inspection.

Assembly Motion: **Disapprove**
Online Vote Results: **Successful**
Support: 62.63% (119) Oppose: 37.37% (71)
Assembly Action: **Disapproved**

Individual Consideration Agenda

Proponent : Amanda Hickman, InterCode Incorporated, representing Reflective Insulation Manufacturers Association International (amanda@intercodeinc.com) requests Approve as Submitted.

Commenter's Reason: We support the IECC Residential Committee's action on this proposal for Approve as Submitted. The committee reasoned that this language is needed in the code because it "will be valuable for product inspection." This proposal ***does not mandate*** the use of a radiant barrier. This language is only providing a definition (which was approved into the IBC) and a well-established ASTM standard in order to provide key information on identification for the code official.

There is a great deal of confusion concerning these products. The proposed definition is the same definition that is currently in the IBC. Inclusion of the appropriate ASTM Standard is also needed in the code as it provides key criteria that will be helpful to code officials when identifying a product installed in building construction across the country. The ASTM C1313/1313M Standard (originally published in 1995) as well as all ASTM documents pertaining to radiant barriers are well established.

Radiant barriers provide benefit by dramatically reducing the thermal radiation into the space below the roof and the heat flow into the conditioned space below the ceiling – this can result in as much as a 35°F reduction in attic temperatures. The material property "emittance" provides this benefit.

The contribution of a radiant barrier to residential energy efficiency depends on the climate zone. There are readily available software applications that recommend in which U.S. climate zones radiant barriers are most cost effective. One such program is the "Roof Savings Calculator" maintained by the Oak Ridge National Laboratory – link: http://rsc.ornl.gov/ (http://rsc.ornl.gov/)

There is also an ICC-ES Acceptance Criteria, AC220 (published 2003), issued by ICC for radiant barriers.

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Disapprove.

Commenter's Reason: This PC coordinates the IECC-C and IECC-R in a manner consistent with a successful floor motion to disapprove and also the commercial energy committee's decision to disapprove CE28. Similar to CE25, this proposal is incomplete in that it is missing important information to determine the main function of the material (thermal performance) in a manner such that comparisons and equivalency can be established with other materials and methods that do quantify thermal performance. While these materials provide thermal benefits in some climates, the benefits can become consequences in other climates and vary with how or where the material is installed in an assembly. These and other conditions of use and limitations are not mentioned or addressed. For these and other reasons, warning have been issued by EPA EnergyStar and others regarding the application of these types of materials for energy conservation purposes.

Proponent : Assembly Motion requests Disapprove.

Commenter's Reason: This code change proposal is on the agenda for individual consideration because the proposal received a successful assembly motion. The assembly action for Disapprove was Successful by a vote of 62.63% (119) to 37.37% (71) by eligible members online during the period of May 11 - May 26, 2016.

CE28-16 Part II

CE29-16 Part II
R303.1.3 (IRC N1101.10.3)

Proposed Change as Submitted

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee; Joseph Hetzel (Jhetzel@thomasamc.com)

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 which are within the scope of the IECC content. The reformatting of Section C403.1.3 is in acknowledging that there are two categories of criteria. The current format wrongly places the door criteria as an exception. Changes to R303.1.3 (N1101.10.3) are to make the format of the two sections identical. Rolling doors are not found in Residential Buildings.
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 (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

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

CE29-16 Part II : R303.1.3-COLLINS13626

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: This language would required garage doors to comply whether the garage was conditioned space are not. This is not necessary.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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.

2. ~~For~~ Where required 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).

Commenter's Reason: The proposal inadvertently left out "where required" in conjunction with garage doors. "Where required" is part of the existing language in the 2015 IECC. CE29-16 Part I was Approved as Modified at the Committee hearings, with the Floor Modification showing the inclusion of the "where required" modifier for garage doors and rolling doors.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

CE29-16 Part II

NOTE: PART I DID NOT RECEIVE A PUBLIC COMMENT AND IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY

CE29-16 Part I

IECC: C303.1.3.

Proposed Change as Submitted

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee; Joseph Hetzel (Jhetzel@thomasamc.com)

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.~~
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* and certified by the manufacturer.

__Products lacking such a *labeled U*-factor shall be assigned a default *U*-factor from Table C303.1.3(1) or C303.1.3(2). The solar heat gain coefficient (SHGC) and *visible transmittance* (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and *labeled* and certified by the manufacturer. Products lacking such a *labeled* SHGC or VT shall be assigned a default SHGC or VT from Table C303.1.3(3).

Reason: The scope of ANSI/DASMA 105 includes both garage doors and rolling doors which are within the scope of the IECC content. The reformatting of Section C403.1.3 is in acknowledging that there are two categories of criteria. The current format wrongly places the door criteria as an exception. Changes to R303.1.3 (N1101.10.3) are to make the format of the two sections identical. Rolling doors are not found in Residential Buildings.
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 (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

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

CE29-16 Part I : C303.1.3-COLLINS13625

Public Hearing Results

Part I

Committee Action: **Approved as Modified**

Modification:

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

1. For windows, doors and skylights, *U*-factor ratings shall be determined in accordance with NFRC 100.
2. ~~For~~ Where required for garage doors and rolling doors, *U*-factor ratings shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

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

Products lacking such a *labeled U*-factor shall be assigned a default *U*-factor from Table C303.1.3(1) or C303.1.3(2). The solar heat gain coefficient (SHGC) and *visible transmittance* (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and *labeled* and certified by the manufacturer. Products lacking such a *labeled* SHGC or VT shall be assigned a default SHGC or VT from Table C303.1.3(3).

Committee Reason: Approval is based on the proponent's published reason statements. The modification indicates that doors don't always need to have a determined U- factor rating.

Assembly Action: **None**

CE31-16 Part I
IECC: C303.1.3.

Proposed Change as Submitted

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:

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 *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, 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).

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 with 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 windows are independently rated and certified and properly labeled.

CE31-16 Part I :
C303.1.3-
FAY13621

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: The current definition of labeled provides the necessary information to the manufacturer, therefore the added text is unnecessary.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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~~ in accordance with a nationally-recognized certification program and *labeled* 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~~ in accordance with a nationally-recognized certification program and *labeled* 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).

Commenter's Reason: CE31, Parts 1 and 2 should be approved as modified by this public comment because this proposal (with the modification) clarifies the language of the IECC as to certification of windows and other fenestration products, strengthening the hand of the building code official and sending a clear set of instructions to fenestration manufacturers about proper certification and labeling of such products. Without proper certification, there can be no assurance that the products used in a building actually meet the requirements of the code – proper certification and labeling allows the code official to easily enforce the fenestration requirements. Because fenestration performance has a disproportionate impact on building energy efficiency, it is critical that fenestration products be consistently and reliably labeled.

To most code users, the current language of Section 303.1.3 is clear – manufacturers must label fenestration products for U-factors and SHGCs as determined by an accredited, independent laboratory, and the product rating must be certified as correct for the product under a nationally accredited certification program. However, the current language ("certified by ... the manufacturer") has been misinterpreted by some to conclude that the manufacturer could self-certify the rating without oversight by any independent certification program. Permitting self-certification without oversight by or participation in an independent national certification program would be a loophole that could lead to false or incorrect ratings and would certainly reduce the credibility of the rating claimed for code compliance. CE31 makes small editorial changes to clarify that this potential loophole does not exist.

To be clear, CE31 does not add new requirements to the code or change the current process for certification and labeling of fenestration products. It simply adds clarity to the code, which will provide clear direction for code officials and fenestration manufacturers. This public comment offers an additional adjustment to the language to address concerns raised at the Committee Action Hearing. Specifically, the modification (replacing "by" with "in accordance with") further clarifies that the certification must be made under and comply with a national certification program. CE31 should be approved as modified by this public comment, or in the alternative, approved as submitted.

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Approve as Submitted.

Commenter's Reason: This code change clarifies that fenestration U-factor and SHGC must be certified by a nationally-recognized certification program, or else a default figure applies. The committee recommended denial.

The committee stated that the current definition of "labeled" provides the necessary information to the manufacturer, therefore the added text is unnecessary. We believe that the proponents here don't intend to make a change so much as provide clarification to those that may still misinterpret the current language such that the manufacturer could self-certify performance without oversight. This leads to potential confusion by architects with regards to performance if different manufacturers test using different methods.

We urge the membership to support approval as submitted.

CE31-16 Part I

CE31-16 Part II
R303.1.3 (IRC N1101.10.3)

Proposed Change as Submitted

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:

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 with 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 windows are independently rated and certified and properly labeled.

CE31-16 Part II :
R303.1.3-
FAY13622

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: No problem has been identified that would require this section to change. The certification programs determine the accreditation.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); William Prindle, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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~~ in accordance with a nationally-recognized certification program, and *labeled* 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~~ in accordance with a nationally-recognized certification program, and *labeled* 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).

Commenter's Reason: CE31, Parts 1 and 2 should be approved as modified by this public comment because this proposal (with the modification) clarifies the language of the IECC as to certification of windows and other fenestration products, strengthening the hand of the building code official and sending a clear set of instructions to fenestration manufacturers about proper certification and labeling of such products. Without proper certification, there can be no assurance that the products used in a building actually meet the requirements of the code – proper certification and labeling allows the code official to easily enforce the fenestration requirements. Because fenestration performance has a disproportionate impact on building energy efficiency, it is critical that fenestration products be consistently and reliably labeled.

To most code users, the current language of Section 303.1.3 is clear – manufacturers must label fenestration products for U-factors and SHGCs as determined by an accredited, independent laboratory, and the product rating must be certified as correct for the product under a nationally accredited certification program. However, the current language ("certified by ... the manufacturer") has been misinterpreted by some to conclude that the manufacturer could self-certify the rating without oversight by any independent certification program. Permitting self-certification without oversight by or participation in an independent national certification program would be a loophole that could lead to false or incorrect ratings and would certainly reduce the credibility of the rating claimed for code compliance. CE31 makes small editorial changes to clarify that this potential loophole does not exist.

To be clear, CE31 does not add new requirements to the code or change the current process for certification and labeling of fenestration products. It simply adds clarity to the code, which will provide clear direction for code officials and fenestration manufacturers. This public comment offers an additional adjustment to the language to address concerns raised at the Committee Action Hearing. Specifically, the modification (replacing "by" with "in accordance with") further clarifies that the certification must be made under and comply with a national certification program. CE31 should be approved as modified by this public comment, or in the alternative, approved as submitted.

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Approve as Submitted.

Commenter's Reason: This change clarifies that fenestration U-factor and SHGC must be certified by a nationally-recognized certification program, or else a default figure applies. The committee recommended denial.

The committee stated that this proposal does not identify any problem with this section that would require a change and that the certification programs determine the accreditation. We believe that the proponent doen't intend to make a change so much as provide clarification to those that may still misinterpret the current language such that the manufacturer could self-certify performance without oversight. This leads to potential confusion by architects with regards to performance if different manufacturers test using different methods.

The AIA urges the membership to approve this change as submitted.

CE31-16 Part II

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).

Proposed Change as Submitted

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, ~~C403.2~~ C405.6, ~~C404, C405.2, C405.3, C405.5, C405.6~~ C408 and ~~C407~~ C409. ~~The building energy cost shall be equal to or less than 85 percent of the standard reference design building.~~

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.

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

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.

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

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.

$EUI_a = (AEU_{bldg} – AEXP_{ren})/TCFA$ (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 pathway as an acceptable method for compliance with 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 pathway 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 with 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 pathway 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 were 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 were derived from the 25th Percentile numbers with 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 where 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 with 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-renewable source energy used onsite on a square foot basis minus renewable energy generated onsite. For consistent expression in source BTUs, imported electricity is multiplied by 3.15, other imported fuels by 1.09 and onsite renewable generation by 3.15.

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

C409.3 The following sections indicate how to demonstrate compliance with 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 with the following requirements:

C409.3.1.1.1 A whole building energy model shall be developed using software 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).

Bibliography: Outcome-Based Pathways for Achieving Energy Performance Goals, Whole Building Design Guide. http://wbdg.org/resources/outcomebasedpathways.php

"Evolving Energy Codes to Address Contemporary Challenges" Journal of the National Institute of Building Sciences by Colker, R.M.; M. Frankel. http://digital.journalofthenationalinstituteofbuildingsciences.com/nibs/june_2015/?pg=33&pm=2&u1=friend

"Alternative Formats to Achieve More Efficient Energy Codes for Commercial Buildings" by Conover, D.; M. Rosenberg, M. Halverson, Z. Taylor and E. Makela. http://www.thefreelibrary.com/Alternative+formats+to+achieve+more+efficient+energy+codes+for...-a0331928022

Compliance Verification Paths for Residential and Commercial Energy Codes PNNL, September 2011. http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20822.pdf

"Developing Effective Codes and Standards for Net-Zero Energy Buildings" by Colker, R.M., D. Hewitt and J. Henderson. Building Design + Construction White Paper on Zero and Near-Zero Energy Buildings + Homes, March 2011. http://www.bdcnetwork.com/sites/default/files/5.%20Developing%20Effective%20Codes%20and%20Standards%20for%20Net-Zero%20Energy%20Buildings.pdf

"Focus on the Outcome, Not Just the Design: Codes, Standards + Rating Systems" by Frankel, M. ECOHOME Magazine, Winter 2013. http://www.ecobuildingpulse.com/codes-and-standards/codes--standards---rating-systems--mark-frankel.aspx?dfpzone=v2020

"Getting to Outcome-Based Building Performance Event Report" by Frankel, M., J. Edelson, and R. Colker. May 2015. http://newbuildings.org/performance-outcomes-event-report

"Outcome-Based Codes: Answering the Preliminary Questions" by Colker, R.M. Strategic Planning for Energy and the Environment, Spring 2012. http://www.tandfonline.com/doi/abs/10.1080/10485236.2012.10491662

Outcome-Based Energy Codes, New Buildings Institute. http://newbuildings.org/outcome-based-energy-codes

"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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Designers will be on the hook for noncompliance problems caused by building operators and maintenance personnel. This proposal creates a trap to fall in.The post occupancy permit will go on until the building finally complies. What if the building is only partly occupied? This could allow use group gaming. The owner would not be able to sell their building to investors if there is an open permit for it. This would require monitoring of the building for years. Very few designers will choose this aggressive approach. This should be the AHJ choice, not the designer's choice. No one will choose this option because of the unknown, uncertain end result.

Assembly Motion: **As Modified**
Online Vote Results: **Failed**
Support: 28.76% (65) Oppose: 71.24% (161)
Assembly Action: **None**

Online Floor Modification:

C409.2.2 Actual energy use intensity (EUIa). The actual energy use intensity (EUIa) 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 EUIa .

EUIa = ~~(~~AEUbldg ~~– AEXPren)~~/TCFA (Equation 4-12)

Where: AEUbldg = 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.

~~AEXPren = 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

Individual Consideration Agenda

Public Comment 1:

Proponent : Ryan Colker, representing National Institute of Building Sciences (rcolker@nibs.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

BOOK PART CA— OUTCOME-BASED COMPLIANCE PATH
CHAPTER PART CA101— SCOPE
~~C409.1~~ CA101.1 ~~Scope~~ General This appendix establishes a compliance path that is an alternative to Section C401.2, based on actual, measured energy performance of the project. 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.~~

CHAPTER PART CA201— GENERAL DEFINITIONS
~~C202~~ CA201.1 ~~POST OCCUPANCY VERIFICATION PERMIT~~ GENERAL DEFINITION. **POST OCCUPANCY VERIFICATION PERMIT.** A permit issued before a certificate of occupancy to address requirements of this code that occur post occupancy.

CHAPTER PART CA301— OUTCOME-BASED COMPLIANCE
~~C401.2~~ CA301.1 Application. Commercial buildings shall comply with ~~one~~ the requirements of ~~the following:~~ Sections C402.5, C405.6, C408 and Appendix CA.

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.~~

~~C409.2~~ CA301.2 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~~ CA301.2(1) shall not be eligible to demonstrate compliance with this code in accordance with ~~Section C409~~ Appendix CA.

~~C409.2.1~~ CA301.2.1 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~~ CA301.2(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~~ CA301.2(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~~ CA-1.

$EUI_{tadj} = EUI_t + EUI_{adj}$ (Equation ~~4-10~~ CA-1)

Where:
EUI_t = the Target Annual Source Energy Use Index in Table ~~C409.2(1~~ CA301.2(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~~ CA-2.

$EUI_{adj} = (HDD_a - HDD_r) * ((HDD_r * EUI_{slope}) + EUI_{base})$ (Equation ~~4-11~~ CA-2)

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~~ CA301.2(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~~ CA301.2(2) for the building use and occupancy.
EUI_{base}= a constant value for EUI in Table ~~C409.2(2~~ CA301.2(2) for the building use and occupancy.

TABLE ~~C409.2.1~~ CA301.2.1
TABLE ~~C409.2(1~~ CA301.2(1) TARGET ANNUAL SOURCE ENERGY USE INDEX (EUI_t)

TABLE ~~C409.2.1~~ CA301.2.1
TABLE ~~C409.2(2~~ CA301.2(2) CHANGE IN EUI_t PER HDD_{65}

~~**C409.2.1.1**~~ **CA301.2.1.1 Weighted occupied floor area.** The target energy use intensity shall be determined utilizing Table ~~C409.2(1~~ CA301.2(1). The EUI_t value from Table ~~C409.2(1~~ CA301.2(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~~ CA301.3.3. For buildings with multiple use or occupancy designations in Table ~~C409.2(1~~ CA301.2(1), the EUI_t shall be adjusted based on the weighted area average of the use or occupancy.

~~**C409.2.2**~~ **CA301.2.2 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~~ CA-2. On-site renewable energy generation shall be included in the calculation of the EUI_a.

$EUI_a = (AEU_{bldg} \cancel{- AEXP_{ren}}\ bldg)/TCFA$ (Equation ~~4-12~~ CA-2)

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**~~ **CA301.2.2.1 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~~ CA301.2.2.

~~**C409.3**~~ **CA301.3 Compliance** Compliance with Section ~~C409.3~~ CA301.3 shall be determined in accordance with Sections ~~C409.3.1~~ CA301.3.1 through ~~C409.3.4~~ CA301.3.4.

~~**C409.3.1**~~ **CA301.3.1 Demonstration of ability to comply with Section ~~C409.3~~ CA301.3 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~~ EUI_t established in Section ~~C409.2.1~~ CA301.2.1 utilizing Section ~~C409.3.1.1~~ CA301.3.1.1 or ~~C409.3.1.2~~ CA301.3.1.2.

~~**C409.3.1.1**~~ **CA301.3.1.1 Modeled approach.** The demonstration of the ability to comply with Section ~~C409.3~~ CA301.3 using a modeling approach shall be determined in accordance with Sections ~~C409.3.1.1.1~~ CA301.3.1.1.1 and ~~C409.3.1.1.2~~ CA301.3.1.1.2.

~~**C409.3.1.1.1**~~ **CA301.3.1.1.1 Energy model.** *No change to text.*

~~**C409.3.1.1.2**~~ **CA301.3.1.1.2 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~~ CA301.3.1.1 shall be provided to the code official for use in verification during inspections.

~~**C409.3.1.2**~~ **CA301.3.1.2 Pre-approved specifications approach.** *No change to text.*

~~**C409.3.2**~~ **CA301.3.2 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~~ Appendix CA, 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~~ CA301.3.4, the code official shall issue a *Certificate of Occupancy*.

~~C409.3.3~~ CA301.3.3 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~~ CA301.2 utilizing a form approved by the code official. The occupancy or use type for the occupied period utilized in Section ~~409.2.2.3~~ CA301.2.2.3 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~~ CA301.3.4 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~~ CA301.2. 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~~ CA301.2.

Commenter's Reason: Reason Statement

This proposal establishes an appendix to the commercial provisions of the IECC to provide 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 (EUI_a) 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 (EUI_r) 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 results
- 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.

Frequently Asked Questions on An Outcome-Based Compliance Path for Energy

<u>Code Officials</u>

- Because ultimate compliance is determined post-occupancy, how will I know the design is capable of meeting the target?
  - The design team must provide the code official with a design that is capable of meeting the target before construction can proceed. This design is proven capable through either a whole building energy model or by providing a prescriptive design that has gone through prior vetting by a mechanism acceptable to the code official (this could include a design under ICC G1-2010 Guideline for Replicable Buildings).
- Since this path is based on maximum flexibility for the designer, how will I inspect the project?
  - As discussed above, the designer will provide the code official with a design that is capable of meeting the target as determined by whole building modeling or a pre-approved prescriptive design. These designs will become the basis for inspection. Inspectors would ensure that the components included in the design are present and installed.
- As a code official, what is my responsibility relative to the Temporary Certificate of Occupancy or Post Occupancy Verification Permit?
  - Once construction is complete and all other code provisions satisfied, the code official may either: 1) issue a Temporary Certificate of Occupancy or 2) issue a Certificate of Occupancy and open a Post Occupancy Verification Permit. While the code department is ultimately responsible for making the TCO a permanent Certificate of Occupancy or closing the POVP, the building owner has a strong incentive to remain diligent and work actively for closure. The TCO or POVP may impact the building owner's insurance or financing, the ability to sell or lease the property, or the ability to open other permits.
- If a project does not meet the target in the required time frame what enforcement mechanisms are there?
  - If the owner is unable to comply within the two year period, the code official may issue a violation and require remedial action. The extent of the remedial action may vary, but may include requiring conduct of an energy audit and the implementation of some level of the identified energy conservation measures; requiring retro-commissioning or payment of a fine. Once the remedial action is conducted, the code official may close the TCO or POVP.
- My department has limited resources (both in time and personnel) to enforce energy code provisions. How does this help?
  - Compliance with the energy code is determined based on the measured energy performance once the building is in operation and not on the verification of specific requirements in the code. This should result in less time spent on enforcement while better realizing the energy use results intended by the code.
- Will this compliance path address concerns that the code development and adoption process has become increasingly dominated by material interests?
  - Yes, this compliance pathway is based on the achievement of a target energy use irrespective of the materials used. Future improvements to the pathway would reduce the target amounts rather than change parameters for specific provisions.

- Does this type of approach exist elsewhere?
  - The city of Seattle has implemented a "Target-Based Compliance Path" within their energy code which provides a similar approach.
  - The state of Virginia has a program that allows communities to provide property tax reductions based on the energy performance. Virginia Beach and other communities have adopted such a program.
  - The 2015 International Green Construction Code (IgCC) includes an outcome-based compliance path.

Building Owners

- Would I be required to follow this compliance path?
  - No, this is an optional compliance path. The performance or prescriptive compliance paths remain in the code.
- When would I select to use this compliance path?
  - A building owner and design team would only select to use this compliance path if:
    they share common project objectives and agree to work collaboratively to reach performance goals
    the owner has an effective operations strategy; and
    the owner anticipates owning the building for at least the period of compliance with no significant changes in occupancy or use.
  - Owner occupied or government buildings would be ideal candidates for use of this option. Speculative developers or buildings were tenants are unknown would not select this option.
- What benefit would such an approach provide to building owners?
  - If the building owner and designer elect to pursue this compliance path, the building owner would be provided with some level of assurance about the building energy use and operating costs and that their investment in energy saving measures is actually realized. Further, the design team would be in the position to find the most cost effective mechanism to achieve the target—thus potentially reducing project cost.
- How would a building owner engage their design team for a project using this compliance path?
  - While this is not an issue covered by the code, it is important to understand how this provision will be used. Many building owners interested in assuring the performance of their buildings have implemented contracts including performance requirements. Such contracts should be carefully crafted to assure that the determination of responsibility for non-achievement of the target and the accompanying remedies are well defined. Specific projects with such performance requirements include the U.S. General Services Administration Federal Center South, the Bullitt Center and State of Washington 1063 Block Replacement. See https://www.wbdg.org/resources/outcomebasedpathways.php.
- How would a building owner be assured that the building is capable of achieving the target?
  - In addition to the regular due diligence of an owner to find a design team capable of meeting their performance requirements, the design team must provide a design that the code official believes is capable of meeting the target. The path retains mandatory code provisions on commissioning, so the building owner receives another level of assurance that the design and construction is in a position to meet the targets.

Designers

- How would the election to use this compliance path impact the design process and liability for operations following occupancy?
  - While this issue is not addressed within code, it is important for designers to be comfortable and understand how such an option impacts their practice. The requirements to meet the targets by the design team would be largely defined within the contract between the owner and the design team.
  - Many building owners interested in assuring the performance of their buildings have implemented contracts including performance requirements. Such contracts should be carefully crafted to assure that the determination of responsibility for non-achievement of the target and the accompanying remedies are well defined. Specific projects with such performance requirements include the U.S. General Services Administration Federal Center South, the Bullitt Center and State of Washington 1063 Block Replacement. See https://www.wbdg.org/resources/outcomebasedpathways.php.
  - While not mandatory, a collaborative design process engaging representatives from the design, construction and operations phase of the building life-cycle is likely to be most effective.
- How does this path benefit designers?
  - This compliance path provides the designer with greater flexibility than is provided under the prescriptive and most modeled performance paths to achieve the energy use anticipated by the code. This includes the utilization of new strategies or products.
  - The path also assures that current energy reduction strategies not currently recognized within the prescriptive or performance compliance paths within the code receive credit for the energy savings.

Governmental Leaders

- What benefit would this approach provide to my community?

- If your community has adopted energy or greenhouse gas reduction goals, current provisions within the energy code do not result in verifiable reductions in energy use. This compliance path would provide a mechanism for communities to assure that the energy code can provide the anticipated energy savings.
- The prescriptive and performance compliance pathways currently existing within the code have limited ability to address the energy use or greenhouse gas emissions associated with plug loads. This compliance path would capture all such energy use.

- What if this provision is adopted into the code, but doesn't meet the needs of our community?
  - Like all other provisions contained in the model code, jurisdictions have the option to amend the code. A jurisdiction may elect to eliminate this compliance option or may decide to develop different target values based on more specific data for their region (e.g., results of a benchmarking and disclosure program or a building stock survey).

SECTION-BY-SECTION ANALYSIS FOR OUTCOME-BASED PATHWAY APPENDIX PROPOSAL TO INTERNATIONAL ENERGY CONSERVATION CODE-COMMERCIAL

Establish New Appendix CA: Outcome-Based Compliance Path

CA101.1 Establishes the outcome-based pathway as an acceptable method for compliance based on actual, measurement of all the energy being used by the building and the energy using elements associated with the building site.

CA201.1. Adds definition for Post Occupancy Verification Permit to support compliance mechanisms established in CA301.3.2.

CA301.1 Establishes the outcome-based pathway as an actual measurement of energy use once in full operation requiring compliance with Sections of the IECC including mandatory requirements of sections C402.5 (Air leakage-thermal envelope), C405.6 (Electrical energy consumption), and C408 (System Commissioning).

CA301.2 Provides general methodology and requirements for compliance through the outcome-based provisions. For buildings with 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 pathway cannot be used.

CA301.2.1 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 CA301.2(1). Table CA301.2(1) values were 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 CA301.2(1) targets were derived from the 25th Percentile numbers with the targeted reduction factor of 72.8%. These EUIt values are a 5.5% improvement from ANSI/ASHRAE/IES Standard 90.1-2013.

Exception: For those locations where HDD_{65} 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 application of the EUI_t. The values to be applied in Equation CA-1 are provided in Table CA301.2(2).The Table values are a derivative (base and slope) of quadratic regression curve fit of EUI_t across climate zones based on Standard 100 Appendix J reference city HDD_{65} for each climate zone. ASHRAE's Building Energy Quotient (bEQ) Labeling Program uses the same methodology for its HDD adjustment factors.

CA301.2.1.1 Provides methodology for calculating target for buildings with multiple occupancy types or changes in occupied floor area.

CA301.2.2 Methodology for calculating the actual energy use (EUI_a). The building's actual energy use in equation CA-2 is calculated based on non-renewable source energy used onsite on a square foot basis minus renewable energy generated onsite. For consistent expression in source BTUs, imported electricity is multiplied by 3.15, other imported fuels by 1.09 and onsite renewable generation by 3.15.

CA301.2.2.1 Metering, utility billing shall be used to determine the annual energy consumption.

CA301.3 The following sections indicate how to demonstrate compliance with this section.

CA301.3.1 The design team must provide assurance to the code official that the proposed design has the capability to meet the EUI_t.

CA301.3.1.1 Modeling may be used to demonstrate capability to meet the target with the following requirements:

CA301.3.1.1.1 A whole building energy model shall be developed using software and parameters approved by the code official.

CA301.3.1.1.2 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.

CA301.3.1.2 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.

CA301.3.2 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 CA301.3.4 and a Certificate of Occupancy.

CA301.3.3 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).

CA301.3.4 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).

Bibliography: Outcome-Based Pathways for Achieving Energy Performance Goals, Whole Building Design Guide. http://wbdg.org/resources/outcomebasedpathways.php

"Evolving Energy Codes to Address Contemporary Challenges" Journal of the National Institute of Building Sciences by Colker, R.M.; M. Frankel. http://digital.journalofthenationalinstituteofbuildingsciences.com/nibs/june_2015/?pg=33&pm=2&u1=friend

"Alternative Formats to Achieve More Efficient Energy Codes for Commercial Buildings" by Conover, D.; M. Rosenberg, M. Halverson, Z. Taylor and E. Makela. http://www.thefreelibrary.com/Alternative+formats+to+achieve+more+efficient+energy+codes+for...-a0331928022

Compliance Verification Paths for Residential and Commercial Energy Codes PNNL, September 2011. http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20822.pdf

"Developing Effective Codes and Standards for Net-Zero Energy Buildings" by Colker, R.M., D. Hewitt and J. Henderson. Building Design + Construction White Paper on Zero and Near-Zero Energy Buildings + Homes, March 2011. http://www.bdcnetwork.com/sites/default/files/5.%20Developing%20Effective%20Codes%20and%20Standards%20for%20Net-Zero%20Energy%20Buildings.pdf

"Focus on the Outcome, Not Just the Design: Codes, Standards + Rating Systems" by Frankel, M. ECOHOME Magazine, Winter 2013. http://www.ecobuildingpulse.com/codes-and-standards/codes--standards---rating-systems--mark-frankel.aspx?dfpzone=v2020

"Getting to Outcome-Based Building Performance Event Report" by Frankel, M., J. Edelson, and R. Colker. May 2015. http://newbuildings.org/performance-outcomes-event-report

"Outcome-Based Codes: Answering the Preliminary Questions" by Colker, R.M.

Strategic Planning for Energy and the Environment, Spring 2012. http://www.tandfonline.com/doi/abs/10.1080/10485236.2012.10491662

Outcome-Based Energy Codes, New Buildings Institute. http://newbuildings.org/outcome-based-energy-codes

"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

CE37-16

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.

Proposed Change as Submitted

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

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.*

Reason: This proposal addresses three issues:

1. The appearance of conflict between C401.2 and C407.3 regarding the level of performance required.
2. The confusion resulting from the use of terms 'mandatory' and 'prescriptive' to when applied to various code provisions.
3. Discrepancy in the listing of 'mandatory' sections in C401.2.and C407.3. Discrepancies between 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 what 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 words 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 was ever provisions which said 'here is how your comply with the 'prescriptive' approach - such text is gone. Losing the word '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 two ways. Users of other codes understand that all provisions are 'mandatory' without the code saying so. With the IECC stating some sections are 'mandatory' the implication is other provisions are purely optional. But what is really the case is just like the other codes, provisions in the IECC must be complied with - if and when 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 two consistent.

- In section R406.2 the treatment of ducts not in the envelope is shown as an exception. In Section R405.2 the same phrase is not an exception. The latter format is correct and would 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 word 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 will make it clearer how the alternative pathways are to be used and in one location calls out which 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 where 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 aware that other proposals will alter the sections listed in the table. As we can not anticipate the final organization of the code, it is assumed that staff will be able to adjust the tables in response to new provisions, deleted provisions or reorganized 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 (http://www.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 which must be informed that certain requirements must be included in a design.

CE38-16 Part I : C401.2-COLLINS13637

Public Hearing Results

Part I

Committee Action: **Approved as Submitted**

Committee Reason: The revisions clarify the intent and remove a problematic ambiguity that has plagued the code. The terms mandatory and prescriptive are not even defined in the code.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Shaunna Mozingo, representing Colorado Chapter of ICC Energy Code Development Committee (smozingo@coloradocode.net) requests Disapprove.

Commenter's Reason: It is our opinion that the existing language as written in the code works much better than this complete re-write done mainly to get rid of the word "mandatory". We do not agree with adding such a large amount of black marks in the new book, which indicates changes, in such a manner when it could have easily been solved by changing the workd "mandatory" to "non-tradeable" or something that served the purpose if there truly is in fact so much confusion about the existing use of the terms (Mandatory) and (Prescriptive). Those terms have been used for so long in the code and are very easily explained.
When a jurisdiction goes to adopt a code and they start showing elected officials and the public the new code that they want to adopt they open the book and people get distracted by how many black lines show up on the sides of the pages. Often we get asked why it has to change so much every time? Do we not know what we are doing so we have to keep changing it? Do we

put things in there before we know if they work and then have to change them? How do we ever learn it if you change it so much?...

Let's save the black lines for something that makes a difference in efficiency or truly clarifes how the code is used. We do not feel as though this change really makes the issue of mandatory/prescriptive/performance any clearer and feel it could have been solved simply by changing the word "Mandatory" to a different term, if it needs changed at all.

CE38-16 Part I

CE38-16 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)

Proposed Change as Submitted

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

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."~~
3. ~~An energy rating index (ERI) approach in Section R406.~~
2. Section R405 and the provisions specified in Table R401.2 applicable to Section R405.
3. An energy rating index (ERI) 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* 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 or 402.1.3 of the 2009 *International Energy Conservation Code*.

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

CE38-16 Part II : R401.2-COLLINS13638

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: The current format is preferred as it helps people understand, for each path, what is necessary to do for that path.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Submitted.

Commenter's Reason: SEHPCAC was the original proponent of CE38. This proposal is also of concern to the SEHPCAC because of inconsistent actions between the Commercial and Energy Code Development Committees. SEHPCAC agrees with the Residential committee that code users should be able to understand what is necessary for each path, the problem is that Sections R405.2 and R406.2 don't tell you what is mandatory, but instead sends the code user another place in the code which then says go see all the places in the code that say mandatory. This proposal puts in one place a complete listing of

mandatory requirements. It tells the user of each path listed at the beginning of Section R401 what is mandatory for each alternative path in one location. The Commercial Energy Code Committee approved this proposal for the much more detailed commercial provisions. It will simplify use of the code. It also has the benefit of being easily maintained in the future. Instead of hoping that the 'mandatory' designation lands on the right section when new sections are added in the future, proponent of new sections can easily amend the table to clearly indicate when requirements are mandatory.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

CE38-16 Part II

CE40-16
IECC: C202, C401.2.

Proposed Change as Submitted

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:

INFORMATION TECHNOLOGY EQUIPMENT Computers, data storage, servers, network equipment and communication equipment.

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 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.
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 renewable energy resources.
Data center applications are unlike their commercial building counterparts in two significant ways. First, they include significantly higher plug loads. And second, they employ rapidly changing technology for the IT equipment and associated power/cooling approaches.

There is also a recognition that current industry modeling tools do not possess all the necessary mathematical models to accurately and appropriately model data center HVAC and power 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 power use effectiveness (PUE), as defined by The Green Grid. However, 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 will 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, 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.

CE40-16 : C401.2-FERGUSON11239

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed standard is not yet published.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: At the time of the Committee Action Hearings, Standard 90.4 was not yet published. It is not final, published, and publicly available.
The intended purpose of this Standard is to create a performance based approach that would be more flexible and accommodating of innovative changes which rapidly occur in the data center design, construction, and operations. Data center applications are unlike their commercial building counterparts because they have significantly higher plug loads and rapidly changing technology for the IT equipment and associated power/cooling approaches.

It has been acknowledged that these differences drive a fundamentally different approach to regulating minimum efficiency requirements for the electrical and mechanical systems that support the plug loads. By using an approach that requires compliance to a "system" level of performance, designers and end-users can utilize various trade-offs in their optimization strategizes depending on their company specific business models.

There was also a recognition that current industry modeling tools maynot possess all the necessary mathematical models to accurately and appropriately model data center HVAC and power design. This standard uses language to relate the calculations of energy efficiency set forth in this standard to a total efficiency number, as well as to allow tradeoffs between electrical and mechanical elements.

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

Commenter's Reason: This proposal aligns the IECC with the now published version of ASHRAE Standard 90.4 (which was approved for publication by ASHRAE on June 29, 2016).
In addition, it correlates to the updated definition of computer rooms in CE9 that was approved as submitted by the committee during the committee action hearings.

CE40-16

CE42-16
IECC: C401.2.

Proposed Change as Submitted

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 growing interest in promoting the performace aspects of building codes, including the IECC. And yet, as currently written, 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 was contructed using the prescriptive path. This seems a disincentive.

To remedy this disincentive, this proposal would 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 shown below according to DOE:

TABLE IV.5—QUANTITATIVE ANALYSIS FINDINGS

Savings in whole-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.

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposal relaxes the code and buildings could be less efficient than current code. No justification provided for the 95%.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Charles Foster (cfoster20187@yahoo.com) requests Approve as Submitted.

Commenter's Reason: This proposal changes the existing 85% threshold to 95% in the performance path of the code. There seems to be growing interest in promoting the performace aspects of building codes, including the IECC. And yet, as currently written, 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 was contructed using the prescriptive path. This seems a disincentive. To remedy this disincentive, this proposal would 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 shown below according to DOE:

TABLE IV.5—QUANTITATIVE ANALYSIS FINDINGS

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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

As a final matter, ASHRAE Std. 90.1-2016 preliminary results suggest yet additional savings of 4.2% site energy / 4.8% energy cost over the previous (2013) standard.

Proponent : Marc Nard, representing Portland Cement Association (mnard@cement.org) requests Approve as Submitted.

Commenter's Reason: For a building designer and to benefit the end user this proposal is a positive step toward evaluating the total building performance as it applies to the net energy use. This is especially the case for a designer not wanting to follow the prescriptive path who would instead choose to follow the alternative total building performance path. This proposed change from 85 to 95 percent offers new maximum design flexibility by using the annual energy cost as the performance metric when evaluating the entire building. To disapprove this proposal penalizes the designer and builder while restricting innovation and alternative methods of construction.

CE43-16
IECC: C401.2, C406.1.

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The percent change is arbitrary with no analysis to support it. The base prescriptive requirements are rising, thus the increase to 80% cannot be justified.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Approve as Submitted.

Commenter's Reason: This code change increases efficiency of performance path by requiring proposed design to demonstrate building energy codes lest than 80 percent of the standard reference design, instead of the current 85 percent; requires all other compliance paths to select two additional EE options from C406 instead of one. The committee recommended denial.
The committee stated that "the percent change is arbitrary with no analysis to support it." The proponent reason statement noted that that performance path option was modified to improve the performance path by 5% as compared to the 2009 IECC because it was consistent with the prescriptive requirement to comply with two additional energy efficiency packages (which

were estimated at 5% energy savings over the 2009 IECC by proponents during the 2012 IECC code cycle). The AIA believes this is a good proposal to improve the performance of the code while maintaining flexibility for the user on how to reach these goals.

We urge the membership to suppor approval as submitted.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); William Prindle, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition requests Approve as Submitted.

Commenter's Reason: CE43 should be approved as submitted because it would improve efficiency in commercial buildings by improving the 2018 IECC by roughly 5%. This approach builds directly upon the approach in Section C406 first established in the 2012 IECC. No other proposal would bring about such a significant improvement to all commercial building compliance paths as CE43.

This improvement is very straightforward:

- For compliance via the prescriptive or UA compliance paths, code users would simply select two of the "additional efficiency options" under C406.1, rather than one as currently required.
- For those who choose compliance via the performance path, rather than replace or re-work the entire performance path (as suggested in other proposals), the proposal simply adjusts the multiplier that applies in Section C401.2 from 85% to 80% (reducing the multiplier by 5%).

Some concern was raised at the Committee Action Hearing regarding whether there would be enough options in C406.1 to provide flexibility for design professionals. We note that the Committee later recommended approval of CE230 as modified, which would add two more options to C406.1. We support the adoption of both CE43 and CE230 because, as a package, they would provide additional energy savings, while providing additional flexibility to code users.

Since the completion of the 2012 IECC update, there has not been an organized, overall improvement in the commercial IECC. CE43 would move all compliance paths forward by a reasonable amount, providing a critical next step for jurisdictions seeking to reduce energy consumption in commercial buildings. CE43 should be approved as submitted.

Proponent : Amanda Hickman, InterCode Incorporated, representing Air Movement Control Association International (amanda@intercodeinc.com) requests Disapprove.

Commenter's Reason: The Air Movement and Control Association International (AMCA) agrees with the ICC Technical Committee's recommendation on this proposal and also their rationale for the disapproval: "The percent change is arbitrary with no analysis to support it. The base prescriptive requirements are rising, thus the increase to 80% cannot be justified."

The Committee also stated on CE232, which is a very similar proposal to this one, and was also disapproved, "without a cost/benefit analysis, it is unclear that the proposal provides energy savings."

Furthermore, some of the options listed are not appropriate for every region or climate zone of the country. Being that the IECC is used as a template for the entire country, going from requiring one option to two is inappropriate. For these reasons we recommend upholding the Committee's action for disapproval.

CE43-16

CE46-16
IECC: C401.2.

Proposed Change as Submitted

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 with other proposed changes, the standard reference design is a building that meets the 2015 IECC, and will 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 would be if Section C407 was 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The standard design will not equal the the proposed design. Until the tables are updated, the code remains adoptable with the current 85%. The current performance path does not account for many things such as the 30% window to wall ratio.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Marc Nard, representing Portland Cement Association (mnard@cement.org) requests Approve as Submitted.

Commenter's Reason: For a building designer and to benefit the end user this proposal is a positive step toward evaluating the total building performance as it applies to the net energy use. This is especially the case for a designer not wanting to follow the prescriptive path who would instead choose to follow the alternative total building performance path. This proposed change offers new maximum design flexibility by using the annual energy cost as the performance metric when evaluating the entire building. Section C401.2, Exception #3 link to the current requirements in terms of maximum energy efficiency. To disapprove this proposal penalizes the designer and builder while restricting innovation and alternative methods of construction.

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

Commenter's Reason: As a result of the committee action hearings in the spring and the current public comment hearings, the energy efficiency of the 2018 code will increase significantly. As tables are updated, the values in C401.2 should be updated as well, and all of the paths should be equivalent. By keeping the 85% value, some designers will decide to use ASHRAE 90.1, which is based on energy costs and does not require a 15% energy cost reduction when using the 90.1 performance path.

CE46-16

CE48-16

IECC: C401.2.1, C402.4.3.4, C503.3.4 (New).

Proposed Change as Submitted

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 C402.4.

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 where 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-weighted averaging to increase usability. Corresponding changes have also been made to section C402.4.3.4.

ASHRAE 90.1 allows area-weighted 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

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Approval is based on the proponent's published reason statements.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); William Prindle, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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*.

C402.4.3.4 Area-weighted *U*-factor and SHGC. An area-weighted average, using the respective area for each fenestration product category listed in Table C402.4, satisfies the *U*-factor requirements. *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*.~~

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 C402.4.

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*.~~

Commenter's Reason: CE48 should either be approved as modified by this public comment or disapproved because the proposal to permit area-weighting of solar heat gain (SHGC) for windows and other fenestration in these buildings would create unnecessary code compliance and enforcement problems and reduce energy efficiency. Although no stakeholder disagreed with moving the replacement fenestration requirements into the existing buildings chapter as proposed, CE48 unfortunately combines this reasonable proposal with another unreasonable proposal. Specifically, the proposal attempts to introduce a poorly-defined, difficult-to-enforce trade-off for fenestration SHGC which will likely result in reduced energy efficiency. Solar heat gain through windows has a substantial impact on the energy efficiency, comfort, equipment sizing and electrical peak demand contribution of commercial buildings. As a result, it is important to get solar heat gain right for individual windows – this proposal does not achieve this objective. We recommend deleting this new SHGC-weighting language or rejecting the entire proposal.

The new area-weighted average SHGC exception suffers from several problems, each of which make it unsuitable for the IECC:

- **Allowing an area-weighted average of fenestration SHGC does not work well with the current projection factor trade-off.** During the last code cycle, the whole purpose behind awarding credit for projection factor – and ultimately for adding six different SHGC requirements for each climate zone – was based on an assumption that specific windows with adequate overhangs would perform in a similar manner to low-SHGC fenestration. CE48, however, would allow all of these windows to be averaged together. This will result in some fenestration receiving double-credit (for SHGC and overhang), while leaving other fenestration over-exposed to solar heat. The proposal can be expected to produce less-comfortable occupants, higher energy use, and an unnecessary complication for code enforcers.
- **CE48 layers several calculations on top of each other, making code compliance and enforcement unnecessarily extremely complicated at best.** Unlike the residential IECC and all previous editions of the commercial IECC, the 2015 IECC commercial fenestration table actually has multiple prescriptive SHGC requirements for each climate zone. Which of these requirements applies?
    - Each climate zone has different prescriptive SHGC requirements for South-East-West facing fenestration and North-facing fenestration.
    - Within these cardinal directions, there are three different SHGC requirements that apply based on projection factor for each window.
    - CE48 would require a code user (and ultimately a code official) to first calculate a projection factor for each window, apply an SHGC requirement to each window based on that projection factor, then somehow calculate an area-weighted average based on all of these factors.
- **There is no definition or common understanding of what is "facing the same direction" for purposes of this new code provision.** If commercial buildings were built as simple boxes, this would not be a problem. But modern buildings often have multiple dimensions, wings, bay windows, angles, or other architectural features. Which of these surfaces count as "facing the same direction" under the proposed new approach?

CE48 will not bring any additional energy-saving benefit to the IECC, but will add layers of unnecessary complication for code users and code officials. While we agree with the recommendation to move the replacement fenestration language to Chapter 5, we recommend modification to eliminate the new area-weighted average language in CE48, as proposed in the modification offered by this public comment. Otherwise, this proposal should be disapproved.

Public Comment 2:

Proponent : Julie Ruth, representing American Architectural Manufacturers Association (julruth@aol.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C402.4.3.4 Area-weighted *U*-factor and SHGC. An area-weighted average, using the respective area for each fenestration product category listed in Table C402.4, satisfies the *U*-factor requirements. ~~*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*.

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 C402.4.

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*.

Commenter's Reason: CE48 would allow area weighted averaging of both U-factor and SHGC across vertical fenestration product groups. It would not, however, permit area weighted averaging of either between vertical fenestration and skylights and sloped glazing.

Not permitting area weighted averaging of U-factor between vertical glazing and skylights is inconsistent with other alternate compliance paths in the IECC. Section R402.1.5 permits area weighted averaging of U-factor for all components of the building thermal envelope (both vertical and horizontal) in residential construction. Similarly, Section C402.1.5 permits it, through Factor A of Equation 4-2, for commercial buildings.

This Public Comment corrects this inconsistency in Section C402.4.3.4 for new construction, and in Section C503.3.4 for replacement fenestration in existing construction.

It should be noted that via this Public Comment, area weighted averaging of SHGC between vertical fenestration and skylights and sloped glazng would still not be permitted.

CE48-16

CE50-16
IECC: C402.1.1.

Proposed Change as Submitted

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. 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.

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 weather or storms. The amount of time that people work in these buildings (for maintenance or testing or repair) is minimal.

Based on feedback from EEI member companies, anywhere from 50% to 100% of utility vaults or enclosed switching stations or substations are not conditioned at all. For electric equipment buildings that are conditioned, the temperature settings are typically much higher in the summer (85 degrees F or higher) and much lower in the winter (60 degrees F or lower) than spaces that are meant for human comfort to be maintained on a regular basis.

Some of the electric equipment vaults being used by utilities are sized at 18 feet by 60 feet, or 1,080 square feet. The size limit of 1,100 square feet will ensure that the exemption is limited to these types of buildings.

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, will not increase the cost of construction for these low energy buildings.

CE50-16 :
C402.1.1-
ROSENSTOCK11747

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed text is in the wrong location, as there is already a section on equipment buildings in the IECC. Substantiation was not given for the change from 500 to 1100 square feet.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Charles Foster (cfoster20187@yahoo.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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. ~~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,~~
4. Buildings that are less than 1,100 square feet in size, are used for electric distribution system purposes and are not space conditioned.

Commenter's Reason: This public comment amends the originally submitted proposal by excepting small buildings without space conditioning. Energy consumption in small utility use buildings is relatively small and the number of these structures is small as well.

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

Commenter's Reason: The provisions in C402.1.2 for "equipment buildings" are not applicable for the vast majority of buildings in this proposal. C402.1.2 only covers equipment buildings that are sized up to 500 square feet. In addition, C402.1.2 only exempts buildings from the *building thermal envelope* provisions of the IECC.
The square footage used in the proposal (1,100 square feet) was based on an industry survey of such buildings. A typical size of the larger buildings in this category is 18 feet by 60 feet (or 1080 square feet).

CE50-16

CE51-16
IECC: C202, C402.1.1, C402.1.2 (New).

Proposed Change as Submitted

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:

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.

Reason: The SEHPCAC recommends this proposal to eliminate a new conflict with the IBC. Approved in Cycle A was a definition of greenhouse for the IBC as well as placement of greenhouses under various occupancies. The IBC definition was different. To make the definitions consistent meant removing the word 'exclusively' from the definition. The SEHPCAC was concerned that such deletion would open the IECC to allowing any greenhouse to be exempt from envelope standards. Finally, the current placement of greenhouses under the low energy building category was 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 newly created Section C402.1.2.
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 (http://www.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 were judged to be exempt from the envelope provisions in the 2015 IECC would continue to be exempt for such provisions in the 2018 edition.

CE51-16 :
C402.1.2 (NEW)-
COLLINS11556

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The word "exclusively" is needed to prevent misapplication. The definition is too wide open without it. The exemption must be strictly limited to true greenhouse applications.

Assembly Motion: **As Submitted**
Online Vote Results: **Failed**
Support: 37.26% (79) Oppose: 62.74% (133)
Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C402.1.2 Greenhouses ~~Greenhouses and greenhouses with accessory occupancies complying with Section 508.2 of the *International Building Code*~~A greenhouse shall be exempt from the building thermal envelope provisions of Section C402 provided that ~~the primary use~~ it complies with one of the following:

1. The greenhouse is used exclusively for the cultivation, protection or maintenance of plants.

2. The area of accessory occupancy spaces within the greenhouse complies with the aggregate area limits of Section 508.2 of the *International Building Code* and is not larger than 1000 square feet (92.9 m^2).

Commenter's Reason: The Commercial Energy Code Development committee was concerned that removing the term 'exclusive' from the definition was not adequately addressed in the amendment to C402.1.2. It is important that the definition of greenhouse in the IECC agrees with the IBC. This proposal does that. Further there are additional amendments for the 2018 IBC addressing greenhouses in Chapter 3, clarifying the occupancy categorization. But exception in the current code completely exempts 'exclusive' greenhouses from the building thermal envelope requirements. The proposed modification moves the 'exclusive' exception from the definition to building envelope provisions as Item 1. Item 2 also allows the envelope exception where 'non-greenhouse' uses are subject to an "aggregate area limit", The limit would be 10% of the floor area of the main occupancy (greenhouse) of the building. This formula means that if you have 5,000 square foot greenhouse then you could have 500 square feet of accessory use and still be exempt from envelope requirements. However, if you had a greenhouse that was 10,001 square feet or larger you would be limited to 1,000 square feet of accessory uses.
This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

CE51-16

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.

Proposed Change as Submitted

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 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:

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposal is irrelevant because the IECC never references Zone 0. Zone 0 is not defined in the code. Disapproval is consistent with the action taken on CE21-16.

Assembly Action: **None**

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

Commenter's Reason: This is a companion proposal to CE21. If CE21 passes, this will also need to pass to ensure Climate Zone 0 is properly accounted for in the existing text of the IECC.

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standards requests Approve as Submitted.

Commenter's Reason: We request as submitted because most of the objections have been satisfied by CE21 Part I AM. CE21 Part I defines Climate Zone 0. In addition, CE21 Part I as modified includes the U.S. map and U.S. county tables indicating climate zones, which addresses most of the comments at the April hearing on CE21 Part I. See additional reasoning in original proposal.

CE52-16

CE54-16

IECC: C402.1.3, C402.1.4.

Proposed Change as Submitted

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
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-0 + R-19ci	~~R-13 + R-13ci~~ R-0 + R-19ci	~~R-13 + R-13ci~~ R-0 + R-19ci	~~R-13 + R-13ci~~ R-0 + R-19ci	~~R-13 + R-13ci~~ R-0 + R-19ci	~~R-13 + R-13ci~~ R-0 + R-22.1ci	R-13+ R-19.5ci	~~R-13 + R-13ci~~ R-0 + R-25ci	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-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 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-0.051	~~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 (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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: A more specific cost effectiveness analysis is needed to justify the new numbers rather than a general analysis on 90.1 as a whole. The proposal imitates ASHRAE 90.1 where it is more stringent but does not imitate 90.1 where it is less stringent. The proposal does not align the IECC with 90.1.The proposal does not indicate how much energy is saved. Cost validation is needed.

Assembly Motion: **As Submitted**

Online Vote Results: **Failed**
Support: 30.61% (75) Oppose: 69.39% (170)
Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects(dcollins@preview-group.com) requests Approve as Submitted.

Commenter's Reason: This change revises prescriptive opaque envelope tables to incorporate ASHRAE 90.1 value where they are more efficient than the IECC values. The committee recommended denial.
The proponent wants to improve energy efficiency by making the commercial building opaque envelope as efficient as under ASHRAE 90.1-2013. The committee stated that a more specific cost effectiveness analysis is needed to justify the new numbers rather than a general analysis on 90.1 as a whole. We believe proposals seeking to better align the IECC with 90.1 have merit, especially those that will increase the efficiency of the model code. As 90.1 is viewed by the IECC as a full option for compliance the cost effectiveness has either been determined before, or isn't relavent.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy(JeffHarris22@outlook.com); William Prindle, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition requests Approve as Submitted.

Commenter's Reason: CE54 should be approved as submitted because it is the only proposal that would bring about a broad improvement in efficiency specifically for opaque envelope components.
The discussion over CE54 at the Committee Action Hearing highlighted the challenge of updating the opaque envelope table – if all of the values from ASHRAE Standard 90.1 are adopted, the efficiency of the IECC increases in some areas and decreases in others. Yet there are clearly areas in which ASHRAE requirements are more efficient, and have been demonstrated to be cost-effective in the ASHRAE process.

CE54 resolves this issue by adopting ASHRAE 90.1 values where they are more efficient than the 2015 IECC. This ensures that no R-value or U-factor is rolled back, but also incorporates improvements that ASHRAE has found to be cost-effective. Opponents to CE54 at the Committee Action Hearing did not single out specific R-values or U-factors, but rather objected on philosophical grounds. The values in the IECC and ASHRAE 90.1 have been subjected to a great deal of analysis and debate, and we consider this proposal to be a reasonable path toward cost-effective energy efficiency improvements.

No other proposal would improve the specific opaque envelope requirements for commercial buildings as broadly and reasonably as CE54. For these reasons and for those outlined in the original Reason Statement, we recommend approval as submitted.

CE55-16

IECC: C402.1.3, C402.1.4, C402.2.4 (New), C402.4.4.

Proposed Change as Submitted

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:

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.

Revise as follows:

C402.4.4 Doors. ~~*Opaque doors*~~Opaque swinging doors shall comply with ~~the applicable requirements for doors as specified in Tables C402.1.3 and~~ Table C402.1.4 and *opaque roll-up or sliding doors* shall comply with Table C402.1.3. All opaque doors shall 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Charging text is needed to state when to use the C-factor or the R-factor. The terminology "non-swinging" needs to be retained. The text regarding framing cavities and continuous insulation in Section 402.1.3 needs to be retained. The proposal omits overhead folding doors.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Hope Medina, representing self (hmedina@coloradocode.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor-based method. *Building thermal envelope* opaque assemblies shall meet the requirements of Sections C402.2 and C402.4 based on the *climate zone* specified in Chapter 3. Building thermal envelope opaque assemblies intended to comply on an assembly *U*-, *C*- or F-factor basis shall have a U-, *C*- or *F*-factor not greater than that specified in Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *U*-, *C*- or *F*-factor from the "Group R" column of Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the *U*-, *C*- or *F*-factor from the "All other" column of Table C402.1.4.

Commenter's Reason: The changes made to this change incorporated teh comments provided by the committee.
Prior to the 2015 edition of the Energy OCde it was understood by the code user that each component of the building thermal envelope tha tis found in current Tables C402.1.3 and C402.1.4 had their own code section in addition to the tables so you knew to find all additional reqruiements fo rthe 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 adn C402.1.4 along wiht some duplicative information for opaque doors. No other envelope components are dealth within these sections, so why did we do away with the code section on below grade walls all together and bury it in these section that covers general information.

The information on opaque doors was removed because it was duplicative. The code section on door already specified the requriements for opaque doors. The wording has been changed to address the issue of nonswinging doors.

Public Comment 2:

Proponent : Hope Medina, representing self (hmedina@coloradocode.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 shall be not less than that specified in Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *R*-values from the "Group R" 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.

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor-based method. *Building thermal envelope opaque assemblies shall meet the requirements of Sections C402.2 and C402.4 based on the climate zone specified in Chapter 3.* Building thermal envelope opaque assemblies intended to comply on an assembly *U*-, *C*- or F-factor basis shall have a U-, *C*- or *F*-factor not greater than that specified in Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *U*-, *C*- or *F*-factor from the "Group R" column of Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the *U*-, *C*- or *F*-factor from the "All other" column of Table C402.1.4.

C402.4.4 Doors. Opaque swinging doors shall comply with Table C402.1.4 and *opaque ~~roll-up or sliding~~ non-swinging doors* shall comply with Table C402.1.3. All opaque doors shall 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.

Commenter's Reason: The changes made to this change incorporated the comments provided by the comittee. Prior to the 2015 edition of the energy code it was understood by the code user that each component of the building thermal envelope that is found in current Tables C402.1.3 and C402.1.4 had their own code section in addition to the tables. You knew to find the additional reqruirements for the compnents in those individual code sections. In the 2015 the code section for below grade walls went away and is buried deep within section C402.1.3 and C402.1.4 along with some duplicative information for opaque doors. No other envelope components are dealt within these sections, so why did we do away with the code section on below grade walls all together and bury it within these sections that cover general information.

The information on opaque doors was removed because it was duplicative. The code section on doors already specified the requriements for opaque doors. The wording has been changed to address the issue of nonswinging doors.

CE55-16

CE57-16

IECC: C402.1.3, C402.1.4.

Proposed Change as Submitted

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~~ R-13 + R-3.8ci or R-20

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposal is not fixing what appears to be an anomaly in the code. The R-value is correct in current code, but the U-value needs to catch up.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Tom Kositzky (tom.kositzky@apawood.org); Mark Halverson, representing APA - The Engineered Wood Association (mark.halverson@apawood.org); Loren Ross (LRoss@awc.org); Greg Johnson (gjohnsonconsulting@gmail.com) requests Approve as Submitted.

Commenter's Reason: The committee voted to disapprove this proposal by a narrow 5-7 margin, reasoning that R-values should take precedence as they are typically established prior to the U-factors. We contend that what was established first is irrelevant, since the cell that needs correcting in Table C402.1.3 was only recently changed. What is imperative is that both the R-value and the U-factor reflect the same level of energy efficiency and that wall systems of different framing material types also translate to similar energy efficiency performance.
As noted in our original reason statement, the 0.064 U-factor for wood frame Group R buildings in Climate Zone 5 and Marine 4 corresponds to a 2x6 wall with cavity insulation (R20), while the corresponding R-value in Table C402.1.3 requires an insulated 2x6 wall with an additional layer of continuous insulation (R20+3.8 c.i.). In keeping with the other Climate Zones, the wood frame R-value and U-factor in this specific Climate Zone should represent the same level of energy efficiency.

Furthermore, the Group R wood-frame R-values in Table C402.1.3 (R13+7.5 or R20+3.8 c.i.), represent a more stringent insulation requirement than the corresponding metal framed R-value and U-factor listed for the same Climate Zone This proposal corrects a single cell in the table so that the wood frame R-value matches the existing wood frame U-factor. When this is done the wood frame R-value is also brought into alignment with the energy efficiency performance of the metal framed wall requirements.

Tables 2 and 3 clearly show that the energy performance of an R-20 wood framed wall is virtually the same as the code-prescribed R-value for the metal frame wall assembly. However, the R20+3.8 c.i. wood-frame wall is approximately 3 percent out of alignment with both and R20 wood wall *and* the prescribed metal frame wall in Table C402.1.3.

By changing this single cell in Table C402.1.3 the wood frame wall R-values and U-factors would be aligned for Climate Zone 5 and equivalent energy-efficiency requirements for wood and metal frame walls would be achieved (see Table 1).

Table 1

Walls, Above Grade	Climate Zone 5 and Marine 4			
	U-Factor		**R-Value**	
	All Other	**Group R**	**All Other**	**Group R**
Metal Framed	0.064	0.064	R13+7.5	R13+7.5
Wood Framed	0.064	0.064	R13+3.8 or R20	R13+3.8 or R20

Providing equitable treatment of material types is an important consideration for a model code. The code should be consistent and material neutral. The energy-use evaluations in Tables 2 and 3 demonstrate that the R-values currently required for Climate Zone 5 and Marine 4 Group R building disadvantage wood wall assemblies by requiring an additional R-3.8 c.i. insulation on 2x6 walls when even an R-20 wood wall assembly (with no continuous insulation) outperforms the steel framed wall system.

Table 2

Wall Assembly Energy Efficiency Comparison (3-Story Multifamily; Climate Zone 5)[1,2,3,4]							
Annual Energy Costs Above or (Below) the Baseline R20 Wall							
Wall System	Glazing Percent	Boston	Buffalo	Chicago	Columbus	Denver	Average
Wood R-20	12%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Wood R-20+3.8c.i	12%	($88.00)	($99.00)	($99.00)	($90.00)	($98.00)	($94.80)
Steel R-13+7.5c.i	12%	$5.00	$2.00	$1.00	$2.00	$2.00	$2.40
Wood R-20	15%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Wood R-20+3.8c.i	15%	($72.00)	($81.00)	($94.00)	($87.00)	($94.00)	($85.60)
Steel R-13+7.5c.i	15%	$7.00	$8.00	$8.00	$7.00	$7.00	$7.40
Wood R-20	18%	$0.00	$0.00	$0.00	$0.00	-$0.00	$0.00
Wood R-20+3.8c.i	18%	($79.00)	($92.00)	($89.00)	($83.00)	($103.00)	($89.20)
Steel R-13+7.5c.i	18%	$7.00	$8.00	$8.00	$7.00	$7.00	$7.40

Table 3

Wall Assembly Energy Efficiency Comparison (5-Story Multifamily; Climate Zone 5)[1,2,3,4]							
Annual Energy Costs Above or (Below) the Baseline R20 Wall							
Wall System	Glazing Percent	Boston	Buffalo	Chicago	Columbus	Denver	Average
Wood R-20	12%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Steel R-13+7.5c.i	12%	$7.00	$7.00	$8.00	$7.00	$6.00	$7.00
Wood R-20+3.8c.i	12%	($153.00)	($184.00)	($178.00)	($167.00)	($185.00)	($173.40)
Wood R-20	15%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Steel R-13+7.5c.i	15%	$24.00	$29.00	$8.00	$8.00	$6.00	$15.00
Wood R-20+3.8c.i	15%	($128.00)	($155.00)	($171.00)	($157.00)	($175.00)	($157.20)
Wood R-20	18%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Steel R-13+7.5c.i	18%	$24.00	$8.00	$8.00	$8.00	$7.00	$11.00
Wood R-20+3.8c.i	18%	($138.00)	($196.00)	($165.00)	($148.00)	($164.00)	($162.20)

(Footnotes apply to Tables 2 and 3)

[1]R-20 wood walls equate to the 0.064 U-factor 0.064 in Table C402.1.

[2]A 15 percent window-to-floor ratio is used to match the US Department of Energy's 2015 IECC methodology to determine cost effectiveness. Twelve and 18 percent window-to-floor ratios were evaluated to determine the impact of more and less opaque wall area on the overall energy efficiency.

[3]Cities located in various locations within Climate Zone 5 were selected to provide a balanced evaluation.

[4]The three-story buildings are 28,500 square feet with 256,500 cubic feet of volume and consist of 27 two bedroom units. The five-story buildings are 42,750 square feet with 384,750 cubic feet of volume and consist of 54 two bedroom units. Both buildings were modeled on a slab foundation with an attic roof system. All building characteristics including slab foundations and attic roof systems were held constant, except for the above grade exterior wall assemblies.

CE57-16

Proposed Change as Submitted

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee; Joseph Hetzel (Jhetzel@thomasamc.com)

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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″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.

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 (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.

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code.

CE60-16 Part I : TABLE C402.1.3-COLLINS13988

Public Hearing Results

Part I

Committee Action: **Approved as Submitted**

Committee Reason: Approval is based on the proponent's published reason statements.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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, ~~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 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.

~~g. Not applicable to garage doors. See Table C402.1.4~~.

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**	
	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
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
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

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
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
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
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
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
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
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
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
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
Opaque doors												
Swinging door	U-~~0.61~~0.370	U-~~0.61~~0.370	U-~~0.61~~0.370	U-~~0.61~~0.370	U-~~0.61~~0.370	U-~~0.61~~0.370	U-~~0.61~~0.370	U-~~0.61~~0.370	U-0.37	U-0.37	U-0.37	U-0.37
Non-swinging door[g] ~~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

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 sinle 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 *fenestration area* is not less than 14% and not more than 25% of the total *door area.*

Commenter's Reason: 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 Rvalue 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.
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.

This is consistent with what I was trying to do in CE53, which was disapproved because of action taken on CE60 (this proposal). This public comment seeks to reconcile CE60 with CE53

Proponent : Shaunna Mozingo, representing Colorado Chapter of ICC Energy Code Development Committee (smozingo@coloradocode.net) requests Disapprove.

Commenter's Reason: We believe that the proposal is actually having a reverse effect in building efficiency than the proponents had desired. Currently, non-swinging doors, including roll up garage doors, that have less than 50% glass must meet the R4.75 R-Value but if they have more than 50% glass they have to meet the fixed or operable fenestration requirements, so in climate zone 5 that would be either .38 or .45 U-factor.

With this proposal, the garage doors having less than 14% glazing would have to have a .31 U-factor but those over 14% glazing would be allowed to be worse with the .38/.45 values for the fenestration. Why would you want a garage door with more glazing to have a worse U-factor?

There was also confusion in whether the garage doors over 14% glazing had to all comply with the fenestration reqirements or if that still only applied to doors having over 50% glass as listed in the definition of opaque door. If it only applies to the non-opaque doors (having over 50% glass) then how do you treat garage doors between 14% glazing and 50% glazing? Either the definition for opaque needs to be changed to include these garage doors or something else needs to happen to make this all more clear on how it has to be applied but no matter what, it doesn't make sense to allow the doors with more glass to have worse U-factors than the ones with less glass.

CE60-16 Part I

IECC-R: Table R402.1.2 (IRC Table N1102.1.2)

Proposed Change as Submitted

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee; Joseph Hetzel (Jhetzel@thomasamc.com)

2015 International Energy Conservation Code

TABLE R402.1.2 (N1102.1.2)
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 (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 Part II : TABLE R402.1.2-COLLINS13989

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: Garage doors are rarely part of the thermal envelope so this requirement is unnecessary to have in the code.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Submitted.

Commenter's Reason: SEHPCAC was a proponent of this change proposal and this public comment. Part I was approved at the Committee hearings. Consistency is needed between the Commercial and Residential codes involving maximum U-factor requirements for garage doors. The proposed title change to the Residential code is not only for consistency with the Commercial code, but also clarifies that the requirements only apply to the building thermal envelope. The garage door related requirements are needed to deal with the situation of when they are part of a building thermal envelope regardless of the frequency of occurrence.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

CE60-16 Part II

CE61-16

IECC: C402.1.3, C402.1.4.

Proposed Change as Submitted

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″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 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~~ 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 (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

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Approval is based on the proponent's published reason statements.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Approve as Modified by this Public Comment.

Modify as Follows:

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-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-7.5 for 12″ below~~	R-5 full slab~~R-10 for 24″ below~~	R-5 full slab~~R-10 for 24″ below~~	R-7.5 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-10 full slab~~R-15 for 36″ below~~	R-10 full slab~~R-20 for 48″ below~~	R-10 full slab~~R-20 for 48″ below~~	R-10 full slab~~R-20 for 48″ below~~	R-10 full slab~~R-20 for 48″″below~~	R-10 full slab~~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~~ 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**	
	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**	**G**
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	0
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	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-0.021	U-0.021	U-0.021	U-0.021	0
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	0

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	0
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	0
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	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-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	0
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	0
Joist/framing	U-0.066[e]	U-0.066[e]	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	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-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.52	F
Heated slabs[f]	F-0.74~~1.02~~	~~F-0.74~~1.02	F-0.74~~1.02~~	~~F-0.74~~1.02	F-0.74~~90~~	F-0.74~~90~~	F-0.64~~86~~	F-0.64~~86~~	F-0.64~~79~~	F-0.64~~79~~	F-0.55~~79~~	F-0.55~~69~~	F-0.55~~69~~	0.
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

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.

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) 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~~ 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 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 • 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.

Commenter's Reason: The purpose of this PC is to coordinate table values for heated slabs in CE61 with subsequent action taken to approve CE62 at the code development hearing. Also, this PC necessarily coordinates with related text changes in CE62 for installation of heated slab (full slab) insulation. Thus, this PC is necessary to avoid potential conficts in the code should CE61 and CE62 remain approved as determined at the code development hearing. It also provides a means of coordinating the IECC commercial heated slab provisions with the acknowledgement that at least R-5 insulation should be placed underneath heated (radiant) slabs-on-grade as required in the mechanical provisions of Section M2103.2 in the IRC (as identified through testimony at the code development hearing for a similar proposal RE22 that was also approved).

Why is the PC needed? CE 61 made changes to the existing F-factors (rather than fixing the R-values) for heated slabs which will result in heated slabs performing much worse (loosing much more heat) than an unheated slab. For this reason, CE62 was subsequently approved to make appropriate corrections to the R-values for heated slabs to achieve consistency with F-factors (performance basis) for heated slabs on grade. The use of full sub-slab insulation for heated (radiant) slabs is far more effective at reducing heat loss than use of thicker perimeter insulation for relatively small depths. The corrections made in CE 62 and applied in this public comment on CE61 correct a number of technical errors in the existing table by coordinating the F-factors and R-values to be consistent with data in Appendix A of ASHRAE 90.1. For additional information, refer to the to reason statement for CE62. Again, this public comment will ensure correlation of action taken to approve both CE61 and CE62 at the code development hearing. This public comment makes no additional technical changes to what has already been approved in CE62 at the code development hearing.

Public Comment 2:

Proponent : Martha VanGeem, representing self requests Approve as Modified by this Public Comment.

Modify as Follows:

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 [g]	R-7.5 for 12″ below + R-5 full slab	R-7.5 for 12″ below + R-5 full slab	R-7.5 for 12″ below + R-5 full slab	R-7.5 for 12″ below + R-5 full slab	R-10 for 24″ below + R-5 full slab	R-10 for 24″ below + R-5 full slab	R-15 for 24″ below + R-5 full slab	R-15 for 24″ below + R-5 full slab	R-15 for 36″ below + R-5 full slab	R-15 for 36″ below + R-5 full slab	R-15 for 36″ below + R-5 full slab	R-20 for 48″ below + R-5 full slab	R-20 for 48″ below + R-5 full slab	R-20 for 48″ below + R-5 full slab	R-20 for 48″below + R-5 full slab	R-20 for 48″ below + R-5 full slab
Opaque doors																
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	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. The first value is for perimeter insulation and the second value is for full slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

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 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-0.52	F-0.52	F-0.52	F-0.51
Heated slabs[f]	F-1.02 + F-0.74	F-1.02 + F-0.74	F-1.02 + F-0.74	F-1.02 + F-0.74	F-0.90 + F-0.74	F-0.90 + F-0.74	F-0.86 + F-0.74	F-0.86 + F-0.74	F-0.79 + F-0.74	F-0.79 + F-0.74	F-0.79 + F-0.74	F-0.69 + F-0.74	F-0.69 + F-0.74	F-0.69 + F-0.74	F-0.69 + F-0.74	F-0.69 + F-0.74
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. The first value is for perimeter insulation and the second value is for full slab insulation.

C402.2.5 Slabs-on-grade perimeter insulation. 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 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.

Exception: Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.

Commenter's Reason: This modification is a compromise between this proposal and CE62. This modification adds the R-5 full slab requirement from the mechanical code for heated slabs. The mechanical code states: **"1209.5.1 Slab-on-grade**

installation. Radiant piping utilized in slab-on-grade applications shall be provided with insulating materials installed beneath the piping having a minimum *R*-value of 5." It is convenient for the user to show this requirement in the IECC.

This modification also includes perimeter insulation to minimize heat loss around heated slabs. CE62 requires only full slab insulation and does not include this perimeter insulation. Generally, most heat loss from slabs is around the perimeter of slabs due to the insulating and thermal mass properties of the soil beneath the slab.

For heated slabs, the first value is for the perimeter insulation and the second value is for the full slab insulation. An F-0.74 is equivalent to R-5 full slab insulation for heated slabs.

CE61-16

CE62-16

IECC: C402.1.3, C402.1.4, C402.2.5, C402.2.6.

Proposed Change as Submitted

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 48″~~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) 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~~ 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 • 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

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: This is the more effective method of insulating slabs. Preventing heat flow downward through the slab is important. Insulating only the edges of slabs is not nearly as effective.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: The International Mechanical Code states:
"1209.5.1 Slab-on-grade installation. Radiant piping utilized in slab-on-grade applications shall be provided with insulating materials installed beneath the piping having a minimum *R*-value of 5."

CE62 increases the heated slab insulation above that required by the mechanical code. And applies it to the whole slab and not just the part including radiant piping. This is an increase in stringency compared to the values in the current IECC. The proponent has not shown cost-effectiveness.

Further this requirement is not practical. For insulation under the slab (full slab insulation) when it is slab-on-grade, there is no required perimeter insulation; therefore the insulation cannot be continuous with the above-grade insulation. For insulation under slabs that are portions of below grade walls, the below grade wall insulation is allowed to be indoors, thus preventing it from being continuous with the under slab insulation. Finally, perimeter insulation that is outdoors cannot be continuous with above grade insulation that is indoors. This requirement is not practical and the proponent has not shown cost-effectiveness for these continuous insulation requirements. The phrase, "or otherwise positioned to minimize heat loss through the slab edge and foundation wall intersection" is poor code language and is unenforceable.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standards requests Disapprove.

Commenter's Reason: We request disapproval of this proposal and are instead in favor of CE61 which was also approved by the committee. No cost justification is given for the amount of slab insulation required for heated slabs in this proposal. The mechanical code

requires R-5 insulation, and no cost justification is provided for more insulation in this proposal. Most heat through slabs is lost around the perimeter of the slabs because of the insulating and thermal mass properties of the soil beneath slabs.
CE61 was also approved. CE61 as modified provides a compromise solution. It requires R-5 insulation below the slab as required by the mechanical code while retaining the perimeter insulation. This proposal does not require perimeter insulation.

We object to this requirement in this proposal: "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." This requirement is unreasonable and cost justification has not been provided. For insulation under the slab (full slab insulation) when it is slab-on-grade, there is no required perimeter insulation; therefore the insulation cannot be continuous with the above-grade insulation. For insulation under slabs that are portions of below grade walls, the below grade wall insulation is allowed to be indoors, thus preventing it from being continuous with the under slab insulation. Finally, perimeter insulation that is outdoors cannot be continuous with above grade insulation that is indoors. It is more cost-effective to place insulation on walls indoors and this proposal does not take this into account. The phrase, "or otherwise positioned to minimize heat loss through the slab edge and foundation wall intersection" is poor code language and is unenforceable.

CE62-16

CE64-16

IECC: C402.1.3, C402.1.4, C402.3, C402.3.1 (New), C402.3.2 (New).

Proposed Change as Submitted

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		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	All other	Group R
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-35ci	R-35ci
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 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-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-5.7ci [c]	R-5.7ci [c]	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building	R-13+ R-6.5ci	R-13+ R-6.5ci	R-13+ R-6.5ci	R-13 + R-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-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-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	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	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	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	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-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	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		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	All other	Group R
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-0.028	U-0.028
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-0.029	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-0.027	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-0.151	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-0.079	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-0.077	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-0.064	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-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-0.322[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-0.066[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-0.73[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-0.70	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-0.61	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.

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 was added to walls 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 wall systems. This could increase the cost of construction if the shading is done by newly 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, which previously would 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 with the new wall SRI requirements.

Analysis: A review of the standard(s) proposed for inclusion in the code, ISO 9050, ASTM E1980 and NFRC 300, 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.

CE64-16 : TABLE C402.1.3-FERGUSON12410

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed standards do not meet the criteria of CP28. Climate zone zero does not exist in the code.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: This is a companion proposal to CE21. If CE21 passes, this will also need to pass to ensure Climate Zone 0 is properly accounted for in the existing text of the IECC.

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standardsrequests Approve as Submitted.

Commenter's Reason: We request as submitted because most of the objections have been satisfied by CE21 Part I AM. CE21 Part I defines Climate Zone 0. In addition, CE21 Part I as modified include the U.S. map and U.S. county tables indicating climate zones, which addresses

most of the comments at the April hearing on CE21 Part I. See additional reasoning in original proposal.

CE64-16

CE66-16
IECC: C402.1.3.

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The footnote will apply only to insulation used in the prescriptive path. The footnote belongs in Section C303.1.4. ASTM is the proper venue for this issue. The proposal could require unnecessary testing in some climate zones.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Bill McHugh, The McHugh Company, representing the Chicago Roofing Contractors Association, representing Chicago Roofing Contractors Association (billmchugh-jr@att.net) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

C303.1.4.2 Building thermal envelope insulation. *The R-Value* of Insulation shall be measured at the lowest value from ASTM C 518 testing at 40F, 75F, and 110F.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:

Commenter's Reason: At the Committee Action Hearings in Louisville, KY, the ICC Energy Conservation Code Development Committee reason given included moving the requirement from a chart to section 303.1.4. Based on the committee reason statement, the requirement is in a new section of 303.1.4, 303.1.4.2.
Secondly, the underlying reason for this proposal is to bring the code requirements to a much more accurate requirement for testing R-Values of various insulation types that can be used at the Building Envelope. In order for the designer, engineer, building owner and manager to evaluate performance and get the value they are paying for, R-Values of insulation in the building envelope need to be reported at resistance to varied temperatures as can be expected. This is critical to measure the actual heat flow through the insulation. This allows the mechanical engineering community to design heating and cooling system capacity to the environment that the insulation will resist heat flow. Current measurement of insulation R-Value at the 75F level means that some insulation types are performing at a temperature that optimizes their performance over other types of materials that may perform better across the wide range of expected temperatures buildings see throughout the seasons. Temperatures need to be measured at 25F, 40F 75F AND 110F through the whole temperature range expected to provide the full performance levels of the material. Also, the 75F exposure temperature is not achievable in many places in real world exposures.

The National Roofing Contractors Association and Canadian Roofing Contractors Association have researched and found that the R-Value of insulation types can vary greatly. Some perform well at 75F while others perform through a range of temperatures at 110F and above as well as at below 40F. With this ASTM C518 testing requirement in the energy codes, the designer, engineer, building owner and manager will be better able to judge the performance of all insulation types across a wide range of temperatures. Requiring insulation to be tested to this standard means optimum matching of both the HVAC Systems and Building Envelope Systems.

Testing the resistance of all insulation types at various temperatures is providing the testing environment that simulates conditions that can be reasonably foreseeable to occur in the environment the building is exposed in all year long, throughout the globe.

The ICC's International Energy Conservation Code needs to communicate the rules for product testing and acceptability using the wide consensus of code officials and others participating in the ICC code development process.

CE66-16

CE71-16
IECC: C402.1.4.

Proposed Change as Submitted

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-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 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	Group 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-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
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-30f	R-30f	R-30f	R-30f	R-30f

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval is based on action taken on CE69-16. Zones 4,5 and 6 for Group R have lower U-factor values which should carry over into Zone 7 also. R-values should be aligned, not U-factors.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standards requests Approve as Submitted.

Commenter's Reason: This is a valid proposal should CE69 be disapproved. I recommended disapproval at the hearing based on approval of CE69. This is a subset of CE69. This proposal changes the values in two cells.

Responding to the committee's reason for disapproval, the U-factors decrease, or stay the same, with an increase in climate zone number.

CE71-16

CE73-16

IECC: C402.1.5, C402.1.5 (New).

Proposed Change as Submitted

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 C402.1.4 and 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 grad~~e and below-grade walls~~.

UA Dif	=	UA Proposed - UA Table.
UA Proposed	=	Proposed *U* -value · Area.
UA Table	=	*U* -factor from Tables C402.1.4, C402.1.5 or 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~~ C = (~~DA~~ CA · UV) - (~~DA~~ CA · U_{Wall}), but not less than zero.

~~DA~~ CA	=	(Proposed Vertical ~~Glazing~~ Fenestration Area) - (Maximum Allowed Prescriptive Vertical ~~Glazing~~ Fenestration 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~~ D = (~~EA~~ DA · US) - (~~EA~~ DA · U_{Roof}), but not less than zero.

~~EA~~ 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The U-factor value for non-swinging doors is incorrect. This needs to align with CE72-16.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Eric Makela, representing Northwest Energy Codes Group (eric.makela@cadmusgroup.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 C402.1.4 and 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.

UA Dif	=	UA Proposed - UA Table.
UA Proposed	=	Proposed *U* -value · Area.
UA Table	=	(*U* -factor from Table C402.1.4, C402.1.5 or C402.4) · Area.

B = Sum of the (FL Dif) values for each distinct ~~slab-ongrade~~ slab-on-grade 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.

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 fenestration area, not including opaque doors and opaque spandrel panels, is less than or equal to the maximum allowed prescriptive vertical fenestration area, the value of C (Excess Vertical Glazing Value) shall be zero. Otherwise:

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:

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.

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
Swinging	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-0.370	U-0.370	U-0.370	U-0.370	U-0.370	U-0.370	U-0.370	U-0.370
Non-Swinging[g]	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310	~~U-0.21~~ U-0.310

[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 *fenestration area* is not less than 14 percent and not more than 25 percent of the total *door area*.

Commenter's Reason:

This Public Comment builds off of CE72 and also corrects Equation 4-2 in the Component Performance Alternative approach. The current equation references Table C402.1.3 which provides minimum insulation R-values which are not appropriate to use for this approach. Equation 4-2 is based on assembly U-factors and the appropriate tables to reference are Table C402.1.4 and C402.4.

Only minimum R-values are provided for Non-swinging doors. This proposal establishes Table C402.1.5 for swinging and non-swinging door maximum U-factors. The values that are contained in Table C402.1.5 are from ASHRAE.

The term "fenestration" is used in the code not glazing so this term has been changed.

The current equation would allow a building with greater than 30% WWR to comply without complying with Section C402.4.1.1 Increased vertical fenestration area with daylight responsive controls. The proposed change would require that the control requirements be met for anything over 30% WWR but allows glass area greater than 40% WWR for the proposed building.

Correct table references and restore ability to use high performance glazing values with component performance path.

CE73-16

CE79-16

IECC: C402.2.2, C402.2.2.1 (New).

Proposed Change as Submitted

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.~~
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.

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 where 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 will be unchanged.

CE79-16 :
C402.2.2-WILEN
AIA CDT
RRO11510

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed text is unclear, can be interpreted multiple ways and is difficult to read. The new text should remain as an exception under C402.2.2 as it relates to exception 1.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jason Wilen AIA CDT RRO, National Roofing Contractors Association (NRCA), representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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**~~ **Exception:**

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.~~
1. 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.

C402.2.2.1 Determination of R-value for above deck tapered insulation. Where continuous above deck tapered roof insulation is used, 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.

Commenter's Reason: In response to concerns raised by The Commercial Energy Conservation Committee, we have reorganized this proposal to better integrate with two other NRCA proposals for this section that were approved as submitted by the committee (CE81-16 and CE82-16).
In this proposal we have deleted Exception 1 because it is not needed. The charging paragraph C402.2.2 Roof assembly references "The minimum thermal resistance (R-value) of the insulating material..." Exception 1 is about U-factor and conflicts with IECC section C402.1.4 Assembly U-factor, C-factor or F-factor method. This exception should be deleted; the U-factor method is already included in Section C402.1.4.

Exception 2 has been relocated to its own subsection and simplified. This adds clarity to the code and provides a simple method to determine R-value for above deck tapered insulation for the purposes of code compliance. The method is based upon the detailed explanation that appears in the IECC commentary.

Public Comment 2:

Proponent : Jason Wilen AIA CDT RRO, National Roofing Contractors Association (NRCA), representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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**~~ **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.

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.~~

C402.2.2.1 Determination of R-value for above deck tapered insulation. Where continuous above deck tapered roof insulation is used, the R-value specified in Table C402.1.3 shall be determined based on an area-weighted average.

Commenter's Reason: In response to concerns raised by The Commercial Energy Conservation Committee, we have reorganized this proposal to better integrate with two other NRCA proposals for this section that were approved as submitted by the committee (CE81-16 and CE82-16).

In this proposal we have deleted Exception 1 because it is not needed. The charging paragraph C402.2.2 Roof assembly references "The minimum thermal resistance (R-value) of the insulating material..." Exception 1 is about U-factor and conflicts with IECC section C402.1.4 Assembly U-factor, C-factor or F-factor method. This exception should be deleted; the U-factor method is already included in Section C402.1.4.

Exception 2 has been relocated to its own subsection and simplified. This adds clarity to the code and provides a simple method to determine R-value for above deck tapered insulation for the purposes of code compliance.

Proponent : Wanda Edwards, RCI, Inc., representing RCI, Inc. (wedwards@rci-online.org) requests Disapprove.

Commenter's Reason: RCI recommends disapproval of this proposal. The IBC Commentary states that roof surfaces are surfaces having an angle less than 60 degrees from the horizontal. Exception 1 refers to continuous insulation for roofs have areas that do not meet the required *R*-value.

Exception 2 addresses tapered insulation which is commonly used to provide drainage to the drains. The commentary states "In the case of this exception, the taper is limited to a maximum of 1 inch and the required *R*-value is determined at the minimum thickness of the insulation. In the case of this exception, the taper is limited to a maximum of 1 inch and the required *R*-value is determined at the minimum thickness of the insulation." The proposal states where it varies more than 1 inch. This appears to change the requirements.

There is not a demonstrated need or reason to modify this section.

CE79-16

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)

Proposed Change as Submitted

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

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^2 × °F (123 kJ/m^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 (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.

CE84-16 Part II :
R402.2.5-
COLLINS13636

Public Hearing Results

Part II

Committee Action: **Approved as Submitted**

Committee Reason: The committee agreed with the published reason statement.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standards requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.2.5 (N1102.1.4) Mass walls. ~~Mass~~ For the purposes of this chapter, mass walls ~~where used as a component of the thermal envelope of a building shall be~~ are above grade walls that comply with one of the following:

1. ~~Above-grade walls~~ Walls of concrete block, concrete, insulated concrete form, masonry cavity, brick other than brick veneer, adobe, compressed earth block, rammed earth, solid timber or solid logs,
2. Any wall having a heat capacity greater than or equal to 6 Btu/ft^2 × °F (123 kJ/m^2 × K).

Commenter's Reason: This modification clarifies that for purposes of this chapter, mass walls are above grade walls.

CE84-16 Part II

NOTE: PART I DID NOT RECEIVE A PUBLIC COMMENT AND IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY

CE84-16 Part I

IECC: C402.1.3, C402.1.4, C402.2.3, C402.2.4.

Proposed Change as Submitted

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

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.*
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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 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:~~ 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 Section C402.2.3.

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 (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.

CE84-16 Part I : TABLE C402.2.3-COLLINS13635

Public Hearing Results

Part I

Committee Action: **Approved as Submitted**

Committee Reason: Approval is based on the proponent's published reason statements.

Assembly Action: **None**

CE87-16 Part I
IECC: C402.2.7 (New).

Proposed Change as Submitted

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

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.

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 Part I :
C402.2.7 (NEW)-
CRANDELL12852

Public Hearing Results

Part I

Committee Action: **Approved as Modified**

Modification:

C402.2.7 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~~
Exception:
The thermal resistance of ~~not less than 1/2-inch thick (12.7 mm) that are~~ air spaces located on the exterior side of the continuous air barrier and ~~are~~ adjacent to and behind the exterior wall covering material shall be ~~assigned~~ determined in accordance with ASTM C1363 modified with an ~~R-value not greater than R-0.7, provided that~~ air-flow entering the ~~R-values~~ bottom and exiting the top of the ~~cladding material and the exterior~~ air-space at a minimum air ~~film are not included in the calculations demonstrating compliance with this code~~ movement rate of 7 cm/sec..

Committee Reason: Air spaces are not being applied correctly and this proposal provides the necessary direction. The Modification introduces a test method rather than a using a random R-value that cannot be verified. It will also help prevent gaming.

Individual Consideration Agenda

Public Comment 1:

Proponent : Lamont Millspaugh, Reflectix Inc., representing Reflectix Inc. (monty.millspaugh@reflectixinc.com) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

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~~ adjacent to a continuous air barrier and is bounded on all sides by building components.

~~**Exception**: The thermal resistance of air spaces located on the exterior side of the continuous air barrier and adjacent to and behind the exterior wall covering material shall be determined in accordance with ASTM C1363 modified with an air-flow entering the bottom and exiting the top of the air-space at a minimum air movement rate of 7cm/sec.~~

Commenter's Reason: Both the original proposal and the proposal as modified have several problems and should be further modified by this public comment in order to address the following issues:

- The stated R-value of R-0.7 is not supported by technical justification.
- ASHRAE 90.1 does not limit the R-value.
- The value of R-0.7 is unsupported and has no test data to validate that value, therefore, it is not appropriate to be included as a code requirement.
- The reason statement contains a confusing discussion on "air leakage". The ASHRAE 90.1 consensus project has agreed that a region on the interior of the air barrier that is enclosed on all sides with building components and is unventilated does not experience any "air leakage" that would impact performance.
- The "Cost Impact" is inaccurate – the end result will require additional materials in the assembly to meet thermal performance within the code requirements. Proper evaluation and assignment of air space R-values in conjunction with other products in the assembly, e.g., reflectives, insures accurate cost evaluation.
- The original language specifies "enclosed airspace located on the interior side of the continuous air barrier" – then goes on to specify different treatment for air spaces outside of the air barrier – these enclosed air spaces have the same characteristics and should not be treated differently.
- Hot Box Tests – ASTM C1363 prohibits any "air flow" within the testing apparatus – this procedure is in place to insure a consistent thermal performance comparison of various materials within assemblies. Additionally, there is not currently an air flow "standard procedure" that would permit this type of testing; it is the responsibility of industry to work through the ASTM process for revisions to ASTM standards, not through the code process.

Public Comment 2:

Proponent : Martha VanGeem, representing self; Stephen Skalko, representing Stephen V. Skalko, PE & Assoctares, LLC (svskalko@cox.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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.

~~**Exception**: The thermal resistance of air spaces located on the exterior side of the continuous air barrier and adjacent to and behind the exterior wall covering material shall be determined in accordance with ASTM C1363 modified with an air-flow entering the bottom and exiting the top of the air-space at a minimum air movement rate of 7cm/sec.~~

Commenter's Reason: The proposal should be modified to remove the last sentence and to remove the floor modification that requires ASTM C1363 testing for the following reasons:
The proposal requires the R-value of an air space outside of the air barrier be limited to R-0.7 and does provide technical justification for this value. The ASHRAE 90.1 addendum does not limit the R-value to 0.7.

The approved as modified by the floor modification added a requirement for testing the assembly according to ASTM C1363 modified to require an air movement rate of 7 cm/sec within the air space. This is not allowed by the scope of ASTM C1363 which does not allow air infiltration through the specimen and states: "1.14 This test method does not permit intentional mass transfer of air or moisture through the specimen during measurements. Air infiltration or moisture migration can alter the net heat transfer. Complicated interactions and dependence upon many variables, coupled with only a limited experience in testing under such conditions, have made it inadvisable to include this type testing in this standard. Further considerations for such testing are given in Appendix X1."

Very few hot boxes (C1363) can operate under these conditions. Hot boxes are required to have very tight control of the air movement in and out of the facility so that it does not affect the heat flow through the wall. The added air would need to be kept at the same temperature as the surfaces surrounding the air space or there would need to be a method of determining the exact amount of heat added or taken away from the air space by the air movement. There is no standard practice for this complexity. The commenter is not aware of any hot boxes that are available for testing that can operate under this specification. Hot box tests cost on the order of $25,000 for each test.

The requirement in the floor modification is a research project requiring a very complex modification to a test method, a very expensive modification to current test facilities, and an expensive test. No published data are available on this methodology that we are aware of. It is unreasonable and not practical. This modification will promote gaming because there is no standard methodology and results will vary widely as testers try to determine how to implement this.

This language in the original proposal will increase the cost of construction (as opposed to what the cost impact states) because it will require more insulation in cases where the R-value of the air space is not allowed to be used.

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

Commenter's Reason: CE87 came to the attention of SEHPCAC because of the inconsistency of action between the Commercial and Energy Code Development Committees. A key goal of the SEHPCAC is to minimize inconsistency between the two halves of the IECC where the same topic is being addressed.
The proposal and the As Modified version should both be disapproved for the following reasons:

- The proposal requires the R-value of an air space outside of the air barrier be limited to R-0.7 and does provide technical justification for this value. The ASHRAE 90.1 addendum does not limit the R-value to 0.7.
- The approved as modified by the floor modification added a requirement for testing the assembly according to ASTM C1363 modified to require an air movement rate of 7 cm/sec within the air space. This is not allowed by the scope of ASTM C1363 which does not allow air infiltration through the specimen and states: "1.14 This test method does not permit intentional mass transfer of air or moisture through the specimen during measurements. Air infiltration or moisture migration can alter the net heat transfer. Complicated interactions and dependence upon many variables, coupled with only a limited experience in testing under such conditions, have made it inadvisable to include this type testing in this standard. Further considerations for such testing are given in Appendix X1."

Very few hot boxes (C1363) can operate under these conditions. Hot boxes are required to have very tight control of the air movement in and out of the facility so that it does not affect the heat flow through the wall. The added air would need to be kept at the same temperature as the surfaces surrounding the air space or there would need to be a method of determining the amount of heat added or taken away from the air space by the air movement. There is no standard practice for this complexity. The commenter is not aware of any hot boxes that are available for testing that can operate under this specification. Hot box tests cost on the order of $25,000 for each test. This requirement is a research project requiring a very complex modification to a test method, a very expensive modification to current test facilities, and an expensive test. No published data are available on this methodology that we are aware of. It is unreasonable and not practical.

This modification will promote gaming because there is no standard methodology and results will vary widely as testers try to determine how to implement this. In this case the SEHPCAC feels the best way to achieve consistency between IECC code halves is to disapprove Part I of CE87.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Proponent : Wesley Hall, Reflectix Inc., representing Reflectix Inc. (wes.hall@reflectixinc.com) requests Disapprove.

Commenter's Reason: Both the original proposal and the proposed modification of C402.2.7 (Air Spaces) that recommends using ASTM C1363 should be disapproved. The proposal in its original form is fatally flawed; furthermore, the modification that was recommended for approval which uses ASTM C1363 does not improve the proposal and, therefore, it should be disapproved altogether.

The proposed modification to use ASTM C1363 to measure R-value with "air entering the bottom and exiting the top" of the test specimen is outside the scope of C1363. ASTM C1363 does not presently include this type of measurement.

ASTM C 1363 Section 1.14 - This test method does not permit intentional mass transfer of air or moisture through the specimen during measurements. Air infiltration or moisture migration can alter the net heat transfer. Complicated interactions and dependence upon many variables, coupled with only a limited experience in testing under such conditions, have made it inadvisable to include this type testing in this standard. Further considerations for such testing are given in Appendix XI.

The specification of a minimum air velocity (such as 7 cm/sec) is incomplete. The volume of air moving into a region is not determined by just the velocity. The temperature and humidity of the air entering the test specimen also impact the results.

This code proposal is premature because research is presently being considered by ASHRAE to establish the parameters for a test like that being proposed.

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standards requests Disapprove.

Commenter's Reason: The proposal and the AM by the floor modification should both be disapproved for the following reasons:

1. The proposal requires the R-value of an air space outside of the air barrier be limited to R-0.7 and does provide technical justification for this value. The ASHRAE 90.1 addendum does not limit the R-value to 0.7.
2. The phrase, "minimize airflow into and out of the enclosed airspace" is not good code language and is difficult to enforce.
3. The approved proposal as modified by the floor modification added a requirement for testing the assembly according to ASTM C1363 modified to require an air movement rate of 7 cm/sec within the air space. This is not allowed by the scope of ASTM C1363 which does not allow air infiltration through the specimen and states: "1.14 This test method does not permit intentional mass transfer of air or moisture through the specimen during measurements. Air infiltration or moisture migration can alter the net heat transfer. Complicated interactions and dependence upon many variables, coupled with only a limited experience in testing under such conditions, have made it inadvisable to include this type testing in this standard. Further considerations for such testing are given in Appendix X1."

Very few hot boxes (C1363) can operate under these conditions. Hot boxes are required to have very tight control of the air movement in and out of the facility so that it does not affect the heat flow through the wall. The added air would need to be kept at the same temperature as the surfaces surrounding the air space or there would need to be a method of determining the exact amount of heat added or taken away from the air space by the air movement. There is no standard practice for this complexity. The commenter is not aware of any hot boxes that are available for testing that can operate under this specification. Hot box tests cost on the order of $25,000 for each test, without this modification to the test method.

This requirement in the floor modificaiton is a research project requiring a very complex modification to a test method, a very expensive modification to current test facilities, and an expensive test. No published data are available on this methodology that we are aware of. It is unreasonable and not practical.

This modification will promote gaming because there is no standard methodology and results will vary widely as testers try to determine how to implement this.

This language will increase the cost of construction (as opposed to what the cost impact states) because it will require more

insulation in cases where the R-value of the air space is not allowed to be used.

CE87-16 Part I

CE87-16 Part II

R402.2.14 (New) [IRC N1102.2.14 (New)]

Proposed Change as Submitted

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

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 recognizes the use of airspaces to help achieve energy code compliance. It is consistent with recent limitations placed on the thermal resistance application of reflective and non-reflective airspaces in ASHRAE 90.1-2013 (Addenda Supplement, Addundum AC). Whether used on commercial or residential buildings, 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 ASRHAE 90.1 has provided a rational interim solution based on extensive review of available 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 such airspace do provide some nominal value and 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 Part II : R402.2.14 (NEW)-CRANDELL12878

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: This language will increase the cost of construction (as opposed to what the cost impact states.) Although this is an important issue, it has to be correct according according to actual testing.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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~~

Exception: The thermal resistance of ~~not less than 1/2-inch thick (12.7 mm) that are~~ airspaces located on the exterior side of the continuous air barrier and ~~are~~ adjacent to and behind the exterior wall covering material shall be ~~assigned~~ determined in accordance with ASTM C1363 modified with an ~~R-value not greater than R-0.7, provided that~~ air-flow entering the ~~R-values~~ bottom and exiting the top of the ~~cladding material and the exterior~~ airspace at a minimum air ~~film are not included in the calculations demonstrating compliance with Section R402.1.4~~ movement rate of 7 cm/sec.

Commenter's Reason: The residential energy committee agreed that CE87-II brings forward an important issue that needs to be resolved. Fortunately, it was resolved by the commercial energy committee's action to approve CE87-I with a modification (supported by various interested parties) to clarify appropriate means of qualifying the R-value of vented airspaces. This proposal makes the same modification to coordinate the residential and commercial energy codes.

Public Comment 2:

Proponent : Theresa Weston, DuPont Protective Solutions, representing DuPont Building Innovations (theresa.a.weston@dupont.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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~~

Exception:
The thermal resistance of ~~not less than 1/2-inch thick (12.7 mm) that are~~ air spaces located on the exterior side of the continuous air barrier and ~~are~~ adjacent to and behind the exterior wall covering material shall be ~~assigned~~ determined in accordance with ASTM C1363 modified with an ~~R-value not greater than R-0.7, provided that~~ air-flow entering the ~~R-values~~ bottom and exiting the top of the ~~cladding material and the exterior~~ air-space at a minimum air ~~film are not included in the calculations demonstrating compliance with Section R402.1.4~~ movement rate of 7 cm/sec.

Commenter's Reason: This is the modification that was approved in Part I at the Committee Hearing. As stated in that committee's reasoning statement, "the modification introduces a test method rather than using a random R-value that cannot be verified". The test method described has been demonstrated to be able to test commercial products.

Proponent : Lamont Millspaugh, Reflectix Inc., representing Reflectix Inc. (monty.millspaugh@reflectixinc.com) requests Disapprove.

Commenter's Reason: This proposal has numerous flaws and should be disapproved. The following problems are listed below:

- The stated R-value of R-0.7 is not supported by technical justification.
- ASHRAE 90.1 does not limit the R-value.
- The "interim solution" of the R-0.7 is unsupported with test data and therefore not appropriate to be included as a code requirement.
- The reason statement contains a confusing discussion on "air leakage". The ASHRAE 90.1 consensus project has agreed that a region on the interior of the air barrier that is enclosed on all sides with building components and is unventilated does not experience any "air leakage" that would impact benefit.
- The "Cost Impact" is inaccurate – the end result will necessitate additional materials in the assembly to meet thermal performance within the code requirements – proper evaluation and assignment of air space R-values in conjunction with other products in the assembly (for example, reflectives) insures accurate cost evaluations.
- And, the original language specifies "enclosed airspace located on the interior side of the continuous air barrier" – then goes on to specify different treatment for air spaces outside of the air barrier – these enclosed air spaces have the same

characteristics and should not be treated differently.

CE87-16 Part II

CE89-16
IECC: C402.3.

Proposed Change as Submitted

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 roofs.~~
   1.3. 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

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: This proposal accomplishes the intent of CE88-16 without the flawed definition and is therefore the preferred solution.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee (SEHPCAC@iccsafe.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 landspace elements.

C402.3 Roof solar reflectance and thermal emittance. Low-sloped roofs directly above cooled conditioned spaces in *Climate Zones* 1, 2 and 3 shall comply with one or more of the options in Table C402.3.

- **Exceptions:** The following roofs and portions of roofs are exempt from the requirements of Table C402.3:
  1. Portions of the roof that include or are covered by the following:
     1.1. Photovoltaic systems or components.
     1.2. Solar air or water-heating systems or components.
     1.3. Vegetative roofs.
     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.

Commenter's Reason: We agree that vegetative roofs should also be listed as one of the features for which the exception from the cool roof requirement applies. For consistency of application with the other codes, a definition of vegetative roof should be included. This proposed definition comes from the IBC with amendments approved in Louisville via code change G24-16.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Public Comment #2 for: Approved as Modified by Public Comment

Public Comment 2:

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 and landscaped roofs.
   1.4. Vegetative roofs.
   1.5. Above-roof decks or walkways.
   1.6. Skylights.
   1.7. 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.

Commenter's Reason: The SEHPCAC agrees with the addition of vegetative roofs for the application of this exception. They are a growing (pun intended) part of the market and provide an appropriate addition to the list of exceptions. However, the two existing similar features 'roof gardens' and 'landscaped roofs' should not be eliminated from the exception merely because they may not be as rigorously defined as vegetative roofs.
Contrary to CE89's proponent positions, "landscaped roofs" are well understood in the IBC. Section 1607.12.3.1 of the 2012 IBC was titled "**Landscaped Roofs**" and for the 2015 IBC was revised to "**Vegetative and Landscaped Roofs**". The definition of vegetative roofs was added to the IBC to distinguish the differences between the two types of roofs, not to remove landscaped roofs from the code. Rooftop gardens and landscaped roofs did not disappear from the 2015 IFC. Section 317, "Rooftop Gardens and Landscaped Roofs" still exists. Building officials have understood these roof materials for many code cycles and the IBC and IFC code adoption process has not seen the need to create definitions.

Therefore, there is no reason to remove these roof types from the exception list, just because a third type of roof vegetation has been added to the building code.

Vegetation acts to cool the roof and should remain in the exception. Roof gardens should remain in the exceptions, as this allows modular vegetative assemblies and other products that do not meet the precise definition of vegetative roofs. These products are widely used to meet the vegetative roof requirements of green building codes and standards.

Code change proposals F22-16 would amend the fire code to use the term vegetative roof exclusively. The proposal was disapproved and should remain disapproved. Vegetative roofs should not be the only acknowledged form of a 'green-ish' roof. F186-16 would have eliminated landscaped roof and rooftop garden from the IBC. The terms need to be retained.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Public Comment 3:

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standards requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C402.3 Roof solar reflectance and thermal emittance. Low-sloped roofs directly above cooled conditioned spaces in *Climate Zones* 1, 2 and 3 shall comply with one or more of the options in Table C402.3.

Exceptions: The following roofs and portions of roofs are exempt from the requirements of Table C402.3:

1. Portions of the roof that include or are covered by the following:
   1.1. Photovoltaic systems or components.
   1.2. Solar air or water-heating systems or components.
   1.3. ~~Vegetative~~ Roof gardens and 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.

Commenter's Reason: We request approval as modified. "Roof gardens" should not have been deleted from the exception and is added back in this modification.

Vegetation acts to cool the roof and should remain in the exception. The addition of roof gardens allows the use of modular vegetative assemblies and other products that do not meet the precise definition of vegetative roofs. These products are widely used to meet the cool roof requirements of green building codes and standards. Modular vegetative assemblies are trays that can be purchased with or without vegetation and placed on roofs, ultimately with vegetation. An example of a modular system is shown here: http://www.liveroof.com/system-overview/

CE89-16

CE91-16

IECC: C402.4, C402.4 (2) (New), C402.4.3, C407.5.1.

Proposed Change as Submitted

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
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

Floors, slab on grade	*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	As proposed
	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.	
	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
	External shading and PF: None	As proposed
Skylights	Area	As proposed
	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	
	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
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 factors are provided than in the proposed design.	As proposed
	Economizer[d] : same as proposed, in accordance with Section C403.3.	As proposed
Service water heating[e]	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 (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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This is an arbitrary application of residential code provisions across all building and occupancy types based only on height. The projection factors are eliminated. A study on occupancy types would be better or the overall glazing percentage should be studied as an approach. The code should not penalize shorter buildings in order to align with the residential provisions. The text arbitrarily breaks up the text into short and tall buildings with the idea that certain types of windows are put into each.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects requests Approve as Submitted.

Commenter's Reason: This change creates a fenestration U-factor/SHGC table in commercial buildings three stories or less. The committee recommended denial.

Currently all commercial buildings have the same fenestration requirements. This proposal treats commercial buildings three stories or less in height similar to residential buildings instead of as a commercial buildings that may be more than three stories in height. The committee stated that this is an arbitrary application of residential code provisions across all building and occupancy types based only on height. The AIA believes that this limit has been traditional for residential buildings and is not capricious. This proposal clarifies which table applies under the standard reference design of the performance path. The benefits may be small, but they are positive for energy efficiency, so we believe this proposal has merit.

We urge the membership to support the change for approval as submitted.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); William Prindle, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition requests Approve as Submitted.

Commenter's Reason: CE91 should be approved as submitted because it improves the efficiency requirements for windows in commercial buildings up to 3 stories in height, using products widely available and proven cost-effective in similar residential buildings. It is a reasonable approach to achieve significant improvement in the insulating properties for windows in smaller commercial buildings. We believe that concerns raised at the Committee Action Hearing and the Committee Reason Statement misunderstand the impact of this proposal, and we offer the following additional clarifications:

- This is one of the few envelope-related proposals to the Commercial Provisions of the IECC that will bring about significant energy savings. As discussed in the original Reason Statement, these improvements would bring about substantial energy cost savings that are cost effective, by specifying window products that are already included in residential code prescriptive requirements and widely used in residential buildings. Given the high percentage of window area in typical commercial buildings and the high U-factors and SHGCs for fenestration as compared with opaque walls, it is critical that windows perform better from an energy efficiency perspective or that their weaker performance is offset by other building components.
- CE91 essentially requires punched-opening fenestration in commercial buildings 3 stories or less to meet the same U-factor and SHGC requirements as in the residential code. For many years, commercial fenestration U-factors have been held back by opponents who claim that certain frame types that achieve more efficient U-factors are not suitable for wind load requirements in high-rise commercial buildings. This proposal recognizes that a significant number of commercial buildings are 1-3 stories in height, and, from a U-factor perspective, operate very much like a residential building. If there are no high-rise specific requirements that apply, there is no reason why the windows in these buildings cannot meet the more stringent efficiency requirements of the residential code for the same size of buildings.
- Under this proposal, curtain wall fenestration and entrance doors would continue to meet the same U-factor requirements as currently required in the commercial code. Examples raised at the hearing, such as 2-story airport terminals with curtain walls, would meet the same fenestration U-factor requirements as currently set in the IECC. Likewise, the example of a mixed-occupancy building with a storefront on the ground floor and two residential stories above would apply the storefront value for the ground floor, and the operable and fixed fenestration value for the top two floors. Again, this proposal focuses only on U-factors only for punched-opening windows in low-rise commercial buildings.
- We disagree with the Committee Reason Statement, which suggests that a better division might be according to occupancy types. Occupancy types tell us little about the actual design of the building. Whatever the use or occupancy type, if a low-rise commercial building has punched-opening windows and has the same height (and associated wind loads) as a residential building, there is no reason to continue to apply a much weaker separate set of fenestration requirements that were designed for high-rise office buildings.
- The U-factors in the new table are readily achieved by a wide range of products in the marketplace. Many more efficient products from the residential sphere are already in use in these low-rise commercial buildings and are available for code compliance.
- Given the size of these commercial buildings (one to three stories) and the goal of simplified, more efficient fenestration requirements for these types of buildings, the SHGC requirements are simplified by removing the projection factor trade-offs consistent with the residential requirements, which also do not permit such trade-offs.

CE91 uses existing and widespread window technology to bring about a significant improvement in fenestration U-factors in smaller commercial buildings. We recommend approval as submitted.

CE91-16

CE92-16
IECC: C402.4.

Proposed Change as Submitted

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 (http://www.efficientwindows.org/comfort.php) 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This is an overreach in terms of energy savings. Big jumps such as proposed make all buildings look like they are in cooling dominated zones. The text should be occupancy dependent. Multi-family projects have heating as the largest load, and in large cities, such jumps would penalize such building projects. No calculations were provided to demonstrate the benefits of the proposed changes.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Approve as Submitted.

Commenter's Reason: The code changes recognizes the changes in technology in building fenestrations and the options to incorporate them. The committee recommended denial.
The committee stated that "This is an overreach in terms of energy savings. Big jumps such as proposed make all buildings look like they are in cooling dominated zones. The text should be occupancy dependent. Multi-family projects have heating as the largest load, and in large cities, such jumps would penalize such building projects. No calculations were provided to demonstrate the benefits of the proposed changes."

We disagree that there is a difference based occupant responses to solar heat gain. Whatever opening is exposed in any building of any occupancy will experience the same heat gain and will put a demand on the structure without regard to what is inside the building. While heating may be the largest load for one occupancy, lowering the solar heat gain will reduce the energy demand for summer design loads and will reduce costs. At most the simple exchange of window glazing is easily ofset by the lowering cooling demand.

The AIA urges the membership to support this change as submitted.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); William Prindle, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance

Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition requests Approve as Submitted.

Commenter's Reason: CE92 should be approved as submitted because it will yield 2-5% additional energy savings in commercial buildings in climate zones 4–6 at little or no extra cost by improving (reducing) the fenestration SHGC in those climate zones. SHGC is the percentage of solar heat allowed by the fenestration product into the building. Lower SHGCs in commercial buildings reduce cooling load, electrical peak demand and energy use and improve summer comfort:

- Lower SHGC fenestration is already widely available, and it has been demonstrated cost-effective. This proposal simply extends the lower SHGC products from climate zones 1-3 into climate zones 4-6, which also have large cooling loads. California Title 24 already requires 0.22-0.26 SHGC for its nonresidential buildings. These SHGCs were found to be cost-effective across the whole state – California's climate varies widely -- covering the equivalent of IECC climate zones 2-6.
- The Committee recommended approval of CE94, which also proposed to reduce SHGCs in these climate zones, but by a much smaller amount. While CE94 will provide minimal energy savings, the reductions proposed in CE92 are far more robust and justified. There is no reason to stop with the paltry savings achieved by CE94.
- More stringent SHGC requirements can allow the builder or design professional to downsize air conditioning equipment, which will not only save a building owner money at construction, but will provide cost savings every time the equipment is replaced. Indeed, in our view, the proposed reduced SHGC, which is a result of a change in window coating, is easily paid for simply by reduced equipment sizes in most cases.
- Lower air conditioning loads will not only save the building owner money – they will also contribute to reducing electrical peak demand. Most utilities – even in the northern portion of the U.S. – are summer-peaking, and any reduction to the overall system peak will help reduce electricity rates for all consumers.
- Improved SHGC will also contribute to occupant comfort, which will mean occupants are less likely to adjust thermostats, which would use more energy to produce comfort through more cooling. As California concluded in setting its SHGC requirement at similar levels, the levels of SHGC reduction required by this proposal can be easily achieved without significantly reducing the amount of visible light, so we do not expect any impact on lighting.
- As outlined in the original Reason Statement, the vast majority of commercial buildings are cooling-dominated, even in northern climate zones. And while the impact on multifamily buildings is not as big, we expect that the additional benefits of a more comfortable home and smaller air conditioning equipment will far outweigh the very low cost of the upgrade. These improved SHGC requirements are commonsense, code-effective improvements for multiple building types.

We disagree with the Committee Reason Statement about this being an "overreach" for energy savings. The SHGC values selected are the same as those already applied in other climate zones and in the state of California, and there are several different approaches that are capable of achieving these values.

Low SHGC fenestration provides a variety of benefits to multiple types of commercial buildings, as well as high-rise residential buildings, including energy and cost savings, improved comfort, and electrical peak demand reduction. For these reasons and all of the reasons outlined in the original proposal, we recommend that CE92 be approved as submitted.

CE92-16

CE93-16

IECC: C402.4, C402.4.3, C402.4.3 (New), C402.4.3.1 (New).

Proposed Change as Submitted

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**~~
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.~~

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 (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 (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.

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposal: makes the code more complicated, deletes the important orientation aspect, eliminates simple to use table, and increases the cost of construction without benefit. Comparing to a DOE analysis for the 2013 standard is not appropriate because the analysis gives the total energy savings for the standard as opposed to savings for each aspect.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Approve as Submitted.

Commenter's Reason: This change simplifies accounting for Projection Factor, and strengthens SHGC requirements. The committee recommended denial.
The committee stated that the proposal makes the code more complicated, deletes the important orientation aspect, eliminates simple to use table, and increases the cost of construction without benefit. However, Projection Factor (PF) credits buildings with projection overhangs above fenestration. Ideally, projections protect buildings from solar heat gain. In reality, low SHGC windows are much more effective, and credit for overhangs that allow high SHGC windows should be reduced. This proposal simplifies code language on PFs and recognizes the effectiveness of high SHGC window films by restoring the more efficient SHCG values of the 2012 IECC.

AIA asks the membership to support this change as submitted.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); William Prindle, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition requests Approve as Submitted.

Commenter's Reason: CE93 should be approved as submitted because it simplifies and improves the fenestration SHGC requirements for the IECC across all climate zones and recaptures energy savings lost in the revisions to the 2012 IECC. The residential and commercial IECC prescriptive tables (and the corresponding tables in ASHRAE 90.1) historically have always established a single SHGC requirement that applied irrespective of orientation. The 2015 IECC changed that by adding a total of 6 potential SHGC requirements for each climate zone, depending on orientation or projection factor. This change created several problems, but the most significant problem is that **the 2015 IECC SHGC requirement is less stringent than the 2012 IECC.**
For example, the 2015 IECC permits up to a 0.33 SHGC in climate zone 1, *even where there is no window overhang*. By contrast, the 2012 IECC requires a 0.25 SHGC for all orientations. The SHGC is only permitted to be increased where there is an actual projection factor over the window, according to a specific calculation. It does not make any sense to weaken the SHGC requirements in a code update – particularly in commercial buildings that tend to be cooling-dominated.

CE93 corrects this code rollback from last cycle by restoring the single SHGC requirement for each climate zone, and adopts a simplified version of the ASHRAE projection factor table (ASHRAE 90.1-2013 Table 5.5.4.4.1) to award credit for actual projection factors. This makes the IECC approach to projection factors consistent with ASHRAE. This proposal both strengthens and simplifies the IECC, while making it more consistent with ASHRAE 90.1 on a key technical issue (projection factor) and we urge approval as submitted.

CE96-16

IECC: C402.4.1, C402.4.1.2, C402.4.2.

Proposed Change as Submitted

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.

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.

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*~~
Where daylight responsive controls complying with Section C405.2.3.1 are ~~installed~~ provided in ~~*daylight zones*~~daylight zones under skylights, the allowed skylight area shall be increased to not greater than 5 percent of the gross roof area.

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.

C402.4.2 Minimum skylight fenestration area. ~~In an~~
Skylights shall be provided in enclosed ~~space~~ spaces 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~~ . The total *daylight zone* under skylights shall be not less than half the floor area and shall ~~provide~~ comply with 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.

(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 (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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Section 402.4.2 needs to state a maximum limit on skylight area.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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.

~~**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.~~

C402.4.1.2 Increased skylight area with daylight responsive controls. Where daylight responsive controls complying with Section C405.2.3.1 are provided in ~~daylight~~ toplit zones ~~under skylights~~, the allowed skylight area shall not be ~~increased to not~~ greater than 5 percent of the gross roof area~~.~~

~~**Exception:** The skylight area shall not be limited to 5 percent of the gross roof area where~~ or that required for compliance with Section ~~C402.4.2~~ C402.1.2, Item 1, whichever is greater.

Commenter's Reason: Restricting skylight area to no more than 5 or 6 (based upon approval of CE97 during the CAH) percent of the roof area in Section C402.4.1.2 conflicts with the intent and requirements of Section C402.4.2. Section C402.4.2 requires that minimum toplighting, along with automatic lighting controls, 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).
C402.4.2 also requires a minimum ratio of skylight area to toplight area of 3% or a minimum skylight effective aperture of 1%. Both of these factors relate to the amount of light that will enter the building through these openings during daylight hours.

Restricting the skylight area to 5 or 6 percent of the roof area increases the difficulty, and in some cases the cost, of complying with this provision in buildings that consist primarily of large, open spaces. Depending upon the geography of the space complying with both the maximum area restriction and minimum area requirement may not be possible.

The reason statement for the original proposal gave examples of this with regards to a large open commercial space, and a fitness/gymnasium facility. Many other examples could be developed for other types of spaces based upon its shape and use.

Although the IECC-Commercial committee appeared to recognize the potential conflict that occurs, they were concerned that the initial proposal, as submitted, does not establish any maximum skylight area when the exception applied. It was not the intent of the SEHPCAC to remove all area restrictions when the exception applied, but merely to establish the area needed to comply with Section C402.4.2 as the maximum skylight area.

This Public Comment revises the original proposal to clarify that intent. It specifically limits the skylight area to either 5 or 6%, or that required to comply with Item 1 of Section C402.4.2, if needed. The Public Comment specifically references only Item 1 of Section C402.4.2 because it provides a fixed skylight area, based upon a minimum skylight VT of 0.4.

Also, the proposal removes the exception from Section C402.4.1 without substitution. Since Section C402.4.2 requires automatic daylighting controls, permitting the skylight area to be greater than the prescriptive limit would only be applicable to Section C402.4.1.2, and not C402.4.1.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

CE99-16

IECC: C402.4.2.

Proposed Change as Submitted

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.

(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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This proposal conflicts with CE98-16 which was recommended for approval. It is not the intent of the code to include specific lighting.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Eric Makela, representing Northwest Energy Codes Group (eric.makela@cadmusgroup.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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, ~~skylights are required to provide~~ the total toplight ~~*daylight zone area*~~ daylight zone 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* ~~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.

$$\text{Skylight Effective Aperture} = \frac{0.85 \cdot \text{Skylight Area} \cdot \text{Skylight VT} \cdot \text{WF}}{\text{Daylight zone under skylight}}$$ **(Equation 4-4)**

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:

2.1. Buildings in Climate Zones 6 through 8.
2.2. Spaces where the combined total *general lighting* and ~~specific application~~ additional interior lighting power density is less than 0.5 W/ft^2 (5.4 W/m^2).
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.

2.4. Spaces where the daylight zone under rooftop monitors is greater than 50 percent of the enclosed space floor area.

2.5. Spaces where the total floor area minus the area of sidelight daylight ~~zone area~~ zones is less than 2,500 square feet (232 m^2), and where the lighting in the daylight zone is controlled in accordance with Section C405.2.3.

Commenter's Reason: Code Change Proposal CE99-16 made changes to terminology used to identify daylighting under skylights and next to vertical fenestration similar to CE98-16. CE99-16 also proposed modifications to Exception 2, changing the exception from less than 0.5 W/ft^2 for general lighting only to less than 0.5 W/ft^2 for general and additional interior lighting installed in the building e.g. retail display lighting, closing a loophole in the code. CE99-16 used incorrect terminology, "specific application lighting," to describe this lighting. This Public Comment corrects the terminology used by referencing "additional interior lighting" (see Section C405.4.2.2.1) that regulates retail display lighting.

The additional interior lighting power allowances for retail exceed 0.5 W/ft^2 in all cases which could result in cases where the general lighting is less than 0.5 W/ft^2 but the retail lighting installed is 0.6 W/ft^2 for example. Large outdoor stores (e.g. Cabelas or Bass Pro Shops) that display ATVs and boats, under large roof areas could install only display lighting at 0.6 W/ft2 (see Retail Area 2) and general lighting at much lower 0.5 W/ft^2 exempting the store from this requirement. This proposed change would close this loophole in the exemption.

This proposed modification, currently adopted as part of Washington State Nonresidential Energy Code, is shown to save and additional $384 to $408 per year over the current estimated energy savings.

This Public Comment also incorporates the changes approved in CE 98 that changed the terminology from "*daylight zones under skylights*" to toplight and "*daylight zones next to vertical fenestration*" to sidelight. This was done to ensure consistent terminology was used throughout the code.

Cost Estimate

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).

CE99-16

CE102-16

IECC: C402.4.4 (New), C405.2.3, C405.2.3.1, C405.2.3.2, C405.2.3.3.

Proposed Change as Submitted

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 we get to Section C402.4.1.1 because they are trying to increase the allowed glazing area, we see this requirement for 50% of the net floor area to be within 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 where that it tells me what 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 what they were 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 what they were talking about.

That can't be the way it's done. So what are our options?

Option 1: go through all of C402.4 and every where it mentions *daylight zone,* add a reference to Sections C405.2.3.2 and C405.2.3.3. You would 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.

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

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. Daylight zones shall include toplit zones and sidelit zones.

C402.4.4.1 ~~Sidelight daylight~~ Sidelit zone. The ~~sidelight~~ sidelit~~*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~~ sidelit zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 2 feet (610 mm), whichever is less, as indicated in Figure 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 C402.4.4.1(2) and C402.4.4.1(3).~~
2. The area of the *fenestration* is not less than 24 square feet (2.23 m^2).
3. 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.
4. Where located in existing buildings, the *visible transmittance* of the *fenestration* is not less than 0.20.

C402.4.4.2 ~~Toplight daylight~~ Toplit zone. The ~~toplight daylight~~ toplit zone is the floor area underneath a roof fenestration assembly which complies with all of the following:

1. The ~~daylight~~ toplit zone shall extend laterally and longitudinally beyond the edge of the roof *fenestration* assembly to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.7 times the ceiling height, whichever is less, as indicated in Figure C402.4.4.2.
2. Where the *fenestration* is located in a rooftop monitor, the toplit *zone* shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the *fenestration*, whichever is less, and longitudinally from the edge of the *fenestration* to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.25 times the height from the floor to the bottom of the *fenestration*, whichever is less, as indicated in Figures C402.4.4.1(2) and C402.4.4.1(3).
3. No building or geological formation blocks direct sunlight from hitting the roof *fenestration* assembly at the peak solar angle on the summer solstice.
4. 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 toplit~~*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~~ sidelit~~*daylight zones*~~ complying with Section 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~~ toplit~~*daylight zones*~~ complying with Section 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~~ Sidelit 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~~ toplit~~*daylight zones*~~ in accordance with Section C402.4.4.2 shall be controlled independently of lights in ~~sidelight~~ sidelit~~*daylight* *zones*~~ in accordance with Section 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~~ sidelit~~*daylight* zones~~ in accordance with Section 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.

Committee Reason: The proposal reorganizes the text to place it in the envelope section where it belongs. The Modification is consistent with previous action on another proposal that changed the terminology.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

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~~ C405.2.3.2 and ~~C402.4.4.2~~ C405.2.3.3, as applicable. Daylight zones shall include toplit zones and sidelit zones.

C405.2.3 Daylight-responsive controls. *Daylight-responsive controls* complying with Section C405.2.3.1 shall be provided to control the electric lights within *daylight zones* in the following spaces:

1. Spaces with a total of more than 150 watts of *general lighting* within sidelit *zones* complying with Section ~~C402.4.4.1~~ C405.2.3.2. *General lighting* does not include lighting that is required to have specific application control in accordance with Section C405.2.4.
2. Spaces with a total of more than 150 watts of *general lighting* within toplit *zones* complying with Section ~~C402.4.4.2~~ C405.2.3.3.

   Exceptions: Daylight responsive controls are not required for the following:

   2.1. Spaces in health care facilities where patient care is directly provided.
   2.2. Dwelling units and sleeping units.
   2.3. Lighting that is required to have specific application control in accordance with Section C405.2.4.
   2.4. Sidelit 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 toplit *zones* in accordance with Section ~~C402.4.4.2~~ C405.2.3.3 shall be controlled independently of lights in sidelit *zones* in accordance with Section ~~C402.4.4.1~~ 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 shutoff of all controlled lights.
6. Lights in sidelit *zones* in accordance with Section ~~C402.4.4.1~~ 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.

~~**C402.4.4.1**~~ **C405.2.3.2 Sidelit zone.** *No change to text.*

~~**C402.4.4.2**~~ **C405.2.3.3 Toplit zone.** *No change to text.*

Commenter's Reason: The proposal points out an important deficiency in the current code, namely that users of Section C402.4 may not know that there are clearly defined requirements for daylight zones in Section C405. However, there is a much

easier fix than what is proposed. Rather than relocating all of the daylight zone content from the lighting section to the envelope section, we should just provide a reference in the envelope section to the appropriate requirements in the lighting section. This has several advantages:

1. By the time the 2018 code is published users will have had three years to learn that the daylight zone requirements are located in Section C405. Why move it and confuse them?

2. When users see 2 pages of new content (all marked as a revision in the code book) in the envelope section, they will need to read through it all carefully to see if it was changed at the same time it was moved. In this case, less change is better.

3. Most importantly, we should consider where this content belongs in the long run. Where is it most likely to be found by the people who need it? We would argue that for every new construction project where an envelope is being built, there are at least 5 alterations where lighting controls are being provided. People who design lighting control systems will be referring to these requirements vastly more frequently than people who design building envelopes.

The changes that were offered as a floor modification and approved by committee are good, and should remain in the proposal. This comment deals only with the issue of where the content should be located.

CE102-16

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.

Proposed Change as Submitted

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^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~~*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)
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**~~ **C402.5.1.2.2 Materials.** Materials with an air permeability not greater than 0.004 cfm/ft^2 (0.02 L/s • m^2) of tested material area 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**~~ **C402.5.1.2.3 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) of tested assembly area 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 where 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 (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. (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 (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/ (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 (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 (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 (https://www.energycodes.gov/development/2018IECC).[7]

CE105-16 : C402.5-WILLIAMS12334

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: The cost of testing is deceasing and builders are learning the procedures. Envelope flaws are usually invisible. This motivates designers to pay attention to details of envelope construction. This is working in residential and is a success story. Research supports that this is cost effective and is a significant energy saver. Testing is an important tool for code enforcement where building details are complex. This prevents deficiencies from being overlooked. The proposal requirements are achievable. Testing based on size and zone is easy in commercial spaces. The current code does not ensure envelope tightness.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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.

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 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.

3. <u>Where new building envelope assemblies are part of an alteration to an existing building, air leakage testing shall be required only for new envelope assemblies.</u>

Commenter's Reason: During the review of proposals approved during the CAH, the SEPHCAC committee was concerned over the approved language for air leakage testing of the building thermal envelope as it relates to alterations. SEPHCAC is submitting this public comment to clarify that whole building air leakage testing is required for new construction and is not required when an alteration to a portion of an existing building thermal envelope occurs. The concern arises from the reference to alterations under Section C503.3 which requires alterations to the building thermal envelope to comply with C402.5, which previously allowed the option to air leakage testing of the air barrier, when individual materials and assemblies meet the requirements outlined in the previous sections C402.5.1 through C402.5.8. Should CE105-16 be approved without this exception, it would appear that the air leakage testing of the entire building would be required anytime a portion of the building thermal envelope is altered. The proposed exception is intended to prevent an existing building that was designed when air leakage testing wasn't required; or contructed to a different threashold - having to comply with the current standard. In such situations the building would likely fail.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Public Comment 2:

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz); Bridget Herring, representing Mathis Consulting Company (bridget@mathisconsulting.com); Theresa Weston, representing DuPont (theresa.a.weston@dupont.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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**~~ **Exception:**

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.~~

Commenter's Reason:

CRANDELL: With appropriate practices, data and experience has shown that commercial buildings can readily achieve a 0.40 cmf/ft^2 leakage rate (or much less). In many cases, commercial buildings are targeting a leakage rate of 0.25 cfm/ft^2 or less, and they are achieving it. Having this exception is unnecessary and creates a loop-hole in the code for one of the major contributors to energy loss in buildings and occupant discomfort. Leaky buildings also tend to have a greater tendency for moisture problems. It is common practice to re-test a failed building after making corrections to verify the minimum performance target is met. This provides a means of ensuring performance and also helping builders and installers achieve a level of good practice necessary for success (without having to re-test). In many cases, appropriate corrections can be made while the test equipment is still on site (and is needed anyway to identify air leaks).

HERRING: During the development of- and voting on Addendum "L" in the 90.1 envelope subcommittee the second exception (402.5.1.2.1 #2) originated from concern about a project coming to the air leakage testing phase and failing. The 0.6 cfm/ft2 allowance was training wheels to come off in the next edition while builders learned how to seal a building. Essentially, this exception undermines the agreed upon 0.4 cfm/ft2, since any project could use the exception at any time. The exception is wholly unnecessary:

1. 0.4 cfm/ft2 is not stringent; in a large study of retrofits 0.25 cmf/ft2 was common.
2. If the builder follows the visual inspection requirements, AND tests, he will comply with ANY air leakage rate.

Considering a safety net is not needed, this exception should be removed.

WESTON: The proposed modification removes a testing loophole. If a building does not pass a building air leakage testing the situation should be resolved and the building re-tested. The original proposal has a vague language which this modification removes.

Public Comment 3:

Proponent : Steven Orlowski, representing Building Owners and Managers Association International (sorlowski@boma.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C503.3 Building envelope. New building envelope assemblies that are part of the *alteration* shall comply with Sections C402.1 through C402.5.

Exception: Alterations to the existing building thermal envelope shall not require air leakage testing of the entire building thermal envelope as required in Section C402.5.1.2.1.

Commenter's Reason: BOMA is submitting this public comment to add an exception to clarify that alterations of an existing buildings thermal envelope will not trigger the whole building air leakage testing. Based on testimony from the hearing and the proponents justification in the reason statement, it is clear that intent of the code change was to require the air leakage testing only in new construction. This exception simply clarifies that where alterations may include changes to the building thermal envelope in an existing building, the air leakage testing shall not be required.

Public Comment 4:

Proponent : Jeremiah Williams, U.S. Department of Energy, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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.~~
   1.1.The entire *building thermal envelope* area of all stories that have any of the following: spaces directly under a roof or above a floor that is part of the *building thermal envelope*, a building entrance, a loading dock, or *building thermal envelope* areas adjacent to the ground.
   1.2.Representative above-grade sections of the building totaling not less than 25 percent of the exterior 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~~ and 1.2, and the remainder of the *building thermal envelope* shall be assigned the same air leakage rate as the area tested under item 1.2 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~~ air leakage rate.
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.

Commenter's Reason: This public comment clarifies the language around sample based leakage testing of larger buildings. All the items that require testing are combined into one item, with the addition of underground and exterior floors.

The method of weighting the tested areas to arrive at a total leakage for the building is stated in more clear language.

The building size threshold and test requirements have not changed.

The support for testing is in the original reason statement.

The original proposal passed as submitted by the committee vote.

Bibliography: See original reason statement.

Public Comment 5:

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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.

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 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.

3. For group R-2 buildings air leakage testing need not be conducted on the whole building provided that the following portions of the building are tested:

   3.1 All conditioned spaces not located within a dwelling unit

   3.2 All dwelling units that have any spaces directly under a roof or above a floor that is part of the *building thermal envelope*.

   3.3 Representative dwelling units that include not less than 25 percent of the dwelling units not tested in item 3.2 and include not less than 25 percent of the total exterior wall area of the dwelling units not tested in item 3.2.

   Each tested dwelling unit and each other conditioned area in the building shall be verified as having an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8. 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, and as further required by the code official, such third party shall select the dwelling units for testing as required by item 3.3.

Commenter's Reason: For multi-family R-2 buildings, this public comment creates an additional path to air barrier testing that allows sampling and matches the requirements in the residential code.

While this is slightly relaxed from the testing required for other buildings, as 0.40 cfm/ft^2 at 75 Pa is roughly equivalent to 2.5 air changes per hour at 50 Pa, it does provide testing for R-2 buildings that is appropriate for the construction.

The benefits stated in the original building statement remain.

Bibliography: See original reason statement.

Public Comment 6:

Proponent : John Woestman, representing Kellen Company, representing Extruded Polystyrene Foam Association (XPSA) (jwoestman@kellencompany.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 in accordance with a nationally recognized standard 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~~ Additional report(s) describing and illustrating the diagnostic evaluation and 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~~.

Commenter's Reason: Consistent with ASHRAE 90.1-2016, this proposal provides needed inspection and verification requirements for actual performance of air barrier systems. Controlling leakage of conditioned air can provide significant energy benefits as well as control over indoor air quality.

While we agree with most parts of the proposal, Exception 2 of 402.5 should be revised.

Early in the design phase of the building, energy efficiency trade-offs are permitted based on a 0.4 cfm/ft2 maximum air leakage rate. Exception 2 increases the allowable air leakage rate, provided a reasonable diagnostic effort has been made to detect and seal leaks. Including the requirement for the diagnostic evaluation to be conducted in accordance with a nationally recognized standard (ASTM E1186, Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems would be eligible to be a "nationally recognized standard" for this application) provides valuable guidance for this diagnostic effort. Additional proposed revisions to Exception 2 add the requirement to develop a report describing and illustrating the diagnostic evaluation. This additional report along with the report identifying the corrective actions taken to seal the leaks is intended to allow the code official to evaluate the quality and extent of remedial actions taken to reduce air infiltration.

Please note deletion of exception #2, per a different public comment, is preferred. This public comment is being offered as a means of ensuring appropriate practices are followed if the exception #2 is retained in CE105.

Public Comment 7:

Proponent : Gayathri Vijayakumar, Steven Winter Associates, Inc., representing self (gayathri@swinter.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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.

2. For Occupancy Group R, air leakage testing need not be conducted on the whole building provided that the dwelling units in the building are tested. The measured air leakage shall not exceed 0.40 cfm/ft^2 (0.2 L/s · m^2) of the dwelling unit envelope surface area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, the building or dwelling units shall be tested in accordance with Section R402.4.1.2.

Commenter's Reason: I completely agree that requiring air-leakage testing is very valuable. This public comment simply offers an exception to the R occupancy group to either conduct compartmentalization testing, rather than whole building testing, or to comply with the air-leakage testing required under Residential Code Section R402.4. Offering a compartmentalization test option to multifamily buildings serves to evaluate both the air-leakage of the exterior envelope, as well as the undesirable leakage between dwelling units.

While it is not currently clear in 2015 IECC Section R402.4 if 100% of the dwelling units must be tested, if proposal RE56 is Approved, it introduces a much needed sampling protocol into that section.

Proponent : Donald Surrena, National Association of Home Builders, representing National Association of Home Builders (dsurrena@nahb.org) requests Disapprove.

Commenter's Reason: This proposal eliminates the current practical option to air barrier testing noted in 2015 IECC Section C402.5.1.2.1, "Materials," by now requiring all of the sixteen referenced building materials to be individually tested to verify the performance of those materials, where previously this testing was not required. For example, plywood, which was previously permitted as an air barrier material in the 2015 IECC would now be required by this proposal to be individually tested by a third-party agency to verify that air does not pass through it. This proposal to have each material individually tested is so cost prohibitive that no designer or builder would consider this option to code compliance and they will in essence be forced to whole-building air testing. This is a significant change and it would add additional costs for the material testing that was not previously required by the 2015 IECC.

This proposal provides a new table titled "Minimum Building Size Requiring Air Leakage Testing" that contains limitations based on climate zones and building floor areas where testing would not be required. The problem with this table is that the floor areas noted are very limited and impractical.

The 2015 IECC Air Barrier Compliance Options noted in Section C402.5.1.2 have worked well by permitting common building materials to be used as an air barrier component and this section of the code should remain as it is in the 2015 IECC.

We feel that this proposal should be disapproved.

Proponent : Ronald Nickson, National Multifamily Housing Council, representing National Multifamily Housing Council (rnickson@nmhc.org) requests Disapprove.

Commenter's Reason: The cost effective analysis used to justify the change is not appropriate for determining the feasibility of constructing multifamily buildings because it does not reflect the analysis used by financial institutions in determining the feasibility of a project. Multifamily construction financing is based on a 7-8 and somethings 10 year maximum payback. If the cost to constuct the project is above the payback period, the financial institutions will not provide the necessary funds to construct the project. The increasing cost of construction inherant in the change is not jusstified adding to the problem of providing affordable housing and housing that is needed in many communities for teachers, firefighters, pollice offices, and others living in the community.

Proponent : Steven Orlowski, representing Building Owners and Managers Association International (sorlowski@boma.org) requests Disapprove.

Commenter's Reason: BOMA International disagrees with the proponents justification to require all commercial buildings to be required to conduct air leakage testing and the committees action to approve CE105-16. By all accounts, the IECC is clear that all air barrier systems must comply with the manufactures installation requirements and designers/contractors are now understanding the importance of paying close attention to the the most common problem areas with their installation. By the proponents own account, when air barrier systems were tested in the field with and without a commissioning agent or third party inspection program, 60% of buildings were found to be in compliance with the proposed required air leakage levels indicated in this proposal. This is indicative of the prescriptive requirements successfully being implemented in the field by

knowledgeable contractors and better enforcement by the code officials. In addition, the proposal as written, would apply the requirements to alterations and additions to existing buildings which would have a significant cost impact on revitalizing existing buildings.

Proponent : Billie Zidek, APPA, representing APPA requests Disapprove.

Commenter's Reason: The APPA I-Code Work Group and the APPA Standards Code Council voted to oppose this proposal because;

- Testing of buildings will require engaging a separate testing contractor who will likely need to be trained, licensed, and certified to preform the testing, introducing a substantial new cost to the project total.
- Testing will delay the ability to occupy the newly constructed facility as the testing cannot be done until the entire envelope is in place and all mechanical systems fully operational. A failed test could result in failure to receive a Certificate of Occupancy introducing even further delay and expense while the problem is investigated and corrected. If a need is revealed for the air barrier layer to be re-exposed for repairs, this could require the expensive dismantling and re-building of finishes already in place. A failed test also introduces a greater likelihood of finger pointing between contractors and designers, delay claims, and legal action.
- There is also a delay concern in that is not enough trained, equipped, and certified testing firms to handle the anticipated workload leading to further concerns over delayed occupancy and high prices resulting from high demand and served by low supply.
- It is the code enforcement officers responsibility to ascertain compliance with the Energy Code by inspection and observation of conformance with reviewed contract documents and established industry best practices, random testing, special inspections were warranted, and review of submittals. The building inspector's responsibility should not be transferred to a third party for-profit private company paid for by the Owner. With proper and strict inspection protocol, code compliance of the final product would be more assured.

CE105-16

CE107-16

IECC: C402.5.1, C408.4 (New), C408.4.1 (New), C408.4.2 (New), C408.4.3 (New).

Proposed Change as Submitted

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 Northwest 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 will not achieve the 0.40 CFM/sf leakage rate required by the testing alternative. Instead, they would 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 went into effect was 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 would 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 with what is required by testing without actually making testing mandatory. The requirements as written are not achieving the energy savings intent of the code, and are therefore introducing complexity without 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 was conducted by Skanska and found that the air barrier commissioning requirement would have an incremental cost of $0.08-0.13/sf depending on building type and regional market.

CE107-16 :
C402.5.1-
DENNISTON13109

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: This fits well with CE105-16 revisions. If buildings fail testing, then commissioning is needed. The code officials are only on the job site for hours, while construction occurs over months. Lighting, HVAC, etc. are commissioned, so why not the envelope? A special inspector is needed.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Theresa Weston, representing DuPont Building Innovations (theresa.a.weston@dupont.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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~~ Verification 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.

C408.4 Air barrier ~~commissioning~~ verification. 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~~ verification and completion in accordance with the provisions of this section.

Exception: Buildings that have met the air leakage testing requirement of Section C402.5.

C408.4.3 Report. A final ~~commissioning~~ verification report indicating compliance with the continuous air barrier requirements shall be provided to the building owner and, upon request, to the *code official.*

Commenter's Reason: "Verification" is more accurate term to describe the actions being required in this proposal than is "commissioning". Commissioning encompasses much more than what is being proposed, as can be seen if ASTM E2813 Standard Practice for Building Enclosure Commissioning is reviewed.

Proponent : Steven Orlowski, representing Building Owners and Managers Association International (sorlowski@boma.org) requests Disapprove.

Commenter's Reason: BOMA disagrees with the committee's action to approve CE107 as a correlating requirement with the approval of CE105. There is no justifiable reason to require commissioning of the building envelope after the building has failed an air leakage test. By the time the building is ready to conduct an air leakage test, most of the air barrier will be concealed by the building exterior finishes. As for the comment regarding the code officials capabilities, there has not been enough data to support that air barrier installations are not being inspected in the field by the local authority. The code official establishes the required inspections and has the authority to require the exterior to remain exposed for observation and inspection. We strongly encourage the assembly to overturn the committees action and disapprove CE107.

CE107-16

CE108-16
IECC: C402.5.1.1.

Proposed Change as Submitted

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. Refrigerent piping penetrations shall be sealed by gasketing and mechanically secured.
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 allows for a mechanical sealing system for penetrations. Mechanical sealing system are used for some types of penetrations such as refrigerant piping which needs to specifically address vibration problems associated with 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 allows an option for a mechanically sealed systems which are already being used in construction

CE108-16 :
C402.5.1.1-
AHERN10909

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

C402.5.1.1 Air barrier construction. The *continuous air barrier* shall be constructed to comply with the following:

1. The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies.
2. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.
3. Penetrations of the air barrier shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Sealing shall allow for expansion and contraction of dissilimar materials and mechanical vibration. 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.~~Refrigerent piping~~

~~penetrations shall be sealed by gasketing and mechanically secured~~.

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.

Committee Reason: Approval is based on the proponent's published reason statements. The modification provides improved language regarding intent.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Hugo Aguilar, representing American Supply Association (haguilar@asa.net) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

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. Sealing shall allow for expansion and contraction ~~of dissilimar materials~~ , and mechanical vibration. 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.

Commenter's Reason: The Committee modification added the language "dissimilar metals." However, there was no reason provided as to why this change was made. The submitter did not mentioned anything about dissimilar metals in the the reason statement. The proposed modification will provide clarity in regards to the prevention of expansion and contraction on all metals; and not only dissimilar metals.

CE108-16

CE109-16
IECC: C402.5.1.1.

Proposed Change as Submitted

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~~ seams associated with penetrations shall be sealed in the same manner or taped or covered with ~~moisture vapor-permeable~~ 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.

Reason: Delete hyphen between vapor and permeable, move it between moisture and vapor. Already says in the first sentence that the sealing material has to be compatible with the construction material and location. Why say it again?

Cost Impact: Will not increase the cost of construction
rewording existing text

CE109-16 :
C402.5.1.1-
MEDINA13006

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Approval is based on the proponent's published reason statements.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Approve as Modified by this Public Comment.

Modify as Follows:

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 seams associated with penetrations shall be sealed in the same manner or taped ~~or covered with moisture-vapor permeable wrapping material~~. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation. Sealing of concealed fire sprinklers, where

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

4. Recessed lighting fixtures shall comply with Section C402.5.8. Where similar objects are installed that penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.

Commenter's Reason: Wrapping materials are not typically adhesive or sealing materials such that they can be used to seal a penetration against air leakage. Simply covering a penetration joint with such materials will not prevent air leakage. Thus, joints in an air barrier at penetrating elements must be sealed using tape or other sealing material. This public comment corrects this problem and clarifies the code with respect to penetrations in an air barrier.

CE109-16

CE110-16
IECC: C402.5.1.2.1.

Proposed Change as Submitted

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 w ith ASHRAE 90.1-2013 w here 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 w ill not increase the cost of construction

CE110-16 :
C402.5.1.2.1-
FERGUSON12490

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The code needs installation requirements to achieve the required air barrier. This subject matter belongs in the section for assemblies of materials. Air moves in the interstitial spaces of the building envelope therefore the stricken words need to remain for the integrity of the list of materials.

Assembly Motion: **As Submitted**
Online Vote Results: **Failed**
Support: 38.62% (73) Oppose: 61.38% (116)
Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: ASHRAE requests that this proposal be approved as submitted.
The International Energy Conservation Code Committee-Commercial was split on this proposal voting 7-6 for disapproval. Many of the committee members, both for and against the proposal, acknowledged the technical merits of the proposal are strong. ASHRAE believes the benefits to code officials and users of IECC and ASHRAE 90.1 of having the two documents in alignment outweigh the benefits of continuing to require manufacturers of single-ply roof membranes test their products for air permeability per ASTM E 2178—a test that routinely shows single-ply roof membranes easily pass the air permeability requirement of IECC section C402.5.1.2.1 Materials and thus provide little value for code officials when determining if overall air barrier systems are code compliant.

A similar change has been approved and will appear in ASHRAE 90.1-2016—an alternative compliance path for the commercial sections of IECC 2018. As part of ASHRAE's public comment ANSI-based process concerns were raised similar to those voiced during testimony for this proposal at the committee action hearings. In the end the change was approved because the technical merits of the change are limited to addressing:

1. The term "Fully-adhered" refers to an "Assembly" and not a Material as the section intends.
2. The removal of "Fully-adhered" does not alter the Material's ability to resist air leakage per the charging language requirement of ASTM E2178.

At the same time ASHRAE acknowledges the concerns related to the overall air barrier sections of ASHRAE 90.1 and IECC. A working group to determine if the air barrier section should be expanded and/or reorganized to achieve additional energy cost savings is currently active.

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

Commenter's Reason: The Commercial Energy Conservation Committee vote was split; ultimately voting 7-6 for disapproval with the chair casting the deciding vote. During testimony committee members stated that the technical merit of the proposal is sound but they are concerned about issues raised during opposition testimony-specifically concerns related to roof membrane system flutter, air leakage at the membrane perimeter and potential energy loss due to air moving within roof assemblies. NRCA believes these issues raised by opponents are not germane to the proposed change. The scope of this change is limited to the air barrier materials section (C402.5.1.2.1). This section does not and is not intended to contain requirements related to the construction and design of the overall building envelope air barrier system. Those requirements are already located in C402.5.1 Air Barriers and C402.5.1.1 Air Barrier Construction
The ASHRAE 90.1 committee has implemented the change for publishing in the 90.1-2016 edition (Addendum AY). As ASHRAE 90.1-2016 is an alternate compliance path for the commercial section of IECC 2018, building code officials will benefit by approving this public comment and ensuring the air barrier materials section of both documents are in sync.

Proponent : Wanda Edwards, representing RCI, Inc. (wedwards@rci-online.org) requests Disapprove.

Commenter's Reason: RCI is an international professional association whose members are architects, engineers and consultants who specialize in building envelope and roof design. Our organization is opposed to this proposal. First, this proposal changes the requirements of the code and the stringency of the code. A single ply membrane functions as an air barrier only when fully adhered. By changing the words fully adhered membrane to single-ply membrane in the deemed to comply list would allow for the installation of mechanically fastened single-ply membranes as air barriers without any additional installation requirements.
The installation requirements given in Section C402.5.1.1 are not adequate instructions on how to use a single ply membrane as an air barrier. Section C402.5.1.1 does not provide guidance on how the interface of the wall air barrier and the roof membrane are to be constructed. The intro to this section of the code says "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." Not all single ply membrane manufacturers have installation instructions about how to use their product as an air barrier, nor have had their product tested in accordance with ASTM E 2178. This would indicate that not all manufacturers intend for their product to be used as an air barrier.

The code change is not consistent with ASHRAE 90.1 in that the IECC does not contain a section on air barrier design as ASHRAE 90.1 does. ASHRAE Section 5.4.3.1.1 Air Barrier Design Requires that the air barrier be designed to resist positive and negative pressures from wind, stack effect, and mechanical *ventilation*. This requirement is found under air barrier

construction in the IECC. A design requirement should not be located with the construction requirements. A fully adhered membrane would meet these design requirements to resist positive and negative pressures from wind. However, a mechanically fastened system will not perform the same under wind pressures as a fully adhered membrane performs.

The problem with using a single ply membrane is not a problem of air leakage, but rather a problem of air intrusion. In a paper written by Baskaran & Molleti 2009 entitled *Air intrusion vs Air Leakage*, they state "although research has been directed to the characterization of individual roof components such as the membrane, relatively little attention has been given to how air movement affects system performance. It has been incorrectly assumed that air movement in roofing assemblies is similar to air movement in wall assemblies. Several factors contribute to this misconception, including existing energy and building-code requirements and the current air-barrier standards, which are all focused on wall assemblies." The paper goes on to say that air intrusion "occurs when conditioned indoor air enters into a building envelope assembly but cannot escape to the exterior environment, as is the case for mechanically attached roofs, it is termed air intrusion." "Using a single ply membrane that is not adhered will allow air from inside the building to pass into the roof assembly. If the building is being heated with warm humid air and the temperature is cold outside, condensation will occur.

Much has been published about air intrusion into the roof assembly and the accumulation of moisture. Most recently is an article by Thomas Taylor with GAF (*Interface* August 2016) which states in the conclusions "Fully adhered membrane systems based on polyiso insulation significantly reduce airflow to the underside of the membrane. In addition, fully adhered systems do not billow upwards due to wind loads, again reducing airflow."

The IBC defines a roof assembly as "a system designed to provide weather protection and resistance to design loads. The system consists of a roof covering and roof deck or a single component serving as both the roof covering and the roof deck. A roof assembly includes the roof deck, vapor retarder, substrate or thermal barrier, insulation, vapor retarder and roof covering." The roof is an assembly, and while various parts of the assembly may pass the air barrier test, it may not necessarily mean the assembly will. Knowledge of how assemblies perform and interact in a system is required to effectively provide a system that will function as an air barrier.

The National Institute of Building Sciences' *Whole Building Design Guide*, recommends the installation of an additional air barrier when using a mechanically fastened membrane. There needs to research and work done to develop test methods for determining the amount of air intrusion into a roof assembly, and until such time as test methods are available, and design criteria included in the code for using a mechanically fastened membrane as an air barrier, the deemed to comply list should remain as is.

CE110-16

CE111-16
IECC: C402.5.1.2.1.

Proposed Change as Submitted

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~~ 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: 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: There is a lack of data to support the proposal.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Mike Fischer, Kellen, representing The Polyisocyanurate Insulation Manufacturers Association (mfischer@kellencompany.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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. ~~Polyisocyanurate~~ Faced 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.

Commenter's Reason: The original proposal sought to remove the foil facing requirement for rigid polyiso insulation to comply with the deem to comply as air barrier materials list in Section C402.5.1.2.1. We prepared a floor modification to retain the facing but remove the requirement that the facing be foil, but did not provide representative test data showing that rigid polyiso with typical commercial coated fiber mat glass facers.

Attached to this comment is ASTM E2178 test data from three manufacturers showing results well below the code requirement of 0.004 cfm/ft^2 for faced rigid polyiso insulation board at nominal 1/2" thickness (.045"). Test values range from 0.00009 to 0.00014 cfm/ft^2 for one producer (RMax). Additional reports and published material properties in the attachments confirm the typical performance values at levels significantly below the code requirement.

The current list of materials include other rigid insulation materials; the data presented demonstrate that rigid polyiso is also in compliance with the air barrier materials requirement. The Polyisocyanurate Insulation Manufacturers Asociation requests that CE111-16 be approved as modified by this public comment.

CE111-16

CE112-16
IECC: C402.5.1.2.1.

Proposed Change as Submitted

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 will be unchanged.

CE112-16 :
C402.5.1.2.1-
WILEN AIA CDT
RRO9964

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval is consistent with the action taken on CE110. If "fully adhered" is removed, the products might not be properly installed and acting as air barriers.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: The Commercial Energy Conservation Committee vote was split; ultimately voting 7-6 for disapproval with the chair casting the deciding vote. During testimony committee members stated that the technical merit of the proposal is sound but they are concerned about issues raised during opposition testimony-specifically concerns related to roof membrane system flutter, air leakage at the membrane perimeter and potential energy loss due to air moving within roof assemblies. NRCA believes these issues raised by opponents are not germane to the proposed change. The scope of this change is limited to the air barrier materials section (C402.5.1.2.1). This section does not and is not intended to contain requirements related to the construction and design of the overall building envelope air barrier system. Those requirements are already located in C402.5.1 Air Barriers and C402.5.1.1 Air Barrier Construction
The ASHRAE 90.1 committee has implemented the change for publishing in the 90.1-2016 edition (Addendum AY). As ASHRAE 90.1-2016 is an alternate compliance path for the commercial section of IECC 2018, building code officials will benefit by approving this public comment and ensuring the air barrier materials section of both documents are in sync.

Proponent : Wanda Edwards, representing RCI, Inc. (wedwards@rci-online.org) requests Disapprove.

Commenter's Reason: RCI is an international professional association whose members are architects, engineers and consultants who specialize in building envelope and roof design. Our organization is opposed to this proposal. First, this proposal changes the requirements of the code and the stringency of the code. A single ply membrane functions as an air barrier only when fully adhered. By changing the words fully adhered membrane to single-ply membrane in the deemed to comply list would allow for the installation of mechanically fastened single-ply membranes as air barriers without any additional installation requirements.

The installation requirements given in Section C402.5.1.1 are not adequate instructions on how to use a single ply membrane as an air barrier. Section C402.5.1.1 does not provide guidance on how the interface of the wall air barrier and the roof membrane are to be constructed. The intro to this section of the code says "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." Not all single ply membrane manufacturers have installation instructions about how to use their product as an air barrier, nor have had their product tested in accordance with ASTM E 2178. This would indicate that not all manufacturers intend for their product to be used as an air barrier.

The code change is not consistent with ASHRAE 90.1 in that the IECC does not contain a section on air barrier design as ASHRAE 90.1 does. ASHRAE Section 5.4.3.1.1 Air Barrier Design Requires that the air barrier be designed to resist positive and negative pressures from wind, stack effect, and mechanical *ventilation*. This requirement is found under air barrier construction in the IECC. A design requirement should not be located with the construction requirements. A fully adhered membrane would meet these design requirements to resist positive and negative pressures from wind. However, a mechanically fastened system will not perform the same under wind pressures as a fully adhered membrane performs.

The problem with using a single ply membrane is not a problem of air leakage, but rather a problem of air intrusion. In a paper written by Baskaran & Molleti 2009 entitled *Air intrusion vs Air Leakage*, they state "although research has been directed to the characterization of individual roof components such as the membrane, relatively little attention has been given to how air movement affects system performance. It has been incorrectly assumed that air movement in roofing assemblies is similar to air movement in wall assemblies. Several factors contribute to this misconception, including existing energy and building-code requirements and the current air-barrier standards, which are all focused on wall assemblies." The paper goes on to say that air intrusion "occurs when conditioned indoor air enters into a building envelope assembly but cannot escape to the exterior environment, as is the case for mechanically attached roofs, it is termed air intrusion." "Using a single ply membrane that is not adhered will allow air from inside the building to pass into the roof assembly. If the building is being heated with warm humid air and the temperature is cold outside, condensation will occur.

Much has been published about air intrusion into the roof assembly and the accumulation of moisture. Most recently is an article by Thomas Taylor with GAF (*Interface* August 2016) which states in the conclusions "Fully adhered membrane systems based on polyiso insulation significantly reduce airflow to the underside of the membrane. In addition, fully adhered systems do not billow upwards due to wind loads, again reducing airflow."

The IBC defines a roof assembly as "a system designed to provide weather protection and resistance to design loads. The system consists of a roof covering and roof deck or a single component serving as both the roof covering and the roof deck. A roof assembly includes the roof deck, vapor retarder, substrate or thermal barrier, insulation, vapor retarder and roof covering." The roof is an assembly, and while various parts of the assembly may pass the air barrier test, it may not necessarily mean the assembly will. Knowledge of how assemblies perform and interact in a system is required to effectively provide a system that will function as an air barrier.

The National Institute of Building Sciences' *Whole Building Design Guide*, recommends the installation of an additional air barrier when using a mechanically fastened membrane. There needs to research and work done to develop test methods for determining the amount of air intrusion into a roof assembly, and until such time as test methods are available, and design criteria included in the code for using a mechanically fastened membrane as an air barrier, the deemed to comply list should remain as is.

CE112-16

CE114-16 Part I
IECC: C402.5.3.

Proposed Change as Submitted

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

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.

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 (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 Part I : C402.5.3-COLLINS13794

Public Hearing Results

Part I

Committee Action: **Approved as Submitted**

Committee Reason: The proposal restructures the text to make the intent more clear.

Assembly Motion: **Disapprove**
Online Vote Results: **Failed**
Support: 33.64% (73) Oppose: 66.36% (144)
Assembly Action: **None**

Individual Consideration Agenda

Proponent : Ted Williams, representing American Gas Association (twilliams@aga.org) requests Disapprove.

Commenter's Reason: This effort to "clean up language" ignores the issue that this coverage does not belong in the IECC to begin with. 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 Northw est 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 w ere 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 w ill be presented at the April hearing. In any case, adoption experience to date has show n 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 w ill increase the cost of construction, w hile it w ill 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 w here combustion safety is addressed, not w ithin the IECC.

CE114-16 Part I

CE114-16 Part II
R402.4.4 (IRC N1102.4.4)

Proposed Change as Submitted

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

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 (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 Part II : R402.4.4-COLLINS13795

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: This is a safety issue which doesn't belong in the IECC.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Submitted.

Commenter's Reason: Part I of this proposal was approved by the Commercial Energy Code committee. The existing code provisions introduced into the 2015 code are unclear. SEHPCAC worked for many hours to refine the provisions so that they clear state when these provisions are invoked and how compliance is achieved.
The Commercial Energy committee recognized that this is an energy issue because it is addressing the practice of punching holes in the building thermal envelope as a method to provide combustion are these space conditioning appliances. The text in the 2015 code is confusing and probably contributed to confusion of the Residential Energy Committee when they concluded in their reason statement for denial that this was a safety issue and doesn't belong in this code. The safety issue is address by the IMC and the mechanical provisions of the IRC. This section is about saving energy and not losing it through uncontrolled openings in the building thermal envelope.

Removal of these provisions from the code would be a mistake in that it leaves this issue unaddressed. This proposal simply takes the 2015 text and organizes it around the key problem – openings in the thermal envelope. The proposal reorganizes the existing text to clearly show the 2 solutions: 1. put the equipment outside the envelope; or 2. Creating a chamber within the envelope which provides protections for the conditioned space.

Concern was also expressed in the hearings that the exception for direct vent appliances is removed. The exception is removed because it is not necessary. The issue regulated by the section is open holes in the envelope through which combustion air is provided. Direct vent appliances don't fall in this category because they are direct vented. The IRC definition of *Direct-vent appliance* is "a fuel burning appliance with a sealed combustion system that draws all air for combustion from the outside atmosphere and discharges all flue gases to the outside atmosphere". These appliances aren't covered by the charging sentence of this proposal therefore there is no need for an exception.

This section isn't about the global issue of providing combustion air to appliances. That is covered by IMC and IRC mechanical provisions. This section is only addresses where the method of providing outdoor combustion air is from openings in the envelope via IRC Section G2407.6 or G2407.7: combustion air opening(s) to the outdoors are provided in the envelope. Rooms with these holes to the exterior are required by this code section to be thermally separated from the interior conditioned spaces. This section does not circumvent the requirements of G2407, Combustion, Ventilation and Dilution Air.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Proponent : Shaunna Mozingo, representing Colorado Chapter of ICC Energy Code Development Committee (smozingo@coloradocode.net) requests Approve as Submitted.

Commenter's Reason: The Colorado Chapter of ICC supports this proposal as submitted as it does clean up this needed section of the code. We do not agree that this code section is strictly about a safety issue and that it doesn't belong in the IECC as stated in the Residential Committee's reason statement.

This code has tightned the requirements for the thermal envelope, including air leakage. It also requires strict attention be paid to mechananical equipment efficiencies and sizing as well as lighting and mechanical controls. All of these things play a huge part in how buildings use energy and how we can make them more efficient, obviously or they wouldn't be in this code. To crank down all of these requirements and then just allow a bunch of unconditioned air be dropped right into the space that we have paid so much attention to isolating from that outside air - seems to fly in the face of the requirements. Equipment sizing gets bigger when you have more infiltation/exfiltration and it has to work harder to keep the space at the appropriate temperature because you are always introducting new air. That is energy based, not safety based reasoning.

As it pertains to safety and durability, without this isolation area, not only are we allowing varying temperatures of outside air to come into the conditioned space, we are also bringing in whatever moisture or pollutants are in that air, which will degrade our assemblies and affect the health of our occupants. These are part of the reasons we started building the tight assemblies in the first place. We feel that this requirement also helps to solve the problems of people stuffing things into the combustion air openings because of the unconditioned air they feel coming in.

CE114-16 Part II

CE115-16 Part I
IECC: C402.5.3.

Proposed Change as Submitted

Proponent : Ted Williams, representing American Gas Association

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*.~~

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 Part I : C402.5.3-WILLIAMS12507

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: The current requirement saves energy and should remain in the code. Direct- vent appliances are an option that simplifies compliance with this section. Openings to the outdoors will cause the building to fail the air barrier test. The committee prefers CE114 Part I.

Assembly Motion: **As Submitted**
Online Vote Results: **Failed**
Support: 42.39% (103) Oppose: 57.61% (140)
Assembly Action: **None**

Individual Consideration Agenda

Proponent : Ted Williams, representing American Gas Association (twilliams@aga.org) requests Approve as Submitted.

Commenter's Reason: These requirements, originally proposed for deletion and appearing for the first time in the 2015 edition of the IECC, do not save energy and do
not belong in the IECC.. The "Committee Reason" for disapproval clairrs that the provisions save energy, but in committee discussion, no evidence or data was identified to support that claim. In fact, the U. S. Department of Energy "deterrrinations" 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 (Illinois) has removed this coverage by amendment for residential occupancies. The
IECC would be well advised to eliminate 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 w here combustion safety is addressed, not within the IECC.

CE115-16 Part I

CE115-16 Part II
R402.4.4 [IRC N1102.4.4]

Proposed Change as Submitted

Proponent : Ted Williams, representing American Gas Association

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
Elimination of costs for thermally isolating rooms with combustion appliances would reduce costs. Since PNNL and others cite that the current provisions would not save energy, no payback would result from these requirements.

CE115-16 Part II :
R402.4.4-
WILLIAMS13453

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: Consistency with Committee's action on RE92-16.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Ted Williams, representing American Gas Association (twilliams@aga.org) requests Approve as Submitted.

Commenter's Reason: These requirements, originally proposed for deletion and appearing for the first time in the 2015 edition of the IECC, do not save energy and donot belong in the IECC.. The "Committee Reason" for disapproval in the committee discussion of Part I clairrs that the provisions save energy, but incommittee discussion at that hearing, no evidence or data w as identified to support that claim. In fact, the U. S. Department ofEnergy "deterrrinations" 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 EnergyEfficiency" and is one of five such proposals so classified that w ere promulgated as new requirements in the 2015edition. Of the four states adopting the 2015 edition of the IECC one state (Illinios) has removed this coverage byamendment for residential occupancies. The IECC w ould be w ell advised to elirnnate this provision .. Also, the "Cost Impact" cited in the IECC monograph states that, "The code change proposal w ill 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 proposalfor the code change cited professed combustion appliance safety concerns. Such concerns should be addressedto the International Fuel Gas Gode and National Fuel Gas Gode processes where combustion safety is addressed, not within the IECC.

CE115-16 Part II

CE120-16
IECC: C403.2.1.

Proposed Change as Submitted

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. The design loads shall account for the building envelope, lighting, ventilation, and occupancy loads based on the project design. 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 were bringing back in the wording from the previous code cycles that clarified what is involved in providing the correct claculations required by plans examiners to verify the correct sized equipment will be installed. If all of the correct information is not used to determine the loads the numbers will not correct, and the incorrect sized equipment may be installed. This may cause for the incorrect sized equipment which may cause for more energy usage. A simple way 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 world?

Will the code requirement really save energy or only on paper?

Cost Impact: Will not increase the cost of construction
This is wording to clear up what is involved with the calculations.

CE120-16 : C403.2.1-MEDINA12938

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: It is not clear what is meant by "occupancy loads". ASHRAE/ACCA 183 already addresses this issue.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Hope Medina, representing self (hmedina@coloradocode.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

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. The design loads shall account for the building envelope, lighting, ventilation, and loads associated with occupancy ~~loads~~ based on the project design. 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.

Commenter's Reason: This is bringing back the wording from previous code cycles that clarify what is involved in providing the correct calculations reqruied by plans examiners to verify the correct size equipment will be installed. If the correct information is not used to determine the loads the numbers will not be correct, and the incorrect sized equipment may be

installed.
THis verbiage does help designers and engineers provide the correct information neede, and for code officials to ask for the correct information.

Proponent : Hope Medina, representing self (hmedina@coloradocode.net) requests Approve as Submitted.

Commenter's Reason: This is bringing back the wording from previous code cycles that clarify what is involved in providing the correct calculations required by plans examiners to verify the correct size equipment will be installed. If the correct information is not used to determine the loads the numbers will not be correct, and the incorrect sized equipment may be installed.
This verbiage does help designers and engineers provide the correct information needed, and for code officials to ask for the correct information.

CE120-16

CE121-16
IECC: C403.2.10.1.

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The last proposed sentence has no technical support. This would prohibit an insulation material that does have inherent protection capabilities. The terms "physical damage protection" are subjective and burden the code official with such determinations.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Tim Ledden, Armacell, LLC, representing Armacell (tim.r.ledden@armacell.com) requests Approve as Submitted.

Commenter's Reason: The committee reasoning for disapproving the original proposal was because the last sentence may disallow insulation products capable of providing adequate protection outdoors without a covering. In reality, the reason that the update to the code is necessary is because there is no insulation product suitable to withstand outdoor conditions without protection but installers and inspectors often take manufacturers' claims or labels of "UV resistant" as satisfying the code. These claims are subjective and do not indicate the expected life of the insulation outdoors. In addition, UV resistance does not protect against the mechanical hazards that also exist outdoors. As a result, insulation installed outdoors is frequently damaged shortly after installation and then, does not provide the energy savings as designed. Furthermore, the damaged insulation increases the likelihood of corrosion under insulation and complete pipe failure. Therefore, the proposal should be

accepted as submitted so that it is clear that all insulation outdoors must be protected from the elements in order to provide the energy savings it was designed to provide and to avoid potentially catastrophic failure.

CE121-16

CE124-16
IECC: C403.2.15, C403.2.16.

Proposed Change as Submitted

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 <u>coolers, walk-in freezers, refrigerated warehouse</u> coolers and ~~walk-in~~ <u>refrigerated warehouse</u> freezers. ~~Site- assembled or site-constructed *walk-in coolers*~~

<u>Refrigerated warehouse coolers, refrigerated warehouse freezers, walk-in coolers</u> and ~~*walk-in freezers*~~<u>walk-in freezers</u> 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.~~
3. <u>Walk-in coolers and refrigerated warehouse coolers shall 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 with an R-value of not less than 32.</u>

- **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 what 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 was limited in application to site built. C403.2.15 covered everything but site built. It came from the State of Washington code. While it was generally the same text as ASHRAE 90.1, there were minor differences. The proposal merges the two into a single one – covers all categories previously covered by the two sections and then selects the clearer of the two parallel provisions. In generel C403.2.16 had better text except in items 3, 9 and 10.
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 (http://www.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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval is based on the action on CE126-16.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Submitted.

Commenter's Reason: Sections C403.2.15 and C403.2.16 are still duplicative provisions which need to be resolved and reduced to a single set of requirements for this category of equipment. CE126-16 was approved, but it doesn't resolve the issues of having 2 regulations covering the same equipment. CE126 does incorporate reference to future federal requirements, but it doesn't eliminate either C403.2.15 or .16.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

CE124-16

CE125-16

IECC: C403.2.15, C403.2.15 (New), C403.2.15.1 (New), C403.2.16.

Proposed Change as Submitted

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.~~
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. ~~*Walk-in freezers*~~ *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.

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 with, and preempted by, federal requirements for many walk-in coolers and walk-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 warehouse coolers and refrigerated warehouse freezers has been simplified, removing reference to those federally-governed products. This change will make it easier on code officials by clearly indicating that they do not have to address the thermal performance of walk-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 -
MATHIS13371

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: It is not appropriate for the code to reference Federal Regulations.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Bridget Herring, Mathis Consulting Company, representing Mathis Consulting Company (bridget@mathisconsulting.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C403.2.15.2 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers. Walk-in coolers and walk-in freezers not covered under Section C403.2.15.1 and 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.
   Exception: Automatic closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.
2. Doorways shall have strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when doors are open.
3. ~~*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.~~
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. *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.
   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) are exempt.
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.~~

Commenter's Reason: The original proposal was affected by cdpACCESS formatting issues, obscuring its intent. That intent was two-fold:
1.Remove requirements for federally preempted walk-in refridgerators and freezers
2. Consolidate duplicate language to simplify and shorten the code
We changed no requirements to those walk-in refridgerators and freezers not covered by federal regulation.

This comment re-submits the original proposal, maintaining the exceptions in C403.2.15.2 (1), (3) and (8). Note that no changes to efficiency have been proposed. This comment clears up an enforcement conflict in the code. Currently, there are federal requirements that mandate efficiency levels for walk-in cools and walk-in freezers. This comment clarifies which products are regulated by federal energy conservation standards and which are regulated by local code officials. This proposal was disapproved by the committee, as they believed it was not appropriate for the code to reference federal regulations. However, the commercial code already references federal regulations for furnaces, boilers, industrial equipment, electric motors, and air conditioners. This change will protect code officials, removing requirements that they can not enforce.

Bibliography:

1. ENERGY INDEPENDENCEAND 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

Public Comment 2:

Proponent : Bridget Herring, Mathis Consulting Company (bridget@mathisconsulting.com) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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.

Execptions:

1. Walk-in coolers and walk-in freezers 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.
2. Products designed and marketed exclusively for medical, scientific, or research purposes.

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.
   1.1. **Exception:** Automatic closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.
2. Doorways shall have strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when doors are open.
3. *Walk-in coolers* and *refrigerated warehouse coolers* shall contain wall, ceiling, and door insulation of not less than R-25 and *walk-in freezers* and *refrigerated warehouse freezers* shall contain wall, ceiling and door insulation of not less than R-32.
   - ~~**Exception:** Glazed portions of doors or structural members need not be insulated.~~

   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.
   8.1. **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 the floor area are exempt.
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.~~

~~**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.~~

Commenter's Reason: The original proposal was affected by cdpACCESS formatting issues, obscuring its intent. That intent was two-fold:

1. Remove requirements for federally preempted walk-in refridgerators and freezers
2. Consolidate duplicate language to simplify and shorten the code

We changed no requirements to those walk-in refridgerators and freezers not covered by federal regulation.

The committee was concerned about the reference to DOE equipment standards (10 CFR 431.306). While the code references other equipment standards for biolers, air conditioners, etc., this comment removes the reference from the proposal, while still taking those walk-in refridgerators and freezers preempted by federal regulation out of the code.

CE125-16

CE129-16
IECC: C403.2.3.

Proposed Change as Submitted

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

2015 International Energy Conservation Code

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. 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 (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. E_c = Combustion efficiency (100 percent less flue losses).~~
~~e. 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 were previously uncovered. In some of those instances, the cost of construction may increase.

CE129-16 : C403.2.3-FERGUSON10453

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The IECC does not have to parallel ASHRAE standard changes. The tables need to remain in the code or the tables need to be down-loadable to allow pasting into code. Control of the IECC should not handed off to another standards developing organization. It is difficult to locate ASHRAE addendum. Differing table entries are not to be taken as errata.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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~~ C403.2.3(8) 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). 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

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	<65,000 Btu/h[b]	All	Split System, three phase	~~13.0 SEER~~	13.0 SEER	AHRI 210/240
			Single Package, three phase	~~13.0 SEER~~	14.0 SEER[c]	
Through-the-wall (air cooled)	≤ 30,000 Btu/h[b]	All	Split system, three phase	~~12.0 SEER~~	12.0 SEER	
			Single Package, three phase	~~12.0 SEER~~	12.0 SEER	
Small-duct high-velocity (air cooled)	<65,000 Btu/h[b]	All	Split System, three phase	~~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~~9 IEER	AHRI 340/360
		All other	Split System and Single Package	~~11.0 EER 11.2 IEER~~	11.0 EER 12.~~6~~7 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	<65,000 Btu/h	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	<65,000 Btu/h	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 <135,000 Btu/h	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 <240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	~~12.0 EER~~ ~~12.2 IEER~~	12.0 EER 12.2 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 <760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	~~11.9 EER~~ ~~12.1 IEER~~	11.9 EER 12.1 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 (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)	< 65,000 Btu/h[b]	All	Split System, three phase	~~13.0 SEER~~[c]	14.0 SEER~~c~~	AHRI 210/240
			Single Package, three phase	~~13.0 SEER~~[c]	14.0 SEER~~c~~	
Through-the-wall, air cooled	≤ 30,000 Btu/h[b]	All	Split System, three phase	~~12.0 SEER~~	12.0 SEER	
			Single Package, three phase	~~12.0 SEER~~	12.0 SEER	
Single-duct high-velocity air cooled	< 65,000 Btu/h[b]	All	Split System, three phase	~~11.0 SEER~~	11.0 SEER	
Air cooled (cooling mode)	≥ 65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	~~11.0 EER 11.2 IEER~~	11.0 EER 12.2 IEER	AHRI 340/360
		All other	Split System and Single Package	~~10.8 EER 11.0 IEER~~	10.8 EER 12.0~~11.8~~ IEER	
	≥ 135,000 Btu/h and <240,000 Btu/h	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 10~~9~~.4 IEER	

Water to Air: Water Loop (cooling mode)	<17,000 Btu/h	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)	<135,000 Btu/h	All	59°F entering water	~~18.0 EER~~	18.0 EER	
Brine to Air: Ground Loop (cooling mode)	<135,000 Btu/h	All	77°F entering water	~~14.1 EER~~	14.1 EER	
Water to Water: WaterLoop (cooling mode)	<135,000 Btu/h	All	86°F entering water	~~10.6 EER~~	10.6 EER	ISO 13256-2
Water to Water: Ground Water (cooling mode)	<135,000 Btu/h	All	59°F entering water	~~16.3 EER~~	16.3 EER	
Brine to Water: Ground Loop (cooling mode)	<135,000 Btu/h	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)	< 65,000 Btu/h[b]	—	Split System, three phase	~~7.7 HSPF~~[e]	8.2 HSPF[e]	AHRI 210/240
		—	Single Package, three phase	~~7.7 HSPF~~[e]	8.0 HSPF[e]	
Through-the-wall, (air cooled, heating mode)	≤ 30,000 Btu/h[b] (cooling capacity)	—	Split System, three phase	~~7.4 HSPF~~	7.4 HSPF	
		—	Single Package, three phase	~~7.4 HSPF~~	7.4 HSPF	
Small-duct high velocity (air cooled, heating mode)	< 65,000 Btu/h[b]	—	Split System, three phase	~~6.8 HSPF~~	6.8 HSPF	
Air cooled (heating mode)	≥ 65,000 Btu/h and <135,000 Btu/h (cooling capacity)	—	47ºF db/43ºF wb outdoor air	~~3.3 COP~~	3.3 COP_H	AHRI 340/360
			17ºF db/15ºF wb outdoor air	~~2.25 COP~~	2.25 COP_H	
	≥ 135,000 Btu/h (cooling capacity)	—	47ºF db/43ºF wb outdoor air	~~3.2 COP~~	3.2 COP_H	
			17ºF db/15ºF wb outdoor air	~~2.05 COP~~	2.05 COP_H	
Water to Air: Water Loop (heating mode)	<135,000 Btu/h (cooling capacity)	—	68°F entering water	~~4.3 COP~~	4.3 COP_H	ISO 13256-1
Water to Air: Ground Water (heating mode)	<135,000 Btu/h (cooling capacity)	—	50°F entering water	~~3.7 COP~~	3.7 COP_H	
Brine to Air: Ground Loop (heating mode)	<135,000 Btu/h (cooling capacity)	—	32°F entering fluid	~~3.2 COP~~	3.2 COP_H	
Water to Water: Water Loop (heating mode)	<135,000 Btu/h (cooling capacity)	—	68°F entering water	~~3.7 COP~~	3.7 COP_H	ISO 13256-2
Water to Water: Ground Water (heating mode)	<135,000 Btu/h (cooling capacity)	—	50°F entering water	~~3.1 COP~~	3.1 COP_H	
Brine to Water: Ground Loop (heating mode)	<135,000 Btu/h (cooling capacity)	—	32°F entering fluid	~~2.5 COP~~	2.5 COP_H	

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~~ By the US Department of Energy Code of Federal Regulations 10 CFR 430 . SEER and HSPF values for single phase products are ~~those~~ set by ~~NAECA~~ the US Department of Energy .

~~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-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air-Conditioner Heat Pu

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
PTAC (cooling mode) standard size~~new construction~~	All Capacities	95°F db outdoor air	14.0 – (0.300 × Cap/1000) EER[c]	AHRI 310/380
PTAC (cooling mode) nonstandard sizereplacements[b]	All Capacities	95°F db outdoor air	10.9 - (0.213 × Cap/1000) EER	
PTHP (cooling mode) standard size~~new construction~~	All Capacities	95°F db outdoor air	14.0 - (0.300 × Cap/1000) EER	
PTHP (cooling mode) nonstandard sizereplacements[b]	All Capacities	95°F db outdoor air	10.8 - (0.213 × Cap/1000) EER	
PTHP (heating mode) standard size~~new construction~~	All Capacities	—	3.7~~2~~ - (0.~~026~~052 × Cap/1000) COP	
PTHP (heating mode) nonstandard sizereplacements[b]	All Capacities	—	2.9 - (0.026 × Cap/1000) COP	
SPVAC (cooling mode)	< 65,000 Btu/h	95°F db/ 75°F wb outdoor air	10.0 EER~~9.0 EER~~	AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h	95°F db/ 75°F wb outdoor air	~~8.9 EER~~10.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95°F db/ 75°F wb outdoor air	~~8.6 EER~~10.0 EER	
SPVHP (cooling mode)	< 65,000 Btu/h	95°F db/ 75°F wb outdoor air	~~9.0 EER~~10.0 EER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	95°F db/ 75°F wb outdoor air	~~8.9 EER~~10.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95°F db/ 75°F wb outdoor air	~~8.6 EER~~10.0 EER	
SPVHP (heating mode)	< 65,000 Btu/h	47°F db/ 43°F wb outdoor air	~~3.0 COP~~3.0COP$_H$	
	≥ 65,000 Btu/h and < 135,000 Btu/h	47°F db/ 43°F wb outdoor air	~~3.0 COP~~3.0COP$_H$	
	≥ 135,000 Btu/h and < 240,000 Btu/h	47°F db/ 75°F wb outdoor air	~~2.9 COP~~3.0COP$_H$	
Room air conditioners, with louvered sides	< 6,000 Btu/h	—	9.7 SEER	ANSI/ AHAM RAC-1
	≥ 6,000 Btu/h and < 8,000 Btu/h	—	9.7 EER	
	≥ 8,000 Btu/h and < 14,000 Btu/h	—	9.8 EER	
	≥ 14,000 Btu/h and < 20,000 Btu/h	—	9.7 SEER	
	≥ 20,000 Btu/h	—	8.5 EER	
Room air conditioners, without louvered sides	< 8,000 Btu/h	—	9.0 EER	
	≥ 8,000 Btu/h and < 20,000 Btu/h	—	8.5 EER	
	≥ 20,000 Btu/h	—	8.5 EER	
Room air-conditioner heat pumps with louvered sides	< 20,000 Btu/h	—	9.0 EER	
	≥ 20,000 Btu/h	—	8.5 EER	
Room air-conditioner heat pumps without louvered sides	< 14,000 Btu/h	—	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	
SPVAC (cooling mode), nonweatherized space constrained	≤30,000 Btu/h	95°F db/ 75°F wb outdoor air	9.2 EER	AHRI 390
	>30,000 Btu/h and ≤ 36,000 Btu/h	95°F db/ 75°F wb outdoor air	9.0 EER	
SPVHP (cooling mode), nonweatherized space constrained	≤30,000 Btu/h	95°F db/ 75°F wb outdoor air	9.2 EER	
	>30,000 Btu/h and ≤ 36,000 Btu/h	95°F db/ 75°F wb outdoor air	9.0 EER	
SPVHP (heating mode), nonweatherized space constrained	≤30,000 Btu/h	47°F db/ 43°F wb outdoor air	3.0 COP_H	
	>30,000 Btu/h and ≤ 36,000 Btu/h	47°F db/ 43°F wb outdoor air	3.0 COP_H	

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 and having a cross sectional area less than 670 in^2 .

~~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

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	Maximum capacity[h]	78% AFUE or 80%E_t[c]	DOE 10 CFR Part 430 or Section 2.39 Thermal efficiency of ANSI Z21.47
	≥ 225,000 Btu/h	Maximum capacity[h]	80%E_t[f]	Section 2.39 Thermal efficiency of ANSI Z21.47
Warm-air furnaces, oil fired	< 225,000 Btu/h	Maximum capacity[h]	78% AFUE or 80%E_t[c]	DOE 10 CFR Part 430 or Section 42, Combustion of UL 727
	≥ 225,000 Btu/h	Maximum capacity[h]	81%E_t[g]	Section 42, Combustion of UL 727
Warm-air duct furnaces, gas fired	All capacities	Maximum capacity[h]	80%E_c[e]	Section 2.10 Efficiency of ANSI Z83.8
Warm-air unit heaters, gas fired	All capacities	Maximum capacity[h]	80%E_c[e,i]	Section 2.10 Efficiency of ANSI Z83.8
Warm-air unit heaters, oil fired	All capacities	Maximum capacity[h]	80%E_c[e,i]	Section 40, Combustion of 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~~ U.S. Department of Energy ~~Conservation Act~~ Code of ~~1987 (NAECA) (3-phase~~ Federal Regulations 10 CFR 430 that utilize three-phase power or have a 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.

h. Compliance of multiple firing rate units shall be at the maximium firing rate.
i. As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include an interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.

TABLE C403.2.3 (5)
MINIMUM EFFICIENCY REQUIREMENTS: GAS- AND OIL-FIRED BOILERS

EQUIPMENT TYPE[a]	SUBCATEGORY OR RATING CONDITION	SIZE CATEGORY (INPUT)	MINIMUM EFFICIENCY[d, e]	EFFICIENCY AFTER 3/2/2020	TEST PROCEDURE
Boilers, hot water	Gas-fired	< 300,000 Btu/h	82~~80~~% AFUE	82% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	80% E_t	80% E_t	10 CFR Part 431
		> 2,500,000 Btu/h[a]	82% E_c	82% E_c	
	Oil-fired[c]	< 300,000 Btu/h	84~~80~~% AFUE	84% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	82% E_t	82% E_t	10 CFR Part 431
		> 2,500,000 Btu/h[a]	84% E_c	84% E_c	
Boilers, steam	Gas-fired	< 300,000 Btu/h	80~~75~~% AFUE	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	79% E_t	10 CFR Part 431
		> 2,500,000 Btu/h[a]	79% E_t	79% E_t	
	Gas-fired-natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	77% E_t	79% E_t	
		> 2,500,000 Btu/h[a]	77% E_t	79% E_t	
	Oil-fired[c]	< 300,000 Btu/h	82~~80~~% AFUE	82% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	81% E_t	81% E_t	10 CFR Part 431
		> 2,500,000 Btu/h[a]	81% E_t	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). See referenced standard for detailed information

e. E_t = Thermal efficiency. See referenced standard for detailed information.

TABLE C403.2.3 (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 (7)
WATER CHILLING PACKAGES – EFFICIENCY REQUIREMENTS[a, b, ~~d~~ e]

EQUIPMENT TYPE	SIZE CATEGORY	UNITS	~~BEFORE 1/1/2015~~		~~AS OF 1/1/2015~~Efficiency		TEST PROCEDURE[~~c~~d]
			~~Path A~~	~~Path B~~	Path A	Path B	
Air-cooled chillers	< 150 Tons	EER (Btu/W)	~~≥ 9.562 FL~~	~~NA[e]~~	≥ 10.100 FL	≥ 9.700 FL	AHRI 550/590
			~~≥ 12.500 IPLV~~		≥ 13.700 IPLV	≥ 15,800 IPLV	
	≥ 150 Tons		~~≥ 9.562 FL~~	~~NA[e]~~	≥ 10.100 FL	≥ 9.700 FL	
			~~≥ 12.500 IPLV~~		≥ 14.000 IPLV	≥ 16.100 IPLV	
Air cooled without condenser, electrically operated	All capacities	EER (Btu/W)	Air-cooled chillers without condenser shall be rated with matching condensers and complying with air-cooled chiller efficiency requirements.				
Water cooled, electrically operated positive displacement	< 75 tons	kW/ton	~~≤ 0.780 FL~~	~~≤ 0.800 FL~~	≤ 0.750 FL	≤ 0.780 FL	
			~~≤ 0.630 IPLV~~	~~≤ 0.600 IPLV~~	≤ 0.600 IPLV	≤ 0.500 IPLV	
	≥75 tons and < 150 tons		~~≤ 0.775 FL~~	~~≤ 0.790 FL~~	≤ 0.720 FL	≤ 0.750 FL	
			~~≤ 0.615 IPLV~~	~~≤ 0.586 IPLV~~	≤ 0.560 IPLV	≤ 0.490 IPLV	
	≥ 150 tons and < 300 tons		~~≤ 0.680 FL~~	~~≤ 0.718 FL~~	≤ 0.660 FL	≤ 0.680 FL	
			~~≤ 0.580 IPLV~~	~~≤ 0.540 IPLV~~	≤ 0.540 IPLV	≤ 0.440 IPLV	
	≥ 300 tons and < 600 tons		~~≤ 0.620 FL~~	~~≤ 0.639 FL~~	≤ 0.610 FL	≤ 0.625 FL	
			~~≤ 0.540 IPLV~~	~~≤ 0.490 IPLV~~	≤ 0.520 IPLV	≤ 0.410 IPLV	
	≥ 600 tons		~~≤ 0.620 FL~~	~~≤ 0.639 FL~~	≤ 0.560 FL	≤ 0.585 FL	
			~~≤ 0.540 IPLV~~	~~≤ 0.490 IPLV~~	≤ 0.500 IPLV	≤ 0.380 IPLV	
Water cooled, electrically operated centrifugal	< 150 Tons	kW/ton	~~≤ 0.634 FL~~	~~≤ 0.639 FL~~	≤ 0.610 FL	≤ 0.695 FL	
			~~≤ 0.596 IPLV~~	~~≤ 0.450 IPLV~~	≤ 0.550 IPLV	≤ 0.440 IPLV	
	≥ 150 tons and < 300 tons		~~≤ 0.634 FL~~	~~≤ 0.639 FL~~	≤ 0.610 FL	≤ 0.635 FL	
			~~≤ 0.596 IPLV~~	~~≤ 0.450 IPLV~~	≤ 0.550 IPLV	≤ 0.400 IPLV	
	≥ 300 tons and < 400 tons		~~≤ 0.576 FL~~	~~≤ 0.600 FL~~	≤ 0.560 FL	≤ 0.595 FL	
			~~≤ 0.549 IPLV~~	~~≤ 0.400 IPLV~~	≤ 0.520 IPLV	≤ 0.390 IPLV	

	≥ 400 tons and < 400 tons		~~≤ 0.576 FL~~	~~≤ 0.600 FL~~	≤ 0.560 FL	≤ 0.585 FL	
			~~≤ 0.549 IPLV~~	~~≤ 0.400 IPLV~~	≤ 0.500 IPLV	≤ 0.380 IPLV	
	≥ 600 Tons		~~≤ 0.570 FL~~	~~≤ 0.590 FL~~	≤ 0.560 FL	≤ 0.585 FL	
			~~≤ 0.539 IPLV~~	~~≤ 0.400 IPLV~~	≤ 0.500 IPLV	≤ 0.380 IPLV	
Air cooled, absorption, single effect	All capacities	COP (W/W)	~~≥ 0.600 FL~~	~~NA[c]~~	≥ 0.600 FL	NA[~~c~~d]	AHRI 560
Water cooled absorption, single effect	All capacities	COP (W/W)	~~≥ 0.700 FL~~	~~NA[c]~~	≥ 0.700 FL	NA[~~c~~d]	
Absorption, double effect, indirect fired	All capacities	COP (W/W)	~~≥ 1.000 FL~~	~~NA[c]~~	≥ 1.000 FL	NA[~~c~~d]	
			~~≥ 1.050 IPLV~~		≥ 1.050 IPLV		
Absorption double effect direct fired	All capacities	COP (W/W)	~~≥ 1.000 FL~~	~~NA[c]~~	≥ 1.000 FL	NA[~~c~~d]	
			~~≥ 1.000 IPLV~~		≥ 1.~~050~~000 IPLV		

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 . Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure

d . NA means the requirements are not applicable for Path B and only Path A can be used for compliance.

~~d~~ e . 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

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 S 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 S 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	≥ 16.1~~14.0~~ gpm/hp	CTI ATC-105 S 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 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 (9)
MINIMUM EFFICIENCY AIR CONDITIONERS AND CONDENSING UNITS SERVING COMPUTER ROOMS

Equipment Type	Net Sensible Cooling Capacity	Standard Model	Minimum Net Sensible COP			Test Procedure
			Return Air Dry-Bulb Temperature/Dew-Point Temperature			
			Class 1	Class 2	Class 3	
			75°F/52°F	85°F/52°F	95°F/52°F	
Water Cooled with fluid economizer	<65,000 Btu/h	Downflow unit	_	2.45	_	AHRI 1360
		Upflow unit - ducted	_	2.25	_	
		Uplow unit - nonducted	2.20	_	_	
		Horizontal-flow unit	_	_	2.60	
	≥65,000 Btu/h and < 240,000 Btu/h	Downflow unit	_	2.35	_	
		Upflow unit - ducted	_	2.15	_	
		Uplow unit - nonducted	2.10	_	_	
		Horizontal-flow unit	_	_	2.55	
	≥240,000 Btu/h	Downflow unit	_	2.20	_	
		Upflow unit - ducted	_	2.05	_	
		Uplow unit - nonducted	2.00	_	_	
		Horizontal-flow unit	_	_	2.40	
Glycol Cooled	<65,000 Btu/h	Downflow unit	_	2.30	_	AHRI 1360
		Upflow unit - ducted	_	2.10	_	
		Uplow unit - nonducted	2.00	_	_	
		Horizontal-flow unit	_	_	2.40	
	≥65,000 Btu/h and < 240,000 Btu/h	Downflow unit	_	2.05	_	
		Upflow unit - ducted	_	1.85	_	
		Uplow unit - nonducted	1.85	_	_	
		Horizontal-flow unit	_	_	2.15	

	≥240,000 Btu/h	Downflow unit	_	1.95	_	
		Upflow unit - ducted	_	1.80	_	
		Uplow unit - nonducted	1.75	_	_	
		Horizontal-flow unit	_	_	2.10	
Glycol cooled with fluid economizer	<65,000 Btu/h	Downflow unit	_	2.25	_	AHRI 1360
		Upflow unit - ducted	_	2.10	_	
		Uplow unit - nonducted	2.00	_	_	
		Horizontal-flow unit	_	_	2.35	
	≥65,000 Btu/h and < 240,000 Btu/h	Downflow unit	_	1.95	_	
		Upflow unit - ducted	_	1.80	_	
		Uplow unit - nonducted	1.75	_	_	
		Horizontal-flow unit	_	_	2.10	
	≥240,000 Btu/h	Downflow unit	_	1.90	_	
		Upflow unit - ducted	_	1.80	_	
		Uplow unit - nonducted	1.70	_	_	
		Horizontal-flow unit	_	_	2.10	
Air Cooled _	<65,000 Btu/h	Downflow unit	_	2.30	_	AHRI 1360
		Upflow unit - ducted	_	2.10	_	
		Uplow unit - nonducted	2.09	_	_	
		Horizontal-flow unit	_	_	2.45	
	≥65,000 Btu/h and < 240,000 Btu/h	Downflow unit	_	2.20	_	
		Upflow unit - ducted	_	2.05	_	
		Uplow unit - nonducted	1.99	_	_	
		Horizontal-flow unit	_	_	2.35	
	≥240,000 Btu/h	Downflow unit	_	2.00	_	
		Upflow unit - ducted	_	1.85	_	
		Uplow unit - nonducted	1.79	_	_	
		Horizontal-flow unit	_	_	2.15	
Water Cooled	<65,000 Btu/h	Downflow unit	_	2.50	_	AHRI 1360
		Upflow unit - ducted	_	2.30	_	
		Uplow unit - nonducted	2.25	_	_	
		Horizontal-flow unit	_	_	2.70	
	≥65,000 Btu/h and < 240,000 Btu/h	Downflow unit	_	2.40	_	
		Upflow unit - ducted	_	2.20	_	
		Uplow unit - nonducted	2.15	_	_	
		Horizontal-flow unit	_	_	2.60	
	≥240,000 Btu/h	Downflow unit	_	2.25	_	
		Upflow unit - ducted	_	2.10	_	
		Uplow unit - nonducted	2.05	_	_	
		Horizontal-flow unit	_	_	2.45	
_	_	_	_	_	_	_
_	_	_	_	_	_	_
_	_	_	_	_	_	_

~~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~~	
	~~< 65,000 Btu/h~~	~~2.60 / 2.49~~	

~~Air conditioners, water cooled~~	~~≥ 65,000 Btu/h and~~	~~2.50 / 2.39~~	~~ANSI/ASHRAE 127~~
	~~≥ 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~~	
	~~≥ 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.~~

Commenter's Reason: This is a proposal to bring in the new efficiencies that are expected to be included in 90.1-2016 as of 7/22/16.

All of these efficiencies have industry buy-in and have met the 90.1 cost effectiveness criteria (scalar ratio).

This comment only updates the existing efficiencies in the IECC. There is a companion comment that adds 4 new tables to the IECC that will be in 90.1-2016 but do not currently exist in the IECC.

This comment is also proposing to delete table 403.2.3 (6) as the entries in that table are in 403.2.3 (1)

Public Comment 3:

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C403.2.3 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables 6.8.1-1, 6.8.1-2, 6.8.1-3, 6.8.1-4, 6.8.1-5, 6.8.1-6, 6.8.1-7, 6.8.1-9, 6.8.1-10, 6.8.1-14, 6.8.1-15, and ~~6.8.1-15~~ 6.8.1-16 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 6.8.1-8 of ASHRAE Standard 90.1. The efficiency shall be verified through certification under an *approved* certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein.

Table 6.8.1-1—Electrically Operated Unitary Air Conditioners and Condensing Units—Minimum Efficiency Requirements
Table 6.8.1-2—Electrically Operated Unitary and Applied Heat Pumps—Minimum Efficiency Requirements
Table 6.8.1-3—Water-Chilling Packages—Efficiency Requirements
Table 6.8.1-4—Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps

—Minimum Efficiency Requirements
Table 6.8.1-5—Warm-Air Furnaces, Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters
Table 6.8.1-6—Gas- and Oil-Fired Boilers—Minimum Efficiency Requirements
Table 6.8.1-7—Performance Requirements for Heat Rejection Equipment
Table 6.8.1-8—Heat Transfer Equipment
Table 6.8.1-9—Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum Efficiency Requirements
Table 6.8.1-10—Electrically Operated Variable-Refrigerant-Flow Air-to-Air and Applied Heat Pumps—Minimum Efficiency Requirements
Table 6.8.1-11—Air Conditioners and Condensing Units Serving Computer Rooms
Table 6.8.1-12—Commercial Refrigerators and Freezers
Table 6.8.1-13—Commercial Refrigeration
Table 6.8.1-14—Indoor Pool Dehumidifiers
Table 6.8.1-15—Electrically Operated DX-DOAS Units, Single Package and Remote Condenser without Energy Recovery—Minimum Efficiency Requirements
Table 6.8.1-16—Electrically Operated DX-DOAS Units, Single Package and Remote Condenser with Energy Recovery—Minimum Efficiency Requirements

Commenter's Reason: he original propsoal CE129 deleted the existing tables and figures and only proposed to add a reference to ASHRAE 90.1 for this information.

This public comment intends modify the original proposal by extracting and reprinting the following Tablesfrom ASHRAE Standard 90-2016:

Table 6.8.1-1—Electrically Operated Unitary Air Conditioners and Condensing Units—Minimum Efficiency Requirements
Table 6.8.1-2—Electrically Operated Unitary and Applied Heat Pumps—Minimum Efficiency Requirements
Table 6.8.1-3—Water-Chilling Packages—Efficiency Requirements
Table 6.8.1-4—Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps—Minimum Efficiency Requirements
Table 6.8.1-5—Warm-Air Furnaces, Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters
Table 6.8.1-6—Gas- and Oil-Fired Boilers—Minimum Efficiency Requirements
Table 6.8.1-7—Performance Requirements for Heat Rejection Equipment
Table 6.8.1-8—Heat Transfer Equipment
Table 6.8.1-9—Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum Efficiency Requirements
Table 6.8.1-10—Electrically Operated Variable-Refrigerant-Flow Air-to-Air and Applied Heat Pumps—Minimum Efficiency Requirements
Table 6.8.1-11—Air Conditioners and Condensing Units Serving Computer Rooms
Table 6.8.1-12—Commercial Refrigerators and Freezers
Table 6.8.1-13—Commercial Refrigeration
Table 6.8.1-14—Indoor Pool Dehumidifiers
Table 6.8.1-15—Electrically Operated DX-DOAS Units, Single Package and Remote Condenser without Energy Recovery—Minimum Efficiency Requirements
Table 6.8.1-16—Electrically Operated DX-DOAS Units, Single Package and Remote Condenser with Energy Recovery—Minimum Efficiency Requirements

By extracting this information, we ensure that all of the HVAC efficiencies in the IECC are consistent with ASHRAE Standard 90.1-2016, this is especially important for the tables where 90.1 sets the efficiencies per Federal law. According to federal pre-emption laws, it would be illegal for jurisdictions to adopt efficiencies lower than the efficiencies in 90.1 without a waiver from the US Department of Energy.

Analysis: This proposal is dependant upon an agreement between ASHRAE and ICC that would allow extraction of copy-righted material. Note that the Figure and Table numbering format is yet to be determined.

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

Commenter's Reason: This comment is requesting as submitted. This is the only way to ensure errata to the 90.1 HVAC efficiency tables are picked up in the IECC, and the only way to be 100% certain that these requirements of the IECC match the corresponding requiremnets in 90.1, some of which are mandated by federal law.

CE129-16

CE134-16 Part I

IECC: C403.2.4.1.1.

Proposed Change as Submitted

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

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.~~

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 with 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 will 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 always) 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 would need to become "heat pump police" to ensure compliance with such an operational specification.

Cost Impact: Will not increase the cost of construction

This proposal would remove existing language from the IECC. In doing so, there would be no change in the way heat pumps systems are either installed or operated. Accordingly, it would have no impact on the cost of construction.

CE134-16 Part I : C403.2.4.1.1-FOSTER11975

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: The definition of Coefficient of Performance in AHRI standard 34360 states that supplementary heat is not included, therefore deleting this code section could result in a backslide in energy efficiency.. The text should be retained considering the level of disagreement on its utility.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Charles Foster, Self, representing self (cfoster20187@yahoo.com) requests Approve as Submitted.

Commenter's Reason: This proposal attempts to make the code more succinct by removing a section that is superflous. Part 1 of the proposal was approved by the residential committee but the commercial committee was worried that approving could result in backsliding -- a reduction in the stringency for heat pumps. Heat pump efficiency for commercial equipment is expressed in terms of their coefficient of performance (COP). The Commercial committee became confused and thought that taking out language addressing operation of heat pumps would affect their COP calculation. It does not - - COP is calculated pursuant to an AHRI test procedure and that would not change.

In addition, under a recently published Department of Energy final rule, the heating efficiency of commercial rooftop packaged heat pumps will increase significantly on 1/1/2018 and then again on 1/1/2023. For single packaged vertical heat pumps, new standards took effect last year, this year, or in 2019 depending on their capacity.

Moreover, the language proposed to be removed does not impose any additional, enforceable requirement.

In other words, leaving it in results in no difference in system operation than does taking it out. Accordingly, it is superflous and should be removed.

CE134-16 Part I

CE134-16 Part II
R403.1.2 (IRC N1103.1.2)

Proposed Change as Submitted

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

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 with 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 will 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 always) 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, code officials would need to become "heat pump police" to ensure compliance with such an operational specification.

Cost Impact: Will not increase the cost of construction

This proposal would remove existing language from the IECC. In doing so, there would be no change in the way heat pumps systems are either installed or operated. Accordingly, it would have no impact on the cost of construction.

CE134-16 Part II : R403.1.2-FOSTER11973

Public Hearing Results

Part II

Committee Action: **Approved as Submitted**

Committee Reason: This section didn't provide any guidance to anyone using the code. The manufacturers already deal with this issue.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Disapprove.

Commenter's Reason: The committee accepted this proposal, which eliminates restrictions on heat pump controls, in part because manufacturers purportedly already deal with this issue. However, the fact that manufacturers or builders "already" achieve the intent a code section is not reason to elimimate that section. The code should retain those requirements to avoid the case of a manufacturer that does *not* already achieve the intent.

A review of thermostats available for heat pump operation found that most residential heat pump thermostats included no

provisions to restrict supplemental heat during warm up after night setback. Programmable thermostats with a night setback function are required under R403.1.1. The two-stage control in many thermostats does not prevent supplemental heat from operating when there is an automatic or manual change of temperature setpoint to warm up the home. Much more expensive commercial thermostats include sequences that will ramp the heat pump and supplemental heat setpoints differently during warmup, but these are not in typical use for residential applications.

For residential applications, a typical method of meeting the requirements of R403.1.2 is to lock out the suplemental heat based on an outdoor air temperature when the heat pump alone can meet the load. This control is an option that requires installation of an outdoor temperature sensor, and can be left out of the bid for the heat pump installation. So, while this control is typically provided because it has been required in code for several cycles, deleting the requirement from code could lead to the option being deleted to reduce the heat pump cost.

Without lockout controls, or other controls that limit supplemental heat use, potentially every day when the house warms up, the less efficient supplemental heat will be operating in parallel with the heat pump. This results in an increase in energy use. An analysis of supplemental heat controls for heat pumps in a residential building found that in Climate Zone 5 when the lock-out controls for supplemental heat were eliminated, electric use for heating increased by about 20%. In milder Climate Zone 4, the increase was about 30%.

Requiring controls that lock out supplemental heat when the heat pump can meet the heating load is important to saving energy.

Part 1 of this proposal was disaproved by the commercial IECC committee by a vote of 12-0.

We urge disapproval of this proposal.

CE134-16 Part II

CE135-16 Part I
IECC: C403.2.4.1.1.

Proposed Change as Submitted

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

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.

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 Part I :
C403.2.4.1.1-
ROSENSTOCK13809

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: Defrost is already covered in the code text. The phrase "the first stage of the thermostat control" is vague. The text refers to equipment malfunction which can't be anticipated and controls can't be programmed for malfunction. The code assumes that the equipment functions as intended. There is no time limit on the manual override which could allow permanent override.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Keith Dennis (keith.dennis@nreca.coop); Charles Foster, representing self (cfoster20187@yahoo.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C403.2.4.1.1 Heat pump supplemental heat. Heat pumps having supplemental electric resistance heat shall have controls that prevent supplemental heat operation where the heat pump vapor compression cycle can provide the necessary heating to satisfy the first stage of the thermostat control.

Exceptions:

1. Defrost operation.
2. Vapor compression cycle heating malfunction.
3. Thermostat malfunction.
4. Manual override of a pre-programmed thermostat setting <u>for not more than 3 consecutive hours during any 12 hour period</u>.

Commenter's Reason:
DENNIS: This public comment would limit the amount of time that a heat pump thermostat could be maually over-ridden to 3 consecutive hours during any 12 hour period.

FOSTER: The original proposal sought to clarify permissable control of heat pumps and in that regard laid out 4 common sense exceptions to the basic rule that use of supplementary heat should be restricted to those times when the heat pump vapor compression operation was unable to meet the demand for space heating.

In addition, under a recently published Department of Energy final rule, the heating efficiency of commercial rooftop packaged heat pumps will increase significantly on 1/1/2018 and then again on 1/1/2023. For single packaged vertical heat pumps, new standards took effect last year, this year, or in 2019 depending on their capacity.

This public comment would further restrict those exceptions by limiting operation of a manual override to a maximum of 3 consecutive hours in any 12 hour period. Even if there is an occasional override of the vapor compression operation of the heat pump, the higher COP's from new DOE standards will offset such operations.

Public Comment 2:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C403.2.4.1.1 Heat pump supplemental heat. Heat pumps having supplemental electric resistance heat shall have controls that prevent supplemental heat operation where the heat pump vapor compression cycle can provide the necessary heating to satisfy the ~~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.

Commenter's Reason: The modifications shown in this public comment are designed to clarify the proposal and address the concerns of the committee. The reference to the first stage of thermostat control has been removed, and it clarifies that any manual override is on a temporary basis and can't be permanent.

In a commercial building, especially one with multiple tenants, the amount of time needed for a manual override may vary quite widely, based on the tenant needs.

CE135-16 Part I

CE135-16 Part II
R403.1.2 (IRC N1103.1.2)

Proposed Change as Submitted

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

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 Part II :
R403.1.2-
ROSENSTOCK13810

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: Consistency with Committee's previous action on CE134-16 Part II.

Assembly Action: **None**

Public Comment 1:

Proponent : Keith Dennis (keith.dennis@nreca.coop) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R403.1.2 (N1103.1.2) Heat pump supplementary heat (Mandatory). Heat pumps having supplemental electric-resistance heat shall have controls that prevent supplemental heat operation when the heat pump vapor compression cycle can provide the necessary heating 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 for no more than 3 consecutive hours during any 12 hour period..

Commenter's Reason: This public comment would limit the time that a heat pump thermostat could be over-ridden to 3 consective hours during any 12 hour period.

Public Comment 2:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R403.1.2 (N1103.1.2) Heat pump supplementary heat (Mandatory). Heat pumps having supplemental electric-resistance heat shall have controls that prevent supplemental heat operation when the heat pump vapor compression cycle can provide the necessary heating to satisfy the ~~first stage of the~~ thermostat control.

Exceptions:

1. Defrost operation.
2. Vapor compression cycle heating malfunction.
3. Thermostat malfunction.
4. ~~Manual~~ Temporary manual override of pre-programmed thermostat setting.

Commenter's Reason: The modifications shown in this public comment are designed to clarify the proposal and address the concerns that were expressed during the committee action hearings. The reference to the first stage of thermostat control has been removed, and it clarifies that any manual override is on a temporary basis and can't be permanent.

In a multi-family residential building, the amount of time needed for a manual override may vary quite widely, based on the needs and activities of different residents.

CE135-16 Part II

CE137-16 Part II

IECC: , (New), 0, R104.1, R303.3, R403.10.1, R403.5.1.

Proposed Change as Submitted

Proponent : David Collins (dcollins@preview-group.com); Dan Buuck (dbuuck@nahb.org); Steven Orlowski (sorlowski@boma.org)

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.

CE137-16 Part II : R403.2.4.2-COLLINS13945

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: These terms are going to be too difficult to explain to contractors.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Submitted.

Commenter's Reason: CE137 came to the attention of SEHPCAC because of the inconsistency of action between the Commercial and Energy Code Development Committees. A key goal of the SEHPCAC is to minimize inconsistency between the two halves of the IECC where the same topic is being addressed.

This proposal is simply an attempt to eliminate the potential for confusion over the term 'accessible'. There is a multiple code change effort to change the I-Codes so that 'accessible is used for provisions for persons with disabilities – and not where the code wants a piece of equipment to be in a location where inspectors and building occupants can reach.

In this case the SEHPCAC feels the best way to achieve consistency between IECC code halves is to approve Part II of CE137.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

CE137-16 Part II

NOTE: PART I DID NOT RECEIVE A PUBLIC COMMENT AND IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY

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.

Proposed Change as Submitted

Proponent : David Collins (dcollins@preview-group.com); Dan Buuck (dbuuck@nahb.org); Steven Orlowski (sorlowski@boma.org)

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 to occupants.~~

1. Shall be 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*").~~

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.

CE137-16 Part I : C403.2.4.2-COLLINS13944

Public Hearing Results

Part I

Committee Action: **Approved as Submitted**

Committee Reason: Approval is based on the proponent's published reason statements.

Assembly Action: **None**

CE138-16

IECC: , C202 (New), C403.2.4.3 (New), C403.2.4.3.1 (New), C403.2.4.3.2 (New).

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

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~~ occupied 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 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~~ Card key ~~card systems~~ controls comply with these requirements.

Committee Reason: Approval is based on the proponent's published reason statements. The Modifications revise the text to use the correct terminology and fix an error in intent.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 ~~occupied~~ 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.

Commenter's Reason: All this public comment is doing is changing
has not been continuously for over 16 hours

to

has been continuously unoccupied for over 16 hours

This matches the original intent of the proposal. Rarely is a hotel room continuously occupied for 16 straight hours. The point is for the controls to change the set points if no one has been in the room for a long time (16 hours).

CE138-16

CE140-16
IECC: C403.2.6.

Proposed Change as Submitted

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* or applicable codes or accreditation standards. Where mechanical ~~ventilation~~*ventilation* is provided, the system shall ~~provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4~~ comply with one of the ~~*International Mechanical Code*.~~following:

1. The system design outdoor air intake flow rate shall not exceed 135 percent of the required minimum outdoor air intake flow rate.
2. The system shall utilize exhaust air energy recovery complying with Section C403.2.7.

Reason: Currently Chapter 4 of the International Mechanical Code establishes the minimum outside air required for ventilation; however, 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 two 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 allowance 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 shown 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, when 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 were below minimum ventilation rates; however, this indicates that half were at or above minimum ventilation rates. The spread of ventilation rates based on peak CO_2 was quite wide with 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 shows 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 was 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 showed 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://www.energycodes.gov/development/2018IECC (https://www.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 (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 (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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposal eliminates designer flexibility and control. This text belongs in the IMC. Item # 1 "intake flow rate" is unclear.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

C403.2.6 Ventilation. Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the *International Mechanical Code*. Where mechanical ventilation is provided, the system shall ~~provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4~~ comply with one of the ~~*International Mechanical Code.*~~following:

1. The ventilation design minimum system outdoor airflow rate shall not exceed 135 percent of the minimum outdoor airflow rate required by Chapter 4 of the *International Mechanical Code*.
2. Dampers, ductwork and controls shall be provided that allow the system to supply not more than the minimum system outdoor airflow rate required by Chapter 4 of the *International Mechanical Code,* with a single setpoint adjustment.
3. The system shall utilize energy recovery complying with Section C403.2.7. The exceptions of Section C403.2.7 shall not apply.

Exception: The outdoor airflow rate is not limited during air economizer operation in accordance with Section C403.3.3 or demand controlled ventilation operation in accordance with Section C403.2.6.1.

Commenter's Reason: This proposal has been revised for language clarity based on SEHPCAC feedback. Since the new requirement calls for a configured condition rather than a capability, an exception was added to make it clear that air economizer or demand controlled ventilation operation did not violate this provision.

In addition the original IECC requirement that the system have the capability to reduce to the minimum required by the International Mechanical Code (IMC) was added as an option. This option is also provided in ASHRAE 90.1-2016, and while not as strict as the original proposal, it does ensure that the minimum outside air capability is available to a future building owner without significant additional cost.

The phrase "or applicable codes or accreditation standards" is removed from the prior proposal, as these alternative ventilation basis are already covered in the IMC.

The original reason statement describing the benefits of limiting ventilation to a reasonable amount above the IMC still applies.

Bibliography: See original reason statement.

CE140-16

CE142-16
IECC: C403.2.6.1.

Proposed Change as Submitted

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 (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 (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 (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 (https://www.energycodes.gov/development/2018IECC).[3]

CE142-16 : C403.2.6.1-WILLIAMS12248

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: No justification was provided to support the proposal.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

GENERAL DEFINITIONS

OCCUPIED-STANDBY MODE: When a zone is scheduled to be occupied and an occupant sensor indicates zero population within the zone.

C403.2.6.2 Occupied standby controls Zones serving only rooms that are required to have occupant sensor lighting controls in accordance with Section C405.2.1 and that have space occupancy classifications from Table 403.3.1.1 of the *International Mechanical Code* where the area outdoor airflow rate in the breathing zone is equal to 0.06 cfm/ft.^{2} shall comply with all of the following not more than 5 minutes after all rooms in that zone have entered an *occupied-standby mode*.

1. The active heating setpoint shall be setback not less than 1°F, and
2. The active cooling setpoint shall be setup not less than 1°F, and
3. All airflow supplied to the zone shall be shut-off whenever the space temperature is between the active heating and cooling setpoints

Exceptions:

1. Multiple zone systems without DDC zone controls.
2. Where the zone supply airflow rate minus any makeup or outgoing transfer air requirement is not more than 200 cfm (95 L/s).
3. Where the system is installed for the sole purpose of providing makeup air to meet exhaust requirements and the system operation is interlocked with the exhaust fan.
4. Zones in Group H-1, H-2, H-3, I-2, and I-3 occupancies.

Commenter's Reason: This proposal replaces the original proposal with a proposal that reduces ventilation in vacant zones during occupied-standby mode that occures during normally scheduled hours when a space is vacant. A definition is added for "occupied-standby mode."

The approach is similar to the occupancy sensor control in the original proposal, except that it only applies in zones where all rooms are equipped with occupancy sensors for lighting control, allowing the occupancy sensor to be shared between systems. This can reduce the cost of the proposal.

Rather than limit the proposal to high density spaces greater than 150 square feet (as in the original proposal), it applies to all zones with lighting occupancy sensors (with exceptions). The savings is proportional to supply air, so the high density people requirement is not needed. Zones with net airflow below 200 cfm are excepted, so the 150 square foot limit (as in the original proposal) is not needed.

The cost and savings are very similar to the cost effectiveness discussed in the original reason statement, and the cost is expected to be less, as only spaces with lighting occupancy sensors are included.

This public comment adds a new ventilation section rather than modifying the DCV section, for three reasons:

1. The requirements are clearer in a separate section,
2. It can be applied in addition to DCV in high-density spaces, saving more energy, and
3. This approach aligns better with a proposal under consideration for ASHRAE Standard 90.1.

There are exceptions provided for makeup air units and zones with limited net supply air as in the original proposal.

Only zones with low standby contaminents and sensitive populations are required to shut off air, including spaces where the area outdoor airflow rate in Table 403.3 of the IMC is 0.06 cfm/ft^2. Other spaces with a higher area ventilation requirement, such as nail salons and art classrooms, would not be included in the requirement. This matches the ventilation shutoff allowance created by addendum P to ASHRAE standard 62.1-2013. Medical, correctional and hazardous use groups are excepted.

While there is a thermal control element to the controls, as in the original proposal, the minor standby adjustments in thermostat setting are intended to allow the ventilation control to function correctly, not achive significant savings through space heat loss or gain reductions. The control requirements start within 5 minutes after entering occupied standby mode. For DDC systems where occupancy is a direct system input, this can start immediately after the space is vacant. Where the signal comes from a lighting occupant sensor with a 20 minute time out, the installation would still comply, as the definition of *occupied standby mode* is when the occupant sensor indicates the space is vacant.

The cost impact and cost effectiveness of this revised proposal is expected to be the same as outlined in the original proposal.

Note: Renumber parking garage ventilation control to C403.2.6.3 and insert this new section after existing demand controled ventilation (C403.2.6.1).

Bibliography: See original proposal.

Public Comment 2:

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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 people or greater 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.

Commenter's Reason:
This completes a clarifying cleanup started by CE141 from SEHPCAC that was approved as submitted by the committee. Both proposals have to do with the space occupant load. That proposal added "or greater" to clarify that the space did not need exactly 25 people per 1000 square feet to meet the requirements. The "or greater" addition is included here for compatability.

This proposal replaces the words "an average" with "a design" modifying occupant load.

The design occupant load is a clearly established number and is determined in accordance with the IMC during design.

The average occupant load is subject to interpretation as to the averaging period and season, so cannot be clearly determined.

There is no cost associated with this proposal as it is clarification only.

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Submitted.

Commenter's Reason: The proponent stands on the original reason statement.
This proposal provides significant savings at a reasonable cost.

Cost effectiveness of similar requirements was demonstrated in the original proposal reason statement.

Bibliography: See original proposal.

CE142-16

CE144-16

IECC: C403.2.6.3 (New).

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: In some zone 2 climates, it can get quite cold and this text would allow no ventilation at all in such cases.

Assembly Action: **None**

Public Comment 1:

Proponent : Mike Moore, representing Broan-NuTone (mmoore@newportventures.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C403.2.6.3 Dwelling unit mechanical ventilation. Mechanical ventilation shall be provided for Group R-2 dwelling units ~~in R-2 occupancies~~ in accordance with the *International Mechanical Code.*

Exception: ~~Mechanical~~ An outdoor air ventilation system is not required for Group R-2 dwelling units in ~~R-2 occupancies where one or more of the following conditions apply:~~
Climate Zones 1~~. The dwelling unit does~~ and 2 that do 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~~.

Commenter's Reason: This public comment cleans up the language in the original proposal and removes an unenforceable and vague exception. The intent of the original proposal and comment is to ensure that tight dwelling units complying with the commercial chapter of the IECC (i.e., high-rise apartments) are provided with the means to access minimum acceptable indoor air quality. This is similar to the IECC residential requirement to provide mechanical ventilation for low-rise dwelling units (R403.6). Occupants of tight, high-rise dwelling units should be afforded access to the same minimum acceptable level of indoor air quality as occupants of low-rise dwelling units.

CE144-16

CE145-16
IECC: C403.2.7.

Proposed Change as Submitted

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 exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values.~~
   - 2.2.Variable-air-volume laboratory exhaust and room supply systems capable of reducing exhaust and makeup airflow rates or that incorporate a heat recovery system to precondition makeup air from laboratory exhaust that meet the following:
     - 3.1.A + B x (E/M)≥ 50%
       - 3.1.1.A is the percentage that the exhaust makeup airflow rates can be reduced from design conditions.
       - 3.1.2.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.
       - 3.1.3.E is the exhaust airflow rate through the heat recovery device at design conditions.
       - 3.1.4.M is the makeup airflow rate of the system design conditions.
   - 2.3.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 with. 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 with 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 where 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 with glycol solution circulated between the two coils), which is addressed by option 1. Also it recognized applications with low air change rates where airflow rate turndown is very limited, which is addressed by the 3rd option

Cost Impact: Will not increase the cost of construction
This proposals allows for alternatives for the requirement therefore increases flexibility and does not increase the cost of construction.

CE145-16 :
C403.2.7-
FERGUSON12888

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval is consistent with the action taken on CE146-16.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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. The energy recovery system shall meet one of the following

1. 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.
2. Laboratory fume hood systems that include variable-air-volume laboratory exhaust and room supply systems capable of reducing exhaust and makeup airflow rates or that incorporate a heat recovery system to precondition makeup air from laboratory exhaust that meet the following:
   A + B x (E/M) ≥ 50%
   Where:
   A = the percentage that the exhaust makeup airflow rates can be reduced from design conditions.
   B = 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.
   E = the exhaust airflow rate through the heat recovery device at design conditions.
   M = the makeup airflow rate of the system design conditions.

~~Exception~~ Exceptions: 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.~~

2. Laboratory fume hood systems that include 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. 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.

Commenter's Reason: This PC modifies the proposal by recasting one exception as an option. There is no change in the intent of the original proposal.
The original proposal had disapproval requested by the proponent to allow for clarifying modification.

The reason and cost impact is the same as for the original proposal. Additional information for the reason statement:
During the last code cycle there were some issues raised on a similar proposal (CE 227-13) due to the possibility of a lab that meets requirement 2 (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

CE145-16

CE147-16 Part I
C202 (New), C403.2.9

Proposed Change as Submitted

Proponent : Jay Peters, representing AQC Industries / TheBlueDuct (peters.jay@me.com)

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*.

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 Air Duct Thermal Efficiency Performance** was developed to test an air duct system's 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 different 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. Although it is not an exact replacement for the ASTM 518 standard when attempting to measure a basic R-Value, 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: 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.

CE147-16 Part I : C403.2.9-PETERS13392

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: There needs to be a referenced standard on how to test the product. It was not shown that TDE is equivalent to an R-value.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jay Peters, Codes and Standards International, representing AQC Industries / TheBlueDuct (peters.jay@me.com); Greg Johnson, Johnson & Associates Consulting Services, representing Self (gjohnsonconsulting@gmail.com); David Eisenberg (strawnet@gmail.com); Gary Klein, Gary Klein and Associates, Inc.; Gil Rossmiller, representing Town of Parker (grossmiller@parkeronline.org); Brent Ursenbach (bursenbach@slco.org); Sharon Bonesteel, representing Salt River Project (SRP) (sharon.bonesteel@srpnet.com); David Purkiss, representing NSF International (purkiss@nsf.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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*. Underground ducts utilizing the Thermal Distribution Efficiency method shall be listed and labeled to indicate the R-Value equivalency. Where located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by 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*.

Commenter's Reason: ADDRESSING COMMITTEE CONCERNS

COMMITTEE CONCERN #1. "A referenced standard for testing the product was needed"

RESPONSE: ASTM518 and NSF P374 Both Referenced: The committee members stated that the NSF P374 was not tied to the testing of the duct and used ASTM 518 as an example. They stated that ASTM 518 is widely accepted as the method for verifying R-value. This is true, but **ASTM 518 is not referenced in the code and is only "tied to the testing of the duct" through ICC LC1014, not the code -- the same as NSF P374.** Currently,

underground ducts are tested and listed to meet ICC ES Listing Criteria LC1014 [1]. ICC ES, IAPMO, UL and NSF all recognize ICC LC1014. Within this LC, there are two options for proving thermal efficiency; **ASTM 518** [2] for R-Value or **NSF P374** [3] for Thermal Distribution Efficiency.

[1] LISTING CRITERIA FOR UNDERGROUND PLASTIC AIR DUCTS (ATTACHED)
[2] ASTM518: STANDARD TEST METHOD FOR STEADY-STATE THERMAL TRANSMISSION PROPERTIES BY MEANS OF THE HEAT FLOW METER APPARATUS TO DETERMINE R-VALUE
[3] NSF P374: AIR DUCT THERMAL EFFICIENCY PERFORMANCE (ATTACHED)

Note: There is no directly referenced standard for the R-value of ducts in the code. ASTM 518 is not a referenced standard in the code.

COMMITTEE CONCERN #2. "It was not proven that TDE is equivalent to an R-value"

RESPONSE: NSF P374 Meets or Exceeds ASTM 518: The committee did not understand that equivalency is proven in side-by-side testing. A letter from Dave Purkiss, General Manager, **NSF (attached) demonstrates that a TDE far exceeds the R-value method for assuring an underground duct's ability to efficiently deliver conditioned air to a space.** The TDE method in NSF P374 not only measures the heat transfer through the material (R-value) but it also takes into account the air leakage, friction loss, thermal mass of the material and measures the dynamic air flow instead of the overly simple and static R-value. It also does restrict insulated ducts from their current complaince path utilizing the traditional R-value method.

Committee Discussion and Testimony: This centered on the need for added language to indicate the Thermal Distribution Efficiency and R-Value equivalency on the duct to eliminate confusion or added research by the AHJ seeking assurance that the duct performs equivalently to a duct insulated to the prescribed R-value per code. This modification now requires the duct manufacturer to list the product and label it accordingly. **The label will indicate the TDE's R-value equivalency.** If a duct has been tested and proved to meet an R-10 equivalency, it will indicate, on the label, that the Thermal Distribution Efficiency = R10 Equivalency.

The Test Basics: The NSF P347 testing protocol consists of two air ducts buried side by side in trenches. One side is the test air duct—the other is the control duct. The control duct consists of a traditional installation of buried PVC-coated spiral sheet metal air duct surrounded on four sides with R-10 (ASTM C518) board insulation per code. The temperature of air entering, flowing through and exiting the test and control ducts is measured and compared (as well as soil temperature). If the comparison is found by the third party testing agency to be equivalent the tested duct is assigned a TDE equivalent to an R-10.

BOTTOMLINE SOLUTION:

Verification of the listing at plan review or an examination of the label in the field prove compliance: The committee identified the need for a simple verification of thermal efficiency so this modification requires ducts attempting to comply through the Thermal Distribution Efficiency option to be listed and labeled for equivalent energy performance. It allows proven, energy efficient, time tested, widely accepted cutting edge products to be used, while eliminating unnecessary insulation when a duct material exhibits an equally efficient method to deliver conditioned air, saving material and energy.

This received strong support from industry (NSF, the Air Conditioning Contractors of America National Code Committee) as well as building and energy officals during the testimony. The committee concerns have been addressed by this modification.

Proponent : David Bixby, Air Conditioning Contractors of America, representing Air Conditioning Contractors of America (david.bixby@acca.org) requests Approve as Submitted.

Commenter's Reason: ACCA supports this proposal. Ducts located under a building are subjected to different conditions than those within attics or crawl spaces 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.

Proponent : Charles Stock, Spunstrand Inc, representing Spunstrand Inc requests Disapprove.

Commenter's Reason: It should be noted that this code change proposal was voted down during committee hearings and, as previously discussed, this boils down to a few key reasons why this addition should not be made to the code.

- As submitted there is no identified way of determining Thermal Distribution Efficiency (TDE). The reason statement mentions an NSF protocol, however, it appears this is not a vetted, trusted, or a consensus-reached testing protocol and should not be in the code. Currently the code specifies insulation requirements, indicates insulation requirements are in terms of R-value, and defines what R-value is and how you evaluate it. On the other hand, TDE is a vague term, very loosely defined if at all, and there appears to be no attempt to indicate how it is measured, obtained or evaluated.
- The reason statement indicates that NSF allows for a "true measure of a ducts overall performance." Has this been verified? And if so by who? To date, our research has yielded numerous questions about the lack of definitions and guidelines in NSF P374 along with concerns about potential discrepancies in the testing outcomes. With these questions unanswered TDE should stay out of the codes.
- The reason statement indicates that TDE measures what is important – "the difference between the entering and leaving temperature of air as it moves through the duct." However it fails to mention how TDE evaluates energy losses during system down time. R-value is a measure of the expected performance of a duct material to save energy while the system is running and when it is not running. If TDE is only measured and determined when air is moving, is it comparable to R-value for measuring insulation properties when air is not moving? Should it be in the code?
- IECC clearly and specifically defines R-value as "The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area (h x ft^2 x °F/Btu)." This change proposal attempts to make TDE and insulation requirements (aka R-value) equivalent while NSF indicates that TDE does not equal R-value.
- Most people, including the IECC itself, recognize that insulation performance characteristics of a material and the required performance of those materials in usage are directly linked to the products R-value and that R-value is determined by ASTM C518.
- The reason statement indicates that the code needs options other than R-value because of the previously used burial methods for insulation underground duct, inferring that insulating methods prior to those used by the manufacturer that is submitting the code revisions did not include integrated insulation. However, Spunstrand has been making an integrated insulation product for over 20 years and have had no issues complying with the code requirements as they are written. There are multiple other underground duct manufacturers that make ductwork that has integrated insulation and still complies with ASTM C518 testing. Are new measurements and definitions needed just to avoid having products tested to ASTM C518?
- The reason statement hints at the fact that new or innovative products require new testing methods. However, as a manufacturer who has been making a quality product for this market while maintaining the integrity of the code requirements as they stand, Spunstrand whole heartedly believes that a product that is promoted as "new and innovative" must be able to meet the standing codes and push performance; not create a slippery slope that waters down and weakens the code in order to achieve compliance.

So in the end it looks like this code change proposal attempts to add an unneeded "characteristic" of a duct material (aka TDE), which it does not indicate or specify how it should be obtained. It then hopes to compare this questionable, unnecessary result as an equivalent to a recognized and trusted fundamental material measurement of insulation performance such as R-value. So why not test the material to ASTM C518? Does anything more need to be said? We believe not and that nothing else is needed in the code. We request that all vote no for CE147 Part 1 and 2.

CE147-16 Part I

CE147-16 Part II

R202 (New) [IRC N1101.6 (New)], R403.3.1 (IRC N1103.3.1)

Proposed Change as Submitted

Proponent : Jay Peters, representing AQC Industries / TheBlueDuct (peters.jay@me.com)

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: 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 Part II : R403.3.1-PETERS13372

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: Protocol P374 is not tied to the testing of the product.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jay Peters, Codes and Standards International, representing AQC Industries / TheBlueDuct (peters.jay@me.com); Greg Johnson, representing Self; Gil Rossmiller, representing Town of Parker (grossmiller@parkeronline.org); Gary Klein, Gary Klein and Associates, Inc., representing self; David Eisenberg, representing Development Center for Appropriate Technology (strawnet@gmail.com); Brent Ursenbach (bursenbach@slco.org); Sharon Bonesteel, representing Salt River Project (SRP) (sharon.bonesteel@srpnet.com); David Purkiss, representing NSF International (purkiss@nsf.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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.* Underground ducts utilizing the *thermal distribution efficiency* method shall be listed and labeled to indicate the R-Value equivalency.

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

Commenter's Reason: Committee Reasoning Statement: "Protocol P374 does not tie to the testing of the duct"

Commenter's Technical Response and Reasoning:

Currently, ICC ES' LC1014, Listing Criteria for Underground Plastic Ducts is the only criteria used to evaluate, certify and list underground plastic ducts in the industry. Multiple third party listing and evaluation agencies test, recognize or list underground plastic ducts to this criteria, includng NSF, UL, ICC ES and IAPMO R&T.

Underwriters Laboratories (UL) confirmed the wide acceptance of LC1014 in the attached letter dated September 23, 2014. Within the letter, John Taecker, senior regulatory engineer, states "UL is aware of requirements in the marketplace specific to underground ducts. These requirements appear in the International Mechanical Code, Uniform Mechanical Code, International Residential Code and specifically ICC-ES PMG Listing Criteria for Underground Plastic Air Ducts, LC-1014." IAPMO and ICC ES both list underground plastic ducts to LC1014.

This Listing Criteria, created by ICC ES, contains standards and criteria necessary for listing underground ducts. Within the LC, it recognizes both ASTM518 and NSF P374 as shown below:

4.4 Determination of Thermal Resistance Values (R-Value) for Ducting Systems: Thermal resistance value of insulation should be determined by ASTM C 518.

4.5 Determination of Thermal Distribution Efficiency (TDE) for Ducting Systems: Thermal distribution efficiency of air ducts should be determined by NSF Protocol 374."

ASTM518 and NSF P374 Referenced: The committee members stated that the NSF P374 was not tied to the testing of the duct and used ASTM 518 as an example. They stated that ASTM 518 is widely accepted as the method for verifying R-value. This is true, but **ASTM 518 is not referenced in the code and is only "tied to the testing of the duct" through ICC LC1014, not the code -- the same as NSF P374.**

Simple Verification for Compliance: Because the committee identified the ease of use of an R-value as a positive, this modification requires ducts that comply with the Thermal Distribution Efficiency option to be listed and labeled for equivalent energy performance for ease of verification for plan reviewers and inspectors. A simple verification of the listing at plan review or an examination of the labels in the field prove compliance.

Conclusion: The original proposal and modification place additional requirements that make it clear to the AHJ that ducts utilizing Thermal Distribution Efficiency to prove their efficiency must be tested, listed and labeled per code. It also confirms that ASTM 518 and NSF P374 are viable, accepted, proven, scientific methods for verifying compliance with the code and verifying the thermal performance of underground plastic ducts. Some cutting edge duct materials are capable of delivering conditioned air as efficiently, or better than, insulated ducts and should not be required to have excess insulation installed.

Proponent : David Bixby, Air Conditioning Contractors of America, representing Air Conditioning Contractors of America (david.bixby@acca.org) requests Approve as Submitted.

Commenter's Reason: ACCA supports this proposal. Ducts located under a building are subjected to different conditions than those within attics or crawl spaces 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.

Proponent : Charles Stock, Spunstrand Inc, representing Spunstrand Inc requests Disapprove.

Commenter's Reason: It should be noted that this code change proposal was voted down during committee hearings and, as previously discussed, this boils down to a few key reasons why this addition should not be made to the code.

- As submitted there is no identified way of determining Thermal Distribution Efficiency (TDE). The reason statement mentions an NSF protocol, however, it appears this is not a vetted, trusted, or a consensus-reached testing protocol and should not be in the code. Currently the code specifies insulation requirements, indicates insulation requirements are in terms of R-value, and defines what R-value is and how you evaluate it. On the other hand, TDE is a vague term, very loosely defined if at all, and there appears to be no attempt to indicate how it is measured, obtained or evaluated.
- The reason statement indicates that NSF allows for a "true measure of a ducts overall performance." Has this been verified? And if so by who? To date, our research has yielded numerous questions about the lack of definitions and guidelines in NSF P374 along with concerns about potential discrepancies in the testing outcomes. With these questions unanswered TDE should stay out of the codes.
- The reason statement indicates that TDE measures what is important – "the difference between the entering and leaving temperature of air as it moves through the duct." However it fails to mention how TDE evaluates energy losses during system down time. R-value is a measure of the expected performance of a duct material to save energy while the system is running and when it is not running. If TDE is only measured and determined when air is moving, is it comparable to R-value for measuring insulation properties when air is not moving? Should it be in the code?
- IECC clearly and specifically defines R-value as "The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area (h x ft^2 x °F/Btu)." This change proposal attempts to make TDE and insulation requirements (aka R-value) equivalent while NSF indicates that TDE does not equal R-value.
- Most people, including the IECC itself, recognize that insulation performance characteristics of a material and the required performance of those materials in usage are directly linked to the products R-value and that R-value is determined by ASTM C518.
- The reason statement indicates that the code needs options other than R-value because of the previously used burial methods for insulation underground duct, inferring that insulating methods prior to those used by the manufacturer that is submitting the code revisions did not include integrated insulation. However, Spunstrand has been making an integrated insulation product for over 20 years and have had no issues complying with the code requirements as they are written. There are multiple other underground duct manufacturers that make ductwork that has integrated insulation and still complies with ASTM C518 testing. Are new measurements and definitions needed just to avoid having products tested to ASTM C518?
- The reason statement hints at the fact that new or innovative products require new testing methods. However, as a manufacturer who has been making a quality product for this market while maintaining the integrity of the code requirements as they stand, Spunstrand whole heartedly believes that a product that is promoted as "new and innovative"

must be able to meet the standing codes and push performance; not create a slippery slope that waters down and weakens the code in order to achieve compliance.

So in the end it looks like this code change proposal attempts to add an unneeded "characteristic" of a duct material (aka TDE), which it does not indicate or specify how it should be obtained. It then hopes to compare this questionable, unnecessary result as an equivalent to a recognized and trusted fundamental material measurement of insulation performance such as R-value. So why not test the material to ASTM C518? Does anything more need to be said? We believe not and that nothing else is needed in the code. We request that all vote no for CE147 Part 1 and 2.

CE147-16 Part II

CE155-16
IECC: C403.2.7.

Proposed Change as Submitted

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) where energy recovery is currently required with 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 two-thirds of the multi-family units (https://www.census.gov/construction/chars/mfu.html). There continues to be a requirement for most dwelling units to have energy recovery in the colder climates. In warmer 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

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Approval is based on the proponent's published reason statements.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Mike Moore, Newport Ventures, representing Broan-NuTone (mmoore@newportventures.net) requests Disapprove.

Commenter's Reason: This proposal completely removes energy recovery requirements for any apartment up to 2750 ft^2 and up to 4 bedrooms in climate zones 1B, 2B, 3B, 4C, and 5C and any apartment up to 1900 ft^2 and up to 2 bedrooms in climate zones 1A, 2A, 3A, 4B, and 5B. The proposal's reason statement incorrectly cites lack of available equipment at low flow rates as the basis for this change. However, for the past several years, the industry has developed ERVs with flow rates down to 10 cfm for this application. In fact, ERVs with flow rates between 10 and 40 cfm are the lowest-cost ERVs available on the market.

The rationale and basis for this proposal are flawed. If not overturned, this proposal will represent a significant step back for energy efficient ventilation.

CE155-16

CE171-16
IECC: C404.2.

Proposed Change as Submitted

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 Resistance > 20 gallons and < 55 gallons Grid-enabled > 20 gallons and < 120 gallons	0.93 - 0.00132*V*, EF ~~0.97 - 0.00 132*V*~~ 0.960 - 0.0003*V*, EF 1.06 - 0.00168*V*, 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 > 55 gallons and ≤ 120 gallons	~~0.93 - 0.00 132*V*~~ 2.057 - 0.00113*V*, EF	DOE 10 CFR Part 430
Storage water heaters, gas	≤ 75,000 Btu/h	≥ 20 gallons and ≤ 55 gallons > 55 gallons and < 100 gallons	~~0.62 - 0.00 19*V*~~ 0.675 - 0.0015*V*, EF ~~0.62 - 0.00 19*V*~~ 0.8012 - 0.00078*V*, EF	DOE 10 CFR Part 430
	> 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~~ 0.82 - 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 ≤ 50 gallons	~~0.59~~ 0.68 - 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	≤ 210,000 Btu/h	≥ 4,000 Btu/h/gal and	0.59 - 0.0019*V*, EF	DOE 10 CFR Part 430
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and	80% E_t	

water heaters, oil	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	78% E_t (Q/800 + 110 V)SL, Btu/h	ANSI Z21.10.3
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	80% E_t (Q/800 + 110 V)SL, 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

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Approval was based on the proponent's published reason statements.

Assembly Action: **None**

Public Comment 1:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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[e], > 20 gallons and < 120 gallons	0.93 - 0.00132*V*, EF	DOE 10 CFR Part 430
		Resistance > 20 gallons and < 55 gallons	0.960 - 0.0003*V*, EF	
		Grid-enabled[f] > 75 ~~20~~ gallons and < 120 gallons	1.061 - 0.00168*V*, 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	2.057 - 0.00113*V*, EF	DOE 10 CFR Part 430
Storage water heaters, gas	≤ 75,000 Btu/h	> 20 gallons and < 55 gallons	0.675 - 0.0015*V*, EF	DOE 10 CFR Part 430
		> 55 gallons and < 100 gallons	0.8012 - 0.00078*V*, EF	
	> 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	0.82 - 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 < 50 gallons	0.68 - 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	≤ 210,000 Btu/h	≥ 4,000 Btu/h/gal and	0.59 - 0.0019V, EF	DOE 10 CFR Part 430

Instantaneous water heaters, oil	> 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, gas	≥ 300,000 Btu/h and	≥ 4,000 Btu/h/gal and ≥ 10 gal	80% E_t (Q/800 + 110 V)SL, 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).

e. A tabletop water heater is a water heater that is enclosed in a rectangular cabinet with a flat top surface not more than 3 feet (0.91 m) in height.
f. A grid-enabled water heater is an electric resistance water heater that meets all of the following:
(1) Has a rated storage tank volume of more than 75 gallons.
(2) Is manufactured on or after April 16, 2015.
(3) Is equipped at the point of manufacture with an activation lock.
(4) Bears a permanent label applied by the manufacturer that complies with all of the following:
(4.1) Is made of material not adversely affected by water.
(4.2) Is attached by means of non-water-soluble adhesive.
(4.3) Advises purchasers and end-users of the intended and appropriate use of the product with the following notice printed in 16.5 point Arial Narrow Bold font: "IMPORTANT INFORMATION: This water heater is intended only for use as part of an electric thermal storage or demand response program. It will not provide adequate hot water unless enrolled in such a program and activated by your utility company or another program operator. Confirm the availability of a program in your local area before purchasing or installing this product."

Commenter's Reason: The proposed modifications make table corrections and add explanatory footnotes for certain types of water heaters.

CE171-16

CE175-16 Part I
IECC: C404.9 (New).

Proposed Change as Submitted

Proponent : Anthony Floyd, Energy Code Specialist, representing City of Scottsdale (afloyd@scottsdaleaz.gov); Karen Hobbs (khobbs@nrdc.org)

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.

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: 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).

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code.

CE175-16 Part I :
C404.9 (NEW)-
FLOYD13382

Public Hearing Results

Part I

Committee Action: **Approved as Submitted**

Committee Reason: When this proposal is presented to the IPC committee, they defer to the IECC committee. Water use has an energy component. These shower heads are being used without issues. The IECC can exceed the other code minimum requirements. It requires energy to move, pump, and heat water. This is an achievable means to save energy without sacrificing comfort.

Assembly Motion: **As Modified**
Online Vote Results: **Successful**
Support: 55.56% (105) Oppose: 44.44% (84)
Assembly Action: **Approved as Modified**

Online Floor Modification:

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CHAPTER 6 Water Efficiency
C601.1 Plumbing fixture efficiency(Madatory) Plumbing fixtures shall meet the minimum water efficiency requirements of this section.

~~C404.9~~ C601.1.1 Shower heads (Mandatory). *No change to text*

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code. T
This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Individual Consideration Agenda

Public Comment 1:

Proponent : Hope Medina, representing self (hmedina@coloradocode.net) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

CHAPTER 6 Water Conservation and Efficiency
601.1 Scope The provisions of this chapter shall establish the means of conserving water and conserving energy associated with the use of water. .

SECTION 602 Plumbing fixture efficiency

602.1 General The provisions of Section 602 shall govern the water consumption and efficiency of plumbing fixtures.

602.2 Shower heads The flow rate of fixed and handheld shower heads shall not exceed 2.0 gpm at 80 psi.

Commenter's Reason: All though the origional change does contain energy efficiency aspects I do feel they are a by product of this measure. This is a concept that should be visited. The placement of this change in the service water heating section isn't the correct section it belongs in, but there isn't really a section within the existing energy code that would best fit this requirement. The solution for this is to create a new chapter that deals with water conservation that contains energy efficiency measures.
This is an opportunity to acknowledge that there is a relationship between water conservation and the energy efficiency that is gained from this. A new chapter that is dedicated to water efficiencies that go hand and hand with energy efficiency is where this concept and other similar concepts should be placed.

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code.
This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Anthony Floyd, Energy Code Specialist, City of Scottsdale, representing City of Scottsdale (afloyd@scottsdaleaz.gov) requests Approve as Submitted.

Commenter's Reason: Hot water use has an energy component. It requires energy to move, pump, and heat water. High-effiicency showerheads with a maxiumum flow rate of. 2.0 gpm save energy by reducing the amount of hot water use in the hot water system, similar to other IECC hot water provisions including insulated hot water lines, circulation systems and controls. High-efficiency showerheads are an effective means for reducing energy without sacrificing comfort. They have a proven performance record and are accepted as a proven energy saving measure in whole-building energy performance analyses.
As with other energy efficiency provisions, the IECC often exceed requirements contained in other I-codes including the IPC and IMC. Creating a separate "water efficiency" chapter defeats the purpose of having Section C404 for Service Water Heating including the existing provisions for hot water pipe insulation, pipe length, volume, circulation and control systems. All other points made regarding energy savings in the original Reason Statement remain applicable to this Public Comment.

Bibliography:
Part I: California Energy Commission, "Staff Analysis of Water Efficiency Standards for Show erheads," 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_Show erheads.pdf

Analysis: Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code. This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Assembly Motion requests Approve as Modified by Committee.

Commenter's Reason: This code change proposal is on the agenda for individual consideration because the proposal received a successful assembly motion. The assembly action for Approve as Modified was Successful by a vote of 55.56% (105) to 44.44% (84) by eligible members online during the period of May 11 - May 26, 2016.

Analysis: Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code. This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Hugo Aguilar, representing American Supply Association requests Disapprove.

Commenter's Reason: There are several issues with the approval of this proposal:
1. The IPC and IECC are both adopted in certain jurisdictions. If the proposed requirement were to get into the IECC, it will create a conflict with the IPC. Water conservation requirements are already addressed in ASHRAE 189.1 (formerly known as the IGCC). The IECC addresses energy efficiency such as building envelopes.

2. The Committee reason provided is incorrect as the IPC Committee does not defer to the IECC Committee for such requirement as the IECC does not address water fixtures and water consumption requirements.

3. Including showerheads in the IECC is not technical correct as showerheads do not produce heat.

4. The proposed language in Section 601.1 is not correct as it is in conflict with the IPC. Again, IECC does not address plumbing fixtures.

Analysis: Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code. This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Matt Sigler, representing Plumbing Manufacturers International requests Disapprove.

Commenter's Reason: PMI **disagrees** with the committee's action of **approved as submitted** for the following reasons:

- As stated in the 2015 IECC Commentary (pg. C1-1): "The code addresses the design of energy efficient building envelopes, and the selection and installation of energy-efficient mechanical, service water-heating, electrical distribution and illumination systems and equipment in residential and commercial buildings alike." Nowhere within the IECC does it state that this code addresses water consumption requirements for plumbing fixtures or fittings.
- The bottom line is that the IECC has never addressed water consumption requirements for plumbing fixtures and fittings. Such requirements have always been addressed in the IGCC (now ASHRAE 189.1), IPC and IRC (Chapter 29).
- Proposals that dealt with water consumption requirements for plumbing fixtures and fittings in the ICC Codes were discussed during the Group A hearings and will be included in the 2018 IPC and/or IRC. If CE175 is approved, it will conflict with the actions taken by the IPC Committee.
- The proponents used residential data to justify changes that impact commercial structures.
- Section C404 pertains to equipment that heats water and insulation of service hot water piping. Showerheads do not contain heating elements and do not supply hot water. They are a fitting that hot water passes through. Therefore, referencing showerheads within the table makes no sense.

Analysis: Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code. This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

CE175-16 Part I

CE175-16 Part II
R403.5.5 (New) [IRC N1103.5.5 (New)]

Proposed Change as Submitted

Proponent : Anthony Floyd, Energy Code Specialist, representing City of Scottsdale (afloyd@scottsdaleaz.gov); Karen Hobbs (khobbs@nrdc.org)

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.
Shower heads operating at 2.0 gpm at 80 psi are commonly available and perform as well as shower heads operating at 2.5 gpm. The WaterSense specification for shower heads 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 both 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).

Cost Impact: Will not 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). Lowe's Home Improvement Store features 185 products from 15 brands, ranging in cost from $5 to $400 (Source: Lowe's Home Improvement Store website: http://www.lowes.com/Bathroom/Showers-Shower-Accessories/Showerheads/_/N-1z0wz0vZ1z0z4gq/pl#!).
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 Part II : R403.5.5 (NEW)-FLOYD13357

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: The market for these products is already driving lower flow fixtures to the consumers. Flow rates for plumbing fixtures are not within the scope of the IECC. However, the Plumbing Codes do not include efficiency in their scopes.

Assembly Motion: **As Modified**
Online Vote Results: **Failed**
Support: 36.44% (82) Oppose: 63.56% (143)
Assembly Action: **None**

Online Floor Modification:

Revise as follows;

CHAPTER 6 [RE]
WATER EFFICIENCY

~~R403.5.5 (N1103.5.5)~~ R601.1 Showerheads (Mandatory). *No change to proposed text.*

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code.

This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Residential Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Individual Consideration Agenda

Public Comment 1:

Proponent : Hope Medina, representing self (hmedina@coloradocode.net) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

CHAPTER 6 [RE] Water Conservation and Efficiency

SECTION R601 GENERAL

R601.1 Scope The provisions of this chapter shall establish the means of conserving water with efficiency and the conservation of energy.

SECTION R602 PLUMBING FIXTURE EFFICIENCY

R602.1 General The provisions of Section 602 shall govern the water consumption and efficiency of plumbing fixtures.

R602.2 Shower heads The flow rate of fixed and handheld shower heads shall not exceed 2.0 gpm at 80 psi.

2015 International Residential Code

SECTION N1112 PLUMBING FIXTURE EFFICIENCY

N1112.1 (R602.1) General. The provisions of this section shall govern the water consumption and efficiency of plumbing fixtures.

N1112.2 (R602.2) Shower heads. The flow rate of fixed and handheld shower heads shall not exceed 2.0 gpm at 80 psi.

Commenter's Reason: Although the original change does contain energy efficiency aspects, I do feel they are a by-product of this measure. This is a concept that should be visited. The placement of this change in the service water heating section isn't the correct section it belongs in, but there isn't really a section within the existing energy code that would best fit this requirement. The solution for this is to create a new chapter that deals with water conservation that contains energy efficiency measures.
This is an opportunity to acknowledge that there is a relationship between water conservation and the energy efficiency that is gained from this. A new chapter that is dedicated to water conservation that go hand and hand with energy efficiency is where this concept and other similar concepts should be placed.

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code and the International Residential Code.

This code change proposal addresses the scope and application of the International Energy Code, the International Plumbing Code and the International Residential Code. The action taken by the Residential Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

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

Commenter's Reason: Part I was approved by the Commercial Energy Code Development Committee and the SEHPCAC believes that the two parts of the code should remain as consistent as possible. In this case the proposal does save energy through the restriction on water flow. Each ounce of water that is delivered to a shower has to be cleaned, pumped for delivery, heated (unless a cold shower is preferred) and then treated through a waste water system. Each of these steps requires the use of energy. By restricting water flow, energy is saved. The Commercial Energy committee recognized this value. It is equally valuable and important for residential development.
This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code and the Inteternational Residential Code.
This code change proposal addresses the scope and application of the International Energy Code, the International Plumbing Code and the Inteternational Residential Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Anthony Floyd, Energy Code Specialist, City of Scottsdale, representing City of Scottsdale (afloyd@scottsdaleaz.gov) requests Approve as Submitted.

Commenter's Reason: Hot water use has an energy component. It requires energy to move, pump, and heat water. High-effiicency showerheads with a maxiumum flow rate of. 2.0 gpm save energy by reducing the amount of hot water use in the hot water system, similar to other IECC hot water provisions including insulated hot water lines, circulation systems and controls. High-efficiency showerheads are an effective means for reducing energy without sacrificing comfort. They have a proven performance record and are accepted as a proven energy saving measure in whole-building energy performance analyses.
As with other energy efficiency provisions, the IECC often exceed requirements contained in other I-codes including the IPC and IMC. Creating a separate "water efficiency" chapter defeats the purpose of having Section C404 for Service Water Heating including the existing provisions for hot water pipe insulation, pipe length, volume, circulation and control systems. All other points made regarding energy savings in the original Reason Statement remain applicable to this Public Comment.

Bibliography:

Part I: California Energy Commission, "Staff Analysis of Water Efficiency Standards for Show erheads," 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_Show erheads.pdf

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code and the International Residential Code.
This code change proposal addresses the scope and application of the International Energy Code, the International Plumbing Code and the International Residential Code. The action taken by the Residential Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Hugo Aguilar, representing American Supply Association (haguilar@asa.net) requests Disapprove.

Commenter's Reason: The proposed language in R403.5.5 will conflict with the requirments of the International Plumbing Code (UPC). Fixtures such as showerheads are already addressed within ASHRAE 189.1, the plumbing code and the residential code. Addressing fixtures in the IECC will create confusion in the industry.

Analysis: This code change proposal addresses the scope and application of the International Energy Code, the International Plumbing Code and the International Residential Code. The action taken by the Residential Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Matt Sigler, Plumbing Manufacturers International (PMI), representing Plumbing Manufacturers International requests Disapprove.

Commenter's Reason: PMI **agrees** with the committee's action of **disapproved** for the following reasons:

- As stated in the 2015 IECC Commentary (pg. C1-1): "The code addresses the design of energy efficient building envelopes, and the selection and installation of energy-efficient mechanical, service water-heating, electrical distribution and illumination systems and equipment in residential and commercial buildings alike." Nowhere within the IECC does it state that this code addresses water consumption requirements for plumbing fixtures or fittings.
- The bottom line is that the IECC and Chapter 11 of the IRC have never addressed water consumption requirements for plumbing fixtures and fittings. Such requirements have always been addressed in the IGCC (now ASHRAE 189.1), IPC and IRC (Chapter 29).
- Proposals that dealt with water consumption requirements for plumbing fixtures and fittings in the ICC Codes were discussed during the Group A hearings and will be included in the 2018 IPC and/or IRC. If CE175 is approved, it will conflict with the actions taken by the IPC Committee.

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code and the Inteternational Residential Code.
This code change proposal addresses the scope and application of the International Energy Code, the International Plumbing Code and the International Residential Code. The action taken by the Residential Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

CE176-16 Part I
IECC: C404.9.3.

Proposed Change as Submitted

Proponent : Jennifer Hatfield, J. Hatfield & Associates, PL, representing Association of Pool & Spa Professionals (jhatfield@apsp.org)

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 a solar energy source, covers or other vapor-retardant means shall not be required.

Reason: 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 residential section of the IECC as well as Chapter 11 of the IRC (See Part II 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 Part I : C404.9.3-HATFIELD12796

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: The proposal changes the intent of the code. The code intended for the heat pump to be a Geo-thermal type, therefore, deleting the "site recovered energy" text would allow any heat pump to be used to meet the exception.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Jennifer Hatfield, J. Hatfield & Associates, PL, representing Association of Pool & Spa Professionals (jhatfield@apsp.org) requests Approve as Submitted.

Commenter's Reason: As noted in the original proposal's reasoning, this two part proposal was being submitted to ensure consistency with what is in the International Swimming Pool & Spa Code as well as clarify what was originally intended when this language was put in the IECC. In the Committee Action Hearings, Part II of this proposal went through As Submitted, which means now the IECC Residential requirements will be consistent with the ISPSC, but the IECC Commercial requirements will not unless the body appoves Part I, As Submitted, which we strongly urge them to do.

The original intent of this exception from the vapor retardant pool or outdoor permanent spa cover requirement was when one was utilizing an air-source swimming pool heat pump. An air-source swimming pool heat pump transfers heat from the air to the pool and is a more efficient way to heat a pool or outdoor permanent spa (which typically uses gas) over other types of heaters that exist.

The language that is currently in this section of the IECC uses the term "site-recovered energy" and this was done without a proper understanding by the pool & spa industry that it is not defined to include an air-source swimming pool heat pump. There is no swimming pool heat pump on the market that would meet the ASHRAE 90.1 definiton of "site-recovered energy" - if the industry had understood that from the begininng, we clearly would not have used those words when first providing for this exception. Further, examples of where this exception has been used since it was included in the code exist, but they are when a consumer utilizes an air-source heat pump, as originally intended by the exception. Therefore, this proposal is simply eliminating that term to clarify the original intent is if a pool or permanent spa utilizes an air-source heat pump for more than 70% of the energy used in heating the pool or permanent spa, that one is exempt from the vapor retardant cover requirement.

To leave the code as it currently is written means the exception will either continue to be enforced incorrectly, as we know it has been or it will become pointless if enforced correctly since no product exists - the latter also not being as originally intended when inserted in the code in the first place. We strongly urge the assembly to overturn the committee's action and move the proposal as submitted in order to be consistent with the International Swimming Pool & Spa Code and what the IEEC Residential Committee did in Part II of this proposal, by making this change. This will also ensure that the code provides for what was originally intended.

CE176-16 Part I

CE176-16 Part II
R403.10.3 (IRC N1103.10.3)

Proposed Change as Submitted

Proponent : Jennifer Hatfield, J. Hatfield & Associates, PL, representing Association of Pool & Spa Professionals (jhatfield@apsp.org)

2015 International Energy Conservation Code

Revise as follows:

R403.10.3 (N1103.10.3) Covers. Outdoor heated pools and outdoor permanent spas shall be provided with a vapor-retardant cover or other *approved* vapor-retardant means.

Exception: Where more than 70 percent of the energy for heating, computed over an operation season, is from ~~site-recovered energy, such as from~~ a heat pump or a solar energy source, covers or other vapor-retardant means shall not be required.

Reason: 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 Part II : R403.10.3-HATFIELD12795

Public Hearing Results

Part II

Committee Action: **Approved as Submitted**

Committee Reason: Changing the language allows for more sources of energy to be available so that covers don't have to be used.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : jim edelson, representing new building institute (jim@newbuildings.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R403.10.3 (N1103.10.3) Covers. Outdoor heated pools and outdoor permanent spas shall be provided with a vapor-retardant cover or other *approved* vapor-retardant means.

Exception: Where more than 70 percent of the energy for heating, computed over an operation season, is from a heat pump or a ~~solar~~ renewable energy source, covers or other vapor-retardant means shall not be required.

Commenter's Reason: The proposal inadvertently removes from the exception those pools that use water directly heated by the earth, such as from hot springs. If not corrected, pools such as those developed in many parks with hot springs would be required to have a cover.

CE176-16 Part II

CE183-16
IECC: C202 (New), C405.2.

Proposed Change as Submitted

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 acknowledge 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 where each luminaire in a space has independence from every other and can therefore maximize incremental control within 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 with luminaires grouped to serve much larger interior areas. Each LLLC is not only 'wirelessly addressable', it can locally process information from integrated sensors to implement lighting control logic as well as can be programmed, overseen and modified through a computer user interface. An LLLC system will 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 will 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

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

LUMINAIRE LEVEL LIGHTING~~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.

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

1. Lighting controls as specified in Sections C405.2.1, C405.2.2, C405.2.3, C405.2.4, and C405.2.5.
2. Luminaire level lighting~~level~~ controls (LLLC) and lighting controls as specified in Sections C405.2.1, C405.2.4, and C405.2.5. The LLLC luminaire shall be independently capable of:

1. Monitoring occupant activity to brighten or dim its lighting when occupied or unoccupied respectively.
2. Monitoring ambient light (both electric light and 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.

Committee Reason: When the code official encounters this technology, and the technology is being implemented, the code needs to provide coverage, guidance and parameters for such technology. This is a type of system, not a specific product. The functions are desribed in the proposed text, so a product standard is not necessary. This will encourage adoption of less expensive and more reliable technology to save energy. The Modification to the terminology/definition matches the text with the acronymn found in the reason statement. An additional Modification picks up the section for occupancy sensor controls to prevent rollback of requirements and to retain options.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

LUMINAIRE LEVEL LIGHTING CONTROLS. A lighting system consisting of one or more luminaires with embedded lighting control logic, occupancy and ambient light sensors, ~~wireless~~ digital networking capabilities, and local override switching capability, where required.

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

1. Lighting controls as specified in Sections C405.2.1, 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:
   2.1 Monitoring occupant activity to brighten or dim its lighting when occupied or unoccupied respectively.

2.2 Monitoring ambient light (both electric light and daylight) and brighten or dim artificial light to maintain desired light level.

2.3 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.

Occupant sensing and daylight responsive controls technology incorporated into LLLC's shall undergo functional testing in accordance with C408.3.1.

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.

Commenter's Reason: This comment improve would the proposal in two ways:
First, the proposal seems to promote one vendor's technology in particular. An LLLC system does require a digital link between components, but this link does not need to be wireless and in fact most systems on the market (including open protocols like DALI, and Power Over Ethernet (POE) lighting systems) rely on wired connections for their digital link. In the long run, wired may well prevail over wireless, and the code should not be a tool for promoting one vendor's technology over another's when both provide identical performance.

Second, users of the code could easily be left with the impression that the functional testing requirements of C408.3.1 are not applicable, since compliance with the daylight responsive controls requirements of C405.2.3 is not required. They would be supported in this view by manufacturers who claim to be selling "self-commissioning" systems which rarely are. We understand that advanced controls do nothing unless they have been tested and commissioned to work properly, and it is essential that the functional testing requirements of this code be applicable to LLLC systems.

Proponent : Glenn Heinmiller, representing International Association of Lighting Designers (glenn@lampartners.com) requests Disapprove.

Commenter's Reason: This proposal is entirely unnecessary and does nothing to improve energy efficiency of buildings.

1. LLLC's, as defined here, are already allowed by the code. There is no regulatory hurdle that needs to be overcome for these products to be more widely used in the marketplace.
2. There is no requirement in this proposal for LLLC's to be used.

If the proposal is not adding a new requirement, or not relaxing a current restriction, then why should it be approved? The only remaining reason would be to make the code easier to use and enforce, but the proposal only make the code more complicated and confusing.

LLLC is not a term which is in widespread use in the lighting industry, and there is no clear definition or rating or qualification for what an LLLC would be. Under these circumstances it would be easier for these systems to comply with the code as currently written rather than getting into a debate over whether a particular manufacturer's system (which may be called an LLLC by the manufacturer, and which may be considered an LLLC by DLC or some other trade group) actually meets the requirement for being an LLLC as defined in the IECC.

There may be a place for LLLC in future versions of the IECC, but the industry needs to gel a little first, and there should be a universally understood and accepted meaning for LLLC before it is added to the IECC.

CE183-16

CE185-16

IECC: C405.2.1, C405.2.1.1, C405.2.1.3 (New).

Proposed Change as Submitted

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. Open plan office areas.
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 and open plan office areas, as 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:

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:

1. The controls shall be configured so that general lighting can be controlled separately in control zones with floor areas not greater than 600 square feet (55 m^2) within the open plan office space.
2. The controls shall automatically turn off general lighting in all control zones within 20 minutes after all occupants have left the open plan office space.
3. The controls shall be configured so that general lighting power in each control zone is reduced by not less than 80 percent of the full zone general lighting power in a reasonably uniform illumination pattern within 20 minutes of all occupants leaving that control zone. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement.
4. The controls shall be configured such that any *daylight responsive control* will activate open plan office space general lighting or control zone general lighting only when occupancy for the same area is detected.

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 "no more than 20%."

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 (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 (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 (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 (https://www.energycodes.gov/development/2018IECC).[2]

CE185-16 :
C405.2.1-
WILLIAMS12261

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

C405.2.1.3 Occupant sensor control function in open plan office areas. Occupant sensor controls in open plan office spaces less than ~~250~~ 300 square feet (~~23~~ 28 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:

1. The controls shall be configured so that general lighting can be controlled separately in control zones with floor areas not greater than 600 square feet (55 m^2) within the open plan office space.
2. The controls shall automatically turn off general lighting in all control zones within 20 minutes after all occupants have left the open plan office space.
3. The controls shall be configured so that general lighting power in each control zone is reduced by not less than 80 percent of the full zone general lighting power in a reasonably uniform illumination pattern within 20 minutes of all occupants leaving that control zone. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement.
4. The controls shall be configured such that any *daylight responsive control* will activate open plan office space general lighting or control zone general lighting only when occupancy for the same area is detected.

Committee Reason: Approval is based upon the proponent's published reason statement. The modification coordinates the threshold with other thresholds in the code.

Assembly Motion: **Disapprove**
Online Vote Results: **Successful**
Support: 57.95% (102) Oppose: 42.05% (74)
Assembly Action: **Disapproved**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

C405.2.1.3 Occupant sensor control function in open plan office areas. Occupant sensor controls in open plan office spaces less than 300 square feet (28 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:

1. The controls shall be configured so that general lighting can be controlled separately in control zones with floor areas not greater than 600 square feet (55 m^2) within the open plan office space.
2. The controls shall be manual-on, or shall automatically turn the lighting on to not more that 20 percent power.
3. The controls shall automatically turn off general lighting in all control zones within 20 minutes after all occupants have left the open plan office space.
4. 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.
5. The controls shall be configured such that any *daylight responsive control* will activate open plan office space general lighting or control zone general lighting only when occupancy for the same area is detected.

Commenter's Reason: Most occupant sensing applications required by the IECC are required to incorporate manual-on control. This is because manual-on control is understood to be much more energy efficient than automatic-on control. This will be especially true in open office areas.

1. Occupant sensors do not have narrowly defined coverage patterns. In order to sense small desktop motion in a 600 square foot area, the sensor will typically sense larger walking movement in a 1,000 square foot area. This means that a sensor which is properly configured to provide coverage of desktops will also sense motion in adjacent aisles.

2. Open office areas are often used for circulation from adjacent occupied spaces, even when no one is working in the open office area.

Therefore, if automatic-on controls are provided in open office areas, every time someone walks through that space the lights will be turned on to full output, and will stay at full output for 20 minutes. This will eliminate almost all of the energy savings that these systems could be providing.

The proposed language would allow the occupant sensors to turn lights on to 20 percent of full power when someone walks through. This is certainly adequate for them to navigate the space, and if they intend to stay, then they can use a wall switch to turn the lights at their work area to full power. This change is essential for these systems to achieve their full potential energy savings.

Public Comment 2:

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C405.2.1.3 Occupant sensor control function in open plan office areas. Occupant sensor controls in open plan office spaces less than ~~300~~ 1000 square feet (~~28~~ 93 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:

1. The controls shall be configured so that general lighting can be controlled separately in control zones with floor areas not greater than ~~600~~ 1000 square feet (~~55~~ 93 m^2) within the open plan office space.
2. The controls shall automatically turn off general lighting in all control zones within 20 minutes after all occupants have

left the open plan office space.

3. The controls shall be configured so that general lighting power in each control zone is reduced by not less than 80 percent of the full zone general lighting power ~~in a reasonably uniform illumination pattern~~ within 20 minutes of all occupants leaving that control zone. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement.
4. The controls shall be configured such that any *daylight responsive control* will activate open plan office space general lighting or control zone general lighting only when occupancy for the same area is detected.

Commenter's Reason:

This proposal to add occupancy sensor control to open plan offices was approved as modified at the Committee Hearing by a vote of 10-2.

There are significant savings from this measure that covers large portions of office buildings that do not currently require occupancy sensors. The savings and cost effectiveness are discussed in the original proposal.

This public comment makes 3 changes.

1. The area threshold where multiple zone occupant sensors are required is increased from 300 square feet to 1000 square feet. Open office areas less than 1000 square feet can be successfully switched for occupancy sensor control with dual-technology occupant sensors.
2. The maximum control zone required within a larger open office area is increased from 600 square feet to 1000 square feet. This allows a reduction in cost, as fewer occupancy sensors would be required in a large office area.
3. The phrase "in a reasonably uniform pattern" is removed. While it is good design practice to apply this concept when switching local control zones vs. a remaining 20% of area lighting, it may be difficult to interpret and is not required to achieve the energy savings. It is expected that lighting designers and electrical contractors will follow this practice without this language being in the code.

While describing the more advanced open office control sequence requires several steps, a much simpler implementation is allowed in the description. Control zone lights can simply be switched in groups of less than 1000 square feet by overhead occupancy sensors. This simple approach is relatively low cost and easy to inspect. Manufacturers are making available lighting fixtures that are individually switched by integrated occupancy sensors. These straightforward products meet the requirements proposed.

The more advanced controls can also be implemented, as described in the four steps. The more advanced controls will typically be designed by a lighting professional, and have proper operation verified by that professional.

There is significant savings from this proposal. Increasing the limit at which multiple control zones are required and the size of control zones makes implementation in simple buildings more expediant and lower cost than in the original reason statement. Removing the need for the building official to interpret "reasonably uniform pattern" makes the language more enforciable based on ICC staff feedback.

We urge the approval of this proposal as modified by this public comment.

Bibliography: See original proposal reason statement.

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Disapprove.

Commenter's Reason: This change adds occupant sensor controls in open office areas. The Committee recommended as modified.

The committee stated that their approval of the change as modified (which coordinates the threshold with other thresholds in the code) is based upon the proponent's published reason statement. This change would apply to all offices and is required to be managed by computers – increasing task lighting that imposes on plug load demand. We also question why the cost benefit numbers offered by the proponent was based on analysis in climate zone 8?

The AIA recommends that the membership deny this change.

Proponent : Assembly Motion requests Disapprove.

Commenter's Reason: This code change proposal is on the agenda for individual consideration because the proposal received a successful assembly motion. The assembly action for Disapprove was Successful by a vote of 57.95% (102) to 42.05% (74) by eligible members online during the period of May 11 - May 26, 2016.

CE189-16

IECC: C405.2.2.1, C405.2.2.2, C408.3.1.2.

Proposed Change as Submitted

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 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.~~
        - 5.7.1. Spaces with less than 60 watts of installed lighting power.
        - 5.7.2. Corridors, electrical rooms, mechanical rooms, parking areas, and stairwells.

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This appears to be locking in LED technology to the exclusion of other technology. No cost justification was provided. The proposed text is difficult to interpret. The text under 1.3 of the exception changed for no apparent reason. The change from light reduction to dimming seems to push specific technology.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: The committee was concerned that this proposal would require the use of light emitting diode (LED) technology, and that the code shouldn't be selectig technological winners and losers. There are several reasons why this should not be a concern:

1. LED is not the only dimmable light source. Fluorescent, which is the technology that most of our lighting power densities have been derived from, is also dimmable.

2. This dimming requirement is only applicable where the design team has chosen to use timeswitch controls in lieu of occupant sensor controls.

3. California Title 24 has required dimming in almost all interior spaces of commercial buildings since the 2013 version went into effect on January 1 of 2014. This is entirely achievable with a variety of technologies.

This proposal is much more modest than what was done in California, but will help to send other states that adopt this code down the right path to improved energy efficiency.

CE189-16

CE192-16
IECC: C405.2.3, C405.4.

Proposed Change as Submitted

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 (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 (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 (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

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

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.
    - **Exception:** *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.

5. ~~Buildings~~ New 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* · (1.0 - 0.4 · *UDZFA* / *TBFA*)] (**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.

Committee Reason: Faced with the cost of day-lighting controls and the challenges associated with commissioning them, lighting designers have found it more cost-effective to use more efficient lamps and luminaries. This proposal adds a design option. The modification is made because the text should apply only to new buildings.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

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.

Exception: *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.
5. New buildings not greater than 50,000 square feet in conditioned floor area 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* · (1.0 - (0.4 · *UDZFA* / *TBFA*)] (**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.

Commenter's Reason:

Buildings larger than 50,000 square feet generally have a lighting design professional engaged who can properly design and commission daylighting controls.

The original proposal is intended to benefit smaller buildings where implementing an effective daylighting design may be more difficult. This public comments restricts the LPD for daylighting tradeoff to new buildings smaller than 50,000 square feet.

There is also a minor change to the formula to make it clear how to apply it.

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

Commenter's Reason: Designers welcome options in the code when those options provide a path around a requirement which poses an unreasonable burden, or which is impossible to achieve in certain situations. The daylight responsive controls requirements in the code do not meet this threshold of being an unreasonable burden. In fact, it is well past time that we kept lights operating at full output in spaces that are filled with daylight, when we have the technological means to avoid this in all cases. We believe that this proposal will hurt energy efficiency in the long run by discouraging the use of daylight responsive controls.

We also believe that this proposal introduces unnecessary complexity to the code. While designers welcome alternate paths around unreasonable requirements, we do not welcome alternate paths for their own sake. This just adds complexity and creates a situation where the designer must go down both paths, and evaluate both options, before deciding which path to choose.

CE192-16

CE194-16
IECC: C405.2.4.

Proposed Change as Submitted

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 or system 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 with the requirement as a system is most likely what is utilized.

Cost Impact: Will not increase the cost of construction
This is just an editorial revision to clarify that systems are allowed to comply with the requirement.

CE194-16 :
C405.2.4 (NEW)-
WILLIAMS11608

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval was based on the action taken on CE195-16.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Marilyn Williams, NEMA, representing National Electrical Manufacturers Association (mar_williams@nema.org) requests Approve as Submitted.

Commenter's Reason: Most methods utilized to comply with section C405.2.4 consist of many devices, which constitutes a system. This proposal makes it clear that a system may be utilized to comply with Section C405.2.4.

CE194-16

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).

Proposed Change as Submitted

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 was added to the 2015 IECC, and the langage does not conform to ICC code writing standards. First, two of the exceptions in the first paragraph, which 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 timeswitch systems. When exterior lighting operations are based on business operating hours, it makes sense that a more robust time switch system is required, which 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 switch system could be used to control both interior and exterior lights.

The proposal also adds one new exception, for "lighting controlled from within dwelling 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 own 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 wiring and controls are expensive, and in many instances the 30% reducion can be achieved by switching off lights which 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 timeswitch 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 switch system pricing is from a mechanical device to a digital device, and the requirements in the 2015 IECC will already require you to use the more expensive digital device in almost all instances.

Putting these two considerations together it appears that there will be a net reduction in construction costs, though this will vary from project to project.

CE196-16 : C405.2.5-BAILEY12061

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

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~~.

Committee Reason: Approval was based on the proponent's published reason statements. The modification eliminates unnecessary text.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Orlowski, BOMA International, representing Building Owners and Managers Association International (sorlowski@boma.org) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

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 covered vehicle entrances and exits from buildings and parking structures where required for safety, security or eye adaptation.
2. Decorative gas lighting systems.
3. Lighting controlled from within dwelling units.
4. Exterior emergency lighting systems.

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.~~ retaining ~~They shall incorporate an automatic holiday setback feature.~~

~~4. They shall have program backup capabilities that prevent~~ programming and the time setting during loss of ~~program and time~~

~~settings~~ power for a period of not less than 10 hours~~, if power is interrupted~~.

Commenter's Reason: As written, the proposal would prohibit the use of mechanical exterior time switches for the control of exterior lighting and would require digital lighting controls even on exterior lighting components which are equipped with daylight sensors. There is no reason to disallow various products which meet the initial requirements for reducing energy consumption and boarders along the lines of restricting acceptable equipment. The original proposal also removed language that clarified that lighting associated with health and safety were not required to meet the requirements of section 402.5.2. There was no justification for removing the exception other than stating that other sections already exempt this type of lighting in other sections. The concern with removing the the exception, is that many times code users see exceptions disappear thinking that the exception no longer exists.

Public Comment 2:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

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. Decorative lighting systems shall comply with Sections C405.2.5.1, C405.2.5.2, and C405.2.5.4.

Exceptions:

1. Lighting for covered vehicle entrances and exits from buildings and parking structures where required for eye adaptation.

2~~. Decorative gas lighting systems.~~

~~3~~. Lighting controlled from within dwelling units.

Commenter's Reason: Gas lighting systems use anywhere from 12 to 73 times more energy than electric lighting systems. Decorative gas lighting systems produce even less light than non-decorative gas lighting systems. In the current code, they are required to be controlled. Exempting them from any controls will increase energy usage for no reason (by allowing them to operate for 24 hours per day, 365 days per year).

Also, based on the committee's approval of CE213, these systems will have electronic controls that will allow for the lights to be turned on and off along with other exterior lights.

This proposal ensures that all decorative lighting systems, whether gas or electric, are controlled to save energy when their light is not needed.

CE196-16

CE200-16
IECC: C405.2.4, C405.4 (New).

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed text is outside of the scope of the code.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : jim edelson, representing new building institute (jim@newbuildings.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

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.

C405.4 ~~Task lighting~~ 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,~~ have ~~lamps having an efficacy~~ a photon efficiency of not less than ~~90 lumens per Watt, or the lighting fixtures shall have a total luminaire efficacy of not less than~~ 1.6 ~~80 lumens-per-watt~~ µmol/J.
EXCEPTION: *Greenhouses.*

Commenter's Reason: At the Louisville hearings, the proponents found intense interest in the proposal but also heard several concerns with the specific requirements. This Public Comment addresses those specific concerns listed below and simplifies the main requirement as follows:

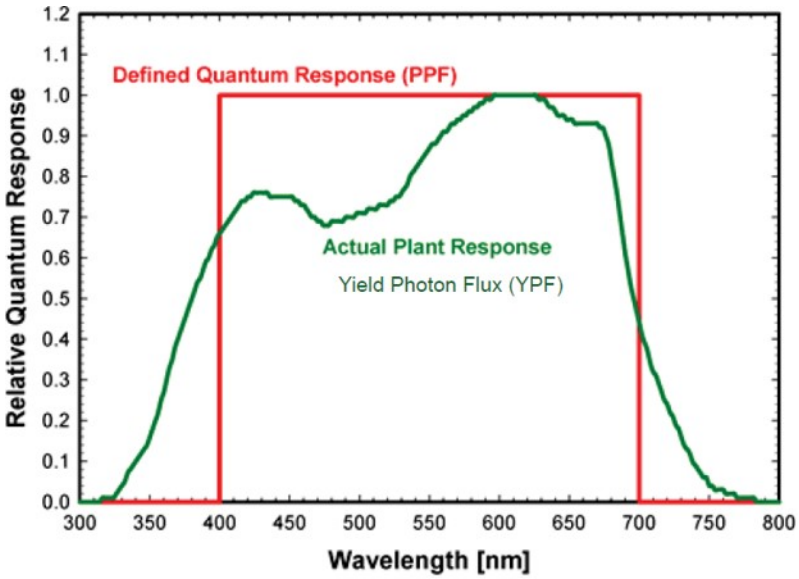
Not less than 95 percent of the permanently installed lighting fixtures used for plant growth and maintenance shall have a photon efficiency of not less than 1.6 µmol/J.

1. SCOPE: The Committee Report stated the reason for disapproval was "The proposed text is outside the scope of the code". However, the IECC already regulates the same classification of lighting application. Section C405.2.4 has control requirements for precisely the same lighting equipment for "nonvisual applications, such as plant growth and food warming". The scope for this proposal is limited to "plant growth and maintenance", and does not expand upon current scope.

2. TASK: The use of the word "Task" in the Section title is redundant and not accurate for this application. It has been deleted.

3. CONTROL ZONE: The control zone size limit was described as arbitrary and of limited usefulness in most agricultural applications. That provision has been deleted.

4. LUMENS METRIC: The concern about the use of a metric based on lumens per watt has been addressed by changing the metric used from luminous efficacy (lumens per watt) to photon efficiency (micromoles of photons per Joule). Lighting intended for human vision applications is properly measured by lumens (ie. "Lumens are for humans") However, lighting intended for plant growth and maintenance applications can differ in the applicable spectral distribution; lumens are measured based on the visible light characteristics of the human eye. The indoor agriculture and greenhouse industries generally do not use lumens as a metric for this reason. The applicable metric in this case is the Photosynthetic Photon Flux (PPF). This is a measure of the total quantity of Photosynthetically Active Radiation (PAR) photons emerging from the fixture measured between 400 and 700 nm. The most widely used and most appropriate metric is photon efficiency. Photon efficiency is measured in micromoles of photons emitted by the fixture per joule of electrical energy consumed, abbreviated **µmol/J**. The units for PPF/W and photon efficiency are identical. But focusing on spectral distribution (light frequency aka color temperature or spectrum) is unnecessary because photon efficiency focuses on PAR wavelengths and the scientific literature on this subject supports that PAR, regardless of spectrum, is the best predictor for growth and yield in most crop plants. The following image shows the correlation between the PAR wavelengths and the measured actual plant response (Yield Photon Flux or YPF) curve.



Source: Bruce Bugbee, 2015 presentation "Toward an optimal spectral quality for plant growth and development: Interactions among species and photon flux"

5. LUMINAIRE PERFORMANCE: The Public Comment sets the minimum photon efficiency for indoor agricultural fixtures at 1.6 µmol/J based on research into the performance of fixtures on the market today. This photon efficiency level is intended to eliminate the poorest-performing fixtures while still allowing growers to choose from a broad range of technology and fixture options. A wide variety of options, including many LEDs, high-performing High Pressure Sodium solutions, and some well-designed Ceramic Metal Halide solutions will be able to meet this performance standard.

The primary research paper on this topic, "Economic Analysis of Greenhouse Lighting: Light Emitting Diodes vs. High Intensity Discharge Fixtures," was published in June 2014 by Jacob Nelson and Bruce Bugbee of Utah State University. The authors tested a total of 22 fixtures, including two double-ended HPS fixtures, five mogul-base HPS fixtures, ten LED fixtures, three ceramic metal halide fixtures, and two fluorescent fixtures. Of those fixtures, a total of five had photon efficiencies greater than 1.6 µmol/J – two double-ended HPS fixtures and three LED fixtures. This table from the paper shows the tested photon efficiencies of all 22 fixtures tested.

Table 3. Photon efficiency and cost per mole of photons, assuming all photons (180°) are captured by plants.

Lamp type and Ballast	Fixture producer[z]	Electrical input (J/s or watts)	Photon output[y] (µmol/s)	Photon efficiency[x] (µmol/J)	Cost of one fixture[w] ($)	Fixtures needed per millimol/s[v]	Fixture cost per mol/s $/(mol/s)	Electric cost per µmol photons[u] $/(µmol/s)yr	Five year electric cost per µmol photons[t] $/(µmol/s)yr
High Pressure Sodium									
400 W magnetic	Sunlight Supply	443	416	0.94	$200	2.40	$0.48	$0.35	$0.40
1000 W magnetic	Sunlight Supply	1067	1090	1.02	$275	0.92	$0.25	$0.32	$0.33
1000 W magnetic	PARsource GLXI	1004	1161	1.16	$350	0.86	$0.30	$0.29	$0.31
1000 W electronic	PARsource GLXI	1024	1333	1.30	$380	0.75	$0.29	$0.25	$0.28
1000 W electronic	PARsource GLXII	1026	1334	1.30	$310	0.75	$0.23	$0.25	$0.27
1000 W electronic	Gavita	1033	1751	1.70	$500	0.57	$0.29	$0.19	$0.23
1000 W electronic	ePapillon	1041	1767	1.70	$600	0.57	$0.34	$0.19	$0.24
LED									
red/blue	LSG	384	653	1.70	$1,200	1.53	$1.84	$0.19	$0.54
red/white	BML	326	541	1.66	$1,000	1.85	$1.85	$0.20	$0.54
red/white	LSG	390	634	1.63	$1,200	1.58	$1.89	$0.20	$0.55
red/white	Illumitex	279	390	1.40	$1,400	2.56	$3.59	$0.24	$0.92
red/white/blue	Lumigrow (Pro 325)	304	390	1.29	$1,000	2.56	$2.56	$0.26	$0.73
red/white	California Lightworks	337	350	1.04	$1,000	2.85	$2.85	$0.32	$0.85
multiple	Black Dog	339	339	1.00	$950	2.95	$2.80	$0.33	$0.85
red/white	Apache	169	163	0.96	$860	6.14	$5.28	$0.34	$1.35
red/blue	Lumigrow (ES330)	318	284	0.90	$1,200	3.52	$4.22	$0.37	$1.16
red/white	Hydrogrow	423	378	0.89	$1,300	2.64	$3.44	$0.37	$1.01
Ceramic Metal Halide									
315 W 3100 K	Cydoptics	337	491	1.46	$640	2.04	$1.30	$0.23	$0.46
315 W 4200 K	Cydoptics	340	468	1.38	$640	2.14	$1.37	$0.24	$0.48
2@315 W 3100 K	Boulderlamp	651	817	1.25	$1,000	1.22	$1.22	$0.26	$0.47
Fluorescent									
400 W induction	iGrow	394	374	0.95	$1,200	2.68	$3.21	$0.35	$0.94
60 W	T8	58	48	0.84	$40	20.77	$0.83	$0.40	$0.51

[z]- See Table S1 for a list of fixture manufacturers and model numbers.
[y]- Integrated total photon output of fixture.
[x]- Photon Output per Electrical Input (µmol per second divided by joules per second).
[w]-Cost of fixtures as of April 2014.
[v]-The number of fixtures to get a total photon output of one millimol (1000 µmol) of photons per second.
[u]-Assumes 3000 hours per year operation and $0.11/kWh.
[t]-Cost of fixture (multiplied by fixtures needed) plus cost of electricity over 5 years. We used a discounted cash flow model assuming a 5% per year cost of capital. Installation and maintenance costs were assumed to be similar for all lamp types and were not included in this calculation.
doi:10.1371/journal.pone.0099010.t003

The fixtures tested by Nelson and Bugbee were all from 2014 or before. The rapid improvement in this field, driven in large part by new developments in LED lighting technology, has been substantial over the last several years. In addition, a wide variety of manufacturers produce a range products and product types with photon efficiency ratings of greater than 1.6 µmol/J. Many fixtures are available with reported photon efficiency ratings greater than 2.0 µmol/J.

This code will take effect in 2018 at the earliest, and later than that in most jurisdictions that adopt it. The rapid historical and projected pace of improvements in LED lighting technology suggests that many more fixtures above 1.6 µmol/J, including many above 2.0 µmol/J, will be available by the time the code takes effect.

6.**LUMINAIRE vs LAMP:** The Comment removes the distinction between lamp and fixture energy performance in the proposal in order to focus exclusively on fixture performance. In the primary research paper on this topic, photon efficiency was measured at the fixture level using both integrating sphere and flat plate integration methodologies: "Measurements of fixture efficiency (lamp, luminaire, and ballast) were made by integrating sphere and flat-plane integration techniques" (Nelson and Bugbee 2014). LED products are often marketed and sold as integrated fixtures rather than with detachable lamps and ballasts. As more LED products enter the marketplace and LED technology takes a greater market share, it makes more sense to focus on fixture performance to ensure comparability between different products. Additionally, because lamps are not generally installed without fixtures (that is, the fixture as a whole is what is used in the field), this also improves the correlation between a fixture's tested or claimed performance and its real-world performance.

7. GREENHOUSES: Greenhouses are exempted from the efficacy requirements because those structures falling under the "greenouse" definition in the IECC must "maintain a specialized sunlit environment....." that is "used for, and essential to, the cultivation, protection or maintenance of plants". Under these conditions in a specialized sunlit environment, the hours of

operation, power demands, and energy consumption already will be significantly reduced.

Conclusion:

Indoor agriculture energy usage is projected to grow substantially over the next several years, driven in large part (but not entirely) by the legalization of medical and recreational marijuana. Fully 25 states and the District of Columbia have legalized marijuana in some form. Four states have legalized recreational marijuana already, and full legalization measures are likely to be on the ballot in another eleven states in 2016. The rapid shift in many parts of the United States is driving much of our nation's energy load growth. The Northwest Power and Conservation Council projects that indoor marijuana growing operations alone will add as much as 300 average megawatts by 2030. That is equivalent to 1.5% of total regional electricity demand. In Colorado, Xcel energy says 45% of its load growth is due to indoor marijuana cultivation operations.

Indoor agriculture operations not related to marijuana are expanding too. The price of LEDs has fallen dramatically in the past few years and local food movements in cities are driving increased demand for fresh high-quality produce. More restaurants are interested in sourcing ingredients directly from the producer, and in dense urban areas a growing number of new indoor agriculture operations have begun to meet this demand.

A potent combination of policy, technology, and market factors is driving a dramatic expansion in indoor agriculture. Failure to approve requirements for the 2018 IECC will delay action on these issues until the 2021 code cycle. By relying on effective dates extending well into the mid-2020s, many millions of square feet of facilities will have already been built out, and a huge opportunity will be lost. It is imperative that meaningful minimum efficiency standards be implemented in this code cycle.

CE200-16

CE209-16
IECC: C405.4.2.2.1.

Proposed Change as Submitted

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 = 300 W + (*Retail Area 1* • 0.36 W/ft^2) + (*Retail Area 2* • 0.36 W/ft^2) + (*Retail Area 3* • 0.84 W/ft^2) + (*Retail 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 Area 3* • 9.04 W/m^2) + (*Retail Area 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 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~~ 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 (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/snapshot2014_mr16.pdf) & http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/caliper_22_summary.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 (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

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Approval was based on the proponent's published reason statement. ASHRAE 90.1 and the IECC do not need to match exactly, as they are optional paths.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 = ~~300~~ 1000 W + (*Retail Area 1* • ~~0.36~~ 0.45 W/ft^2) + (*Retail Area 2* • ~~0.36~~ 0.45 W/ft^2) + (*Retail Area 3* • ~~0.84~~ 1.05 W/ft^2) + (*Retail Area 4* • 1.87 W/ft^2)
   For SI units:
   Additional interior lighting power allowance = ~~300~~ 1000 W + (*Retail Area 1* ~~• 3.87~~ 4.8 W/m^2) + (*Retail Area 2* • 4.84 W/m^2) + (*Retail Area 3* • 11 W/m^2) + (*Retail Area ~~2~~ 4* • ~~3.87~~ 20 W/m^2) ~~+ (*Retail Area 3* • 9.04 W/m^2) + (*Retail Area 4* • 20.1 W/m^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/ft^2 (10.7 W/m^2) of such spaces.

Commenter's Reason: ASHRAE 90.1 had not developed revised values in time to submit a proposal. The 90.1 Lighting sub-committee had the advantage of seeing the DOE proposal, initial public comments and other research before developing an addendum to 90.1. Based on our evaluation of proposals to the committee and the light sources, 90.1 developed revised values in January of 2016. We recommend adopting the values recently developed by 90.1 for the following reasons:

- The base allowance should be restored to 1000 watts. A large retail facility, like a department store or big box store may not need this allowance, but a small stand-alone store often will not have sufficient display lighting allowance based on their small footprint (sq. ft.). The allowance is intended as a cushion for the small retailer.
- Public commenters uniformly stated that a reduction of 25-30% would be acceptable. The DOE proposal is 40% for three of the retail categories.
- Retail display lighting models at ASHRAE had been based on halogen and ceramic metal halide. Per the public comments, and DOE response, it was the intent to provide sufficient allowance for the continued limited use of non-LED sources.
- Most importantly, halogen and ceramic metal halide are 90-100 CRI sources. The retail display allowances should be sufficient to allow the use of 90+ CRI LED sources. These sources are currently 25% less efficient than 80CRI LED sources. In order to allow quality lighting design and encourage adoption of good LED sources, these modifications are being proposed

CE209-16

CE213-16
IECC: C405.5.2 (New).

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Approval was based on the proponent's published reason statements

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Ted Williams, representing American Gas Association (twilliams@aga.org) requests Disapprove.

Commenter's Reason: The proponent's rationale and potential unintended consequences of this new coverage argue for disapproval of this change. The energy savings from elimination of "pilots" for this appliance is artificially and unrealistically high in terms of the firing rate. Additionally, comparison to the site energy consumption of a 60 watt electrical bulb does not take into account upstream energy losses for providing electricity to the bulb. An obvious unintended consequency of this change will be to incentivize continuously- lit gas lights at a normal firing rate and reduce any opportunity for main element deactivation and from pilot ignition. The impact of eliminating pilot ignition as an option will cause gas lights to burn longer closer to full output and, on net, increase energy consumption. Additionally, comparing light output to a 60 watt electrical bulb is misleading in that it ignores the product utility of gas lights, aesthetic appeal. These are not simply sources of lumens. The proponent and the IECC would be better served to propose to the U. S. Department of Energy that gas lights be included as a

"covered product" for federal minimum energy efficiency standards consideration where a full and transparent analysis of these products and the costs and benefits (and consumer utility) can be reviewed in the course of developing any technological restrictions.

CE213-16

CE215-16
IECC: C405.5.1.

Proposed Change as Submitted

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
Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	**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
	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 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.)	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~~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~~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~~ofcovered and uncovered area~~	~~0.5~~0.35 W/ft^2~~ofcovered 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

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Approval was based on the proponent's published reason statements.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standards requests Approve as Modified by this Public Comment.

Modify as Follows:

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 (Base allowance is usable in tradable or nontradable surfaces.)		350 W	400 W	500 W	900 W
Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	**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	0.5 W/linear foot	0.5 W/linear foot	0.6 W/linear foot	0.7 W/linear foot
	Walkways and Ramps 10 feet wide or greater, plaza areas, special feature areas	0.10 W/ft^2	0.10 W/ft^2	0.11 W/ft^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
	Stairways	0.6 W/ft^2	0.7 W/ft^2	0.7 W/ft^2	0.7 W/ft^2
	Pedestrian tunnels	0.12 W/ft^2	0.12 W/ft^2	0.14 W/ft^2	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	14 W/linear foot of opening	14 W/linear foot of opening	21 W/linear foot of opening	21 W/linear foot of opening
	Entry canopies	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	0.4 W/ft^2	0.4 W/ft^2	0.6 W/ft^2	0.7 W/ft^2
	Outdoor Sales				
	Open areas (including vehicle sales lots)	0.2 W/ft^2	0.2 W/ft^2	0.35 W/ft^2	0.5 W/ft^2
	Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	7 W/linear foot	7 W/linear foot	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 or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	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	135 W per location plus 45 W per additional ATM per location	135 W per location plus 45 W per additional ATM per location	135 W per location plus 45 W per additional ATM per location	135 W per location plus 45 W per additional ATM per location
	Uncoveredentrances and gatehouse inspection stations at guarded facilities	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
	Uncoveredloading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.35 W/ft^2	0.35 W/ft^2	0.35 W/ft^2	0.35 W/ft^2
	Drive-up windows/doors	200 W per drive-through	200 W per drive-through	200 W per drive-through	200 W per drive-through
	Parking near 24-hour retail entrances	400 W per main entry	400 W per main entry	400 W per main entry	400 W per main entry

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m^2.
W = watts.

Commenter's Reason: This modification reinstates the lighting values for parking areas and drives to the values in the 2015 IECC. We are opposed to the decrease in lighting power allowances for parking areas and drives in the original proposal.
It has come to our attention that it might not be possible to meet the lighting requirements for parking lots and drives in this proposal with a concrete surface – it might require an asphalt surface. This comes from IES RP-20-14 *Lighting for Parking Facilities* which requires twice the illuminance (lux or footcandles) for concrete parking lots as asphalt parking lots. Here are the relevant sections from this document.

- "For parking facilities with concrete pavement, a minimum point value of 10 lux (1 fc) horizontal, should be maintained to insure the visibility required to see this task. For parking facilities with asphalt pavement, a minimum point value of 5 lux (0.5 fc) should be maintained due to increased contrast between the pavement and curb."

- "...based upon reflectance and contrast between important surfaces (pavement vs. wheel stops and curbs)"

- Calculations were performed for a clean unpainted concrete curb (reflectance =35 per cent) on an asphalt pavement (reflectance = 7 per cent). Asphalt pavement is typically found on open-surface parking lots. These reflectance values are representative of measurements taken in numerous parking facilities.

This conclusion (that concrete surfaces require more lighting than asphalt surfaces) seems counterintuitive to most since dark surfaces absorb light. It is also counter to the desire to mitigate heat islands (as required or encouraged in green building codes and standards) and the longevity of concrete parking lots compared to asphalt parking lots. It also does not take into account the coatings that can be applied to asphalt and other ways to make asphalt parking lots more reflective. It also ignores the fact that most parking areas in northern climates do not have parking stops except when the parking space is adjacent to a sidewalk. In warmer climates, asphalt parking stops are sometimes used. It also indicates that analysis was not performed for concrete parking lots.

IES RP-20-14 is new and controversial within the lighting industry. IES RP-8 *Roadway lighting* on pavements continues to allow less lighting for concrete pavement than for asphalt pavement. This approach should be used for parking lots and drives. The lighting power allowances for parking areas and drives should not be reduced until this controversy is settled within the lighting industry. IES RP-20 and RP-8 are developed by a committee and are not circulated for public comments.

Therefore, we cannot agree to lower lighting levels for parking lots and drives until this issue is resolved. The IECC 2015 values have been reinstated for parking lots and drives for this modification.

CE215-16

CE216-16
IECC: C405.5.1.

Proposed Change as Submitted

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 parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	**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				
	~~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 or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	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~~
	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 (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 (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 (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 (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 (https://www.energycodes.gov/development/2018IECC).[3]

CE216-16 : TABLE C405.5.1-WILLIAMS12368

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval was based on the action taken on CE215-16.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standards requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE 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.)		350 W	400 W	500 W	900 W
Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and	**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	0.5 W/linear foot	0.5 W/linear foot	0.6 W/linear foot	0.7 W/linear foot
	Walkways/Ramps 10 feet wide or greater, plaza areas, special feature areas	0.10 W/ft^2	0.10 W/ft^2	0 .11 W/ft^2	0.14 W/ft^2
	Stairways	0.6 W/ft^2	0.7 W/ft^2	0.7 W/ft^2	0.7 W/ft^2
	Pedestrian tunnels	0.12 W/ft^2	0.12 W/ft^2	0.14 W/ft^2	0.21 W/ft^2
	Building Entrances and Exits				
	Pedestrian and vehicular entrances and exits	14 W/linear foot of opening	14 W/linear foot of opening	21 W/linear foot of opening	21 W/linear foot of opening

outdoor sales areas are tradable.)	Entry canopies	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	0.4 W/ft^2	0.4 W/ft^2	0.6 W/ft^2	0.7 W/ft^2
	Outdoor Sales				
	Open areas (including vehicle sales lots)	0.2 W/ft^2	0.2 W/ft^2	0.35 W/ft^2	0.5 W/ft^2
	Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	7 W/linear foot	7 W/linear foot	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 or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	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	135 W per location plus 45 W per additional ATM per location	135 W per location plus 45 W per additional ATM per location	135 W per location plus 45 W per additional ATM per location	135 W per location plus 45 W per additional ATM per location
	Uncovered entrances and gatehouse inspection stations at guarded facilities	0.5 W/ft^2	0.5 W/ft^2	0.5 W/ft^2	0.5 W/ft^2
	Uncovered loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.35 W/ft^2	0.35 W/ft^2	0.35 W/ft^2	0.35 W/ft^2
	Drive-up windows/doors	200 W per drive-through	200 W per drive-through	200 W per drive-through	200 W per drive-through
	Parking near 24-hour retail entrances	400 W per main entry	400 W per main entry	400 W per main entry	400 W per main entry

For SI units: W/m^2 = 10.76 • W/ft^2. W/linear m = 3.281 • W/linear foot.
W = watts.

Commenter's Reason: This modification reinstates the lighting values for parking areas and drives to the values in the 2015 IECC. We are opposed to the decrease in lighting power allowances for parking areas and drives in the original proposal.
It has come to our attention that it might not be possible to meet the lighting requirements for parking lots and drives in this proposal with a concrete surface – it might require an asphalt surface. This comes from IES RP-20-14 *Lighting for Parking Facilities* which requires twice the illuminance (lux or footcandles) for concrete parking lots as asphalt parking lots. Here are the relevant sections from this document.

- "For parking facilities with concrete pavement, a minimum point value of 10 lux (1 fc) horizontal, should be maintained to insure the visibility required to see this task. For parking facilities with asphalt pavement, a minimum point value of 5 lux (0.5 fc) should be maintained due to increased contrast between the pavement and curb."

- "...based upon reflectance and contrast between important surfaces (pavement vs. wheel stops and curbs)"

- Calculations were performed for a clean unpainted concrete curb (reflectance =35 per cent) on an asphalt pavement (reflectance = 7 per cent). Asphalt pavement is typically found on open-surface parking lots. These reflectance values are representative of measurements taken in numerous parking facilities.

This conclusion (that concrete surfaces require more lighting than asphalt surfaces) seems counterintuitive to most since dark surfaces absorb light. It is also counter to the desire to mitigate heat islands (as required or encouraged in green building codes and standards) and the longevity of concrete parking lots compared to asphalt parking lots. It also does not take into account the coatings that can be applied to asphalt and other ways to make asphalt parking lots more reflective. It also ignores the fact that most parking areas in northern climates do not have parking stops except when the parking space is adjacent to a sidewalk. In warmer climates, asphalt parking stops are sometimes used. It also indicates that analysis was not performed for concrete parking lots.

IES RP-20-14 is new and controversial within the lighting industry. IES RP-8 *Roadway lighting* on pavements continues to allow less lighting for concrete pavement than for asphalt pavement. This approach should be used for parking lots and drives. The lighting power allowances for parking areas and drives should not be reduced until this controversy is settled within the lighting industry. IES RP-20 and RP-8 are developed by a committee and are not circulated for public comments.

Therefore, we cannot agree to lower lighting levels for parking lots and drives until this issue is resolved. The IECC 2015 values have been reinstated for parking lots and drives for this modification.

CE216-16

CE217-16
IECC: C405.5.2 (New).

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval was based on the action taken on CE215-16.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : jim edelson, representing new building institute (jim@newbuildings.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C405.5.2 Exterior ~~building grounds~~ parking areas and drives lighting. ~~Exterior building grounds luminaires~~ Luminaires used to illuminate parking areas and drives 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.

Commenter's Reason: Committee remarks and hearing testimony showed concern that the proposal would limit flexibility in outdoor lighting designs. Those objectives of visual clarity and safety without compromising aesthetics will be met by the modification which limits the efficacy requirement only to Parking Areas and Drives. The exterior LPDs proposed in CE 215 for the "Parking Area and Drives" category, even though based on higher efficacy lamps, do not in themselves limit the efficacy of each lamp utilized for a parking area. This requirement ensures each lamp to be higher efficacy, and can add additional energy savings in many compliance scenarios where lower efficacy lamps are used even though the LPD does not exceed the overall limit for the entire parking and drive area. In addition, this proposal restores a longstanding exterior lighting provision that was in the 2012 IECC, but removed for the 2015 IECC.

CE217-16

CE218-16

IECC: C405.6, C405.6.1 (New).

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The committee fails to see the utility in the proposed requirements. The cost/benefit analysis does not accurately reflect the front-end costs verses the cost savings.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: ASHRAE is requesting this proposal be approved as submitted.

It was originally disapproved because "The committee fails to see the utility in the proposed requirements. The cost/benefit analysis does not accurately reflect the front-end costs verses the cost savings. "

The following reports and studies outline the front-end costs and explain the cost savings:

https://www.ashrae.org/File%20Library/docLib/Journal%20Documents/2011%20April/020-027_plourde.pdf

https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-23892.pdf

The exact utility of these meters is that the information from the meters, when acted on, can result in significant end use energy reductions — typically 5 to 15 percent of the whole building energy use.

CE218-16

CE219-16
IECC: C405.7 (New).

Proposed Change as Submitted

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:

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:

1. 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.
2. Independent program schedules for automatic controls shall be configured to control receptacles in areas that are not greater than 5,000 square feet.
3. Independent program schedules for automatic controls shall be configured to control receptacles in areas on a single floor.
4. 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*
5. 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.

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.

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval was based on the action on CE296-16.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: ASHRAE is requesting this proposal be approved as submitted.
CE219 was disapproved at the committee action hearings because of action taken on CE296 ("There is safety concern for the increased use of extension cords and relocatable power taps and the overloading of circuits. Users will connect all loads to the one receptacle that remains powered. There is no requirement for the distribution of receptacle outlets in office spaces. ")

In response to the first concern. The issue raised by the IECC Committee is something that's specifically prohibited by OSHA in 29 CFR 1910.303(a). The committee should not be relying on justification which violates of Federal Law.

In response to there being no requirement for the distribution of receptacle outlets in office spaces.

Cost effectiveness studies (e.g. Zhang2012) have found that the simply payback on this type of equipment is between 1.5 and 9 years for small and large offices, which take into account the most comprehensive information on office plug load types, installation densities, usage pattersn, and power states based on field surveys and monitoring (Kawamoto 2000, 2001; Moorefield, Frazer & Bendt 2011; Roberson 2002, 2004; Roth 2002, 2004; Sanchez 2007; Webber 2001, 2005).

While it is true there's not requirement for receptacle density, an office designer will ensure there is an appropriate distribution of receptacles in order to effectively accomplish the mission of the office. There's no evidence that the distribution of receptacle outlets, and controlling *some* of them has any adverse impact on the utility of this requirement.

A CASE initiative study for CA Title 24-0213 found that smaller offices (10,000 swft) had an annual electrical savings of 4,900 kwh/year and a demand savings of 1.97 kW. Based on installed costs and utilization of lighting control system elements already installed, the simple payback was 4.2 years. For larger office buildings (175,000 sqft) the annual electrical savings were 107,000 kwh/year and a demand savings of 23.6 kW for a simple payback of 2.4 years.

It is a common misconception that office plug loads are decreasing because of more efficient technology. Miscellaneous Energy Loads in Buildings report number A133 of June 2013 by ACEEE extensively studied the growing energy consumption and demand which receptacle loads will play in the future as other energy efficiency of lighting, HVAC, envelope continues to be driven down by codes and advancement in technology. It states "After space conditioning, MELS are the biggest category of energy use in buildings."..."For instance, saving 50% of the energy from MELSs is approximately equivalent to eliminating U.S. oil imports from the Middle East." Regardless of the known benefits of receptacle control requirements in ASHRAE 90.1, California Title 24 and the state of Washington code, the IECC has no requirements to address this growing energy consumption category, and proven receptacle control technologies and payback should be implemented. The study highlights how a move to more efficient products on the market would make a substantial impact. Therefore receptacle control is a safety net for efficiency and reduces energy consumption on efficient and less efficient receptacle powered devices alike.

A GSA Green Proving Ground Program study conducted in 8 buildings with monitored receptacle control through market available plug strips found "Results underscored the effectiveness of schedule-based functionality, which reduce plug loads at workstations by 26%, even through advanced computer power management was already in place, and nearly 50% in printer room and kitchens." In the study buildings, receptacle loads averaged 21% of building energy use and monitored more than 295 devices over three different test periods to validate the findings. It found payback through timer scheduled control of kitchens of 0.7 years, printer rooms of 1.1 years and miscellaneous devices in 4.1 years. At workstations, the payback was 7.8 years.

A study done on "Office Space Plug Load Profiles and Energy Savings Interventions" at the University of Idaho and presented at the ACEEE summer Study in 2012 found that average savings of 0.60 kWh/SF Yr with plug strip control interventions. This study provided guidance for utility programs to assist with development of plug load efficiency measures and was based on a more detailed report, "Plug Load Profiles" (Acker, B. et. al. 2012).

The DOE Better Buildings program issued a December 2015 "Decision Guides for Plug and Process Loads Controls" to help educate and guide decision processes for effective receptacle based load control. It highlights that "Plug and Process Loads" account for 33% of the total energy consumed by commercial buildings. It sites seven decision strategies including that of Integrated plug load controls with other building systems as one of the largest for energy savings across most building types for whole-building retrofit and new construction categories

Bibliography:

Acker, B., Duarte, C., Van Den Wymelenberg, K., 2012, Office Space Plug Load Profiles and Energy Savings Interventions. aceee.org/files/proceedings/2012/data/papers/0193-000277.pdf

Kawamoto, K., Koomey, J., Nordman, B., Brown, R., Piette, MA., and Meier, A. 2000. Electricity Used by Office Equipment and Network Equipment in the U.S. LBNL-45917. Lawrence Berkeley National Laboratory.

Kawamoto, K., Koomey, J., Nordman, B., Brown, R., Piette, MA., Ting, M., Meier, A. 2001. Electricity Used by Office Equipment and Network Equipment in the U.S.: Detailed report and appendices. LBNL-45917. Lawrence Berkeley National Laboratory.
Moorefield, L., Frazer, B., and Bendt, P. 2011. Office Plug Load Field Monitoring Report. CEC-500-2011-10, California Energy

Commission Roberson, J., Homan, G., Mahajan, A., Nordman, B., Webber, C., Brown, R., McWhinney, M., Koomey, J. 2002. Energy Use and Power Levels in New Monitors and Personal Computers. LBNL-48581. Lawrence Berkeley National Laboratory.
Roberson, J., Webber, C., McWhinney, M., Brown, R., Pinckard, M., and Busch, J. 2004. After-hours Power Status of Office Equipment and Energy Use of Miscellaneous Plug-Load Equipment. LBNL-53729-Revised. Lawrence Berkeley National Laboratory.
Roth, K., Goldstein, F., Kleinman, J. 2002. Energy Consumption by Office and Telecommunications Equipment in Commercial Buildings Volume I: Energy Consumption Baseline. Arthur D. Little Reference No. 72895-00. DOE Contract No.: DE-AC01-96CE23798. Arthur D. Little, Inc. prepared for Department of Energy.
Roth, K., Goldstein, F., Kleinman, J. 2004. Energy Consumption by Office and Telecommunications Equipment in Commercial Buildings Volume II: Energy Savings Potential. TIAX Reference No. D0065-11.08. DOE Contract No.: DE-AM26-99FT40465. TIAX LLC prepared for Department of Energy
Webber, C., Roberson, J., Brown, R., Payne, C., Nordman, B., Koomey, J. 2001. Field Surveys of Office Equipment Operating Patterns. LBNL-46930. Lawrence Berkeley National Laboratory.
Webber, C., Roberson, J., McWhinney, M., Brown, R., Pinckard, M., Busch, J. 2005. After-hours Power Status of Office Equipment in the USA. LBNL-57470. Lawrence Berkeley National Laboratory.
Zhang, Y., Bonneville, C., Higa, R. 2012. Integrated Lighting and Plug Load Controls.
http://aceee.org/files/proceedings/2012/data/papers/0193-000089.pdf ACEEE Summer Study on Energy Efficiency in Buildings.

CE219-16

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).

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: There is no way that this text can or will be enforced to verify that it is being implemented. There is no analysis to indicate the benefits verses the costs of these requirements. The exception to C405.8 exempts tenant spaces with less than 5000 sq ft but does not exempt penthouse dwellings over 5000 sq ft, which should not be subject to these requirements. The exception to C405.8 conflicts with exception #3 of C405.8.2. System failures will be evident without the need for these requirements.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Marilyn Williams, NEMA, representing National Electrical Manufacturers Association (mar_williams@nema.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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~~ 5,000 square feet where a dedicated source meter complying with Section C405.8.3 is provided.

Commenter's Reason: The proposal was modified to reflect the request of the committee to make the exception for C405.8.2 consistent with the exception for C405.8.

The investment made for the infrastructure of a building in order to comply with the IECC is significant. The assumption that is currently made upon commissioning a facility is that energy efficiency measures will not degrade, or go out of calibration, over time and their energy consumption will not increase as time passes from the time they were commissioned. Such an assumption is completely inaccurate and any payback assumed for energy efficient infrastructure investments will be lengthened, thereby reducing the ROI and increasing the payback period. The only means to retain the energy performance of a building is to continuously monitor energy consumption levels of various energy consuming systems and compare them to previous levels. Monitoring sub-systems provides key indications when changes have been made or systems are not operating to specification, which increases energy consumption. Examples include, but are not limited to:

1. Increased energy consumption in HVAC system loads will point to failures in motors, drive systems, bearings, etc.
2. Degrading building envelope.
3. Configuration changes to the building that may drive increased energy consumption.
4. Increase of energy consumption from lighting loads may indicate changes in arrangement of the office space that resulted in reduced lighting driving the installation of more lighting above permitted energy code levels, failure of occupant sensors, inappropriate lighting schedules, lamps that need to be replaced or cleaned, etc.
5. Monitoring plug loads will indicate when computer equipment is left on during non-working hours and use of space heaters that compromise the efficiency of the facility due to set points on the HVAC system.The requirements in this proposal save energy by continually monitoring and reporting actionable energy consumption data to building owners and operators. For large buildings, this data is further broken out by the major sub-systems (HVAC, lighting, process loads, and plug loads). The GSA-HPGB 2015 estimates potential savings of 1.16 billion kilowatt-hours for Federal buildings alone by using submeters. Electricity Consumption And The Potential Economic And Environmental Impact On Ontario study's findings are significant: 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.The 2013 version of ASHRAE Std. 90.1 and several state energy codes have recognized the benefits and require energy monitoring to support a continual high level of performance from the energy efficient investment.

If sub-metering were deployed in all currently bulk-metered multi-residential buildings, the annual potential electricity savings following complete deployment over five years could be 3.3 TWh – more than all of the electricity produced from Ontario's wind power facilities in 2010.

The 2012 Navigant Evaluation Of The Impact Of Sub-Metering On Multiresidential

There are well documented studies that demonstrate the energy savings from submetering and monitoring systems

CE222-16

CE224-16
IECC: C405.9.2.

Proposed Change as Submitted

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.
Exception: A power factor controller that reduces operating voltage in response to light loading conditions is an alternative to the reduced speed function.

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

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Approval was based on the proponent's published reason statements.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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.
Exception: A ~~power factor controller~~ variable voltage drive system that reduces operating voltage in response to light loading conditions is an alternative to the reduced speed function.

Commenter's Reason: Power factor control technologies only affect the power factor of the energy consuming systems. They do not affect the voltage of the motors.
Variable voltage drives do change the voltage. As described in the report published by the Airport Cooperative Research Program in 2014, ACRP Report 117, sponsored by the Federal Aviation Administration, entitled *Airport Escalators and Moving Walkways—Cost-Savings and Energy Reduction Technologies*, "A variable voltage drive (VVD) increases and decreases the voltage delivered to the motor, directly affecting the energy consumption of the motor."

Bibliography: *Airport Escalators and Moving Walkways—Cost-Savings and Energy Reduction Technologies,* ACRP Report 117, Transportation Research Board / National Academy of Sciences, 2014, Chapter 3 (report pages 6-22), http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_117.pdf

CE225-16
IECC: , C405.10 (New).

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

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.
5. Dwelling units in compliance with C405.6

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.**

Committee Reason: Approval was based on the second paragraph of the proponent's published reason statements. This proposal moves part-way toward submeter-ready buildings, leading to submetering implementation for valuable data. The Modification to the table is to correct improper word usage. The Modification to C405.10 clarifies how multi-family buildings are handled.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

C405.10 Energy distribution design and load type isolation in buildings. Energy distribution systems within, on, or adjacent to and serving a new *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 new 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~~ 10% 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.
5. Dwelling units in compliance with C405.6.

TABLE C405.10
ENERGY USE CATEGORIES

Load category	Description of Energy Use
HVAC loads	**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	**Lighting energy used within the *building*.**
Plug loads	**Energy used by devices, appliances and equipment connected to convenience receptacle outlets.**
Service Water Heating	**Energy used to produce hot water for uses other than space heating.**
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	**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.**

Commenter's Reason: This proposal clarifies that this requirement only applies to new buildings. To be consistent with language in ASHRAE 90.1, it changes the 5% threshold to 10%, which account for possible changes in activities or equipment in mutli-tenant buildings.
It also creates a separate category for metering of service water heating. In certain building types, such as hotels, restaurants, gyms, dorms, carwashes, and laundromats, service water heating will consume a significant amount of the building's energy.

Proponent : Steven Orlowski, representing Building Owners and Managers Association International (sorlowski@boma.org) requests Disapprove.

Commenter's Reason: BOMA is submitting the public comment to overturn the committees action. To be clear, this proposal does not reduce or improve the energy efficiency in buildings. This proposal requires the electrical distribution system to be designed in such a manner that allows the future installation of monitoring equipment. This will result in future building needlessly having to seperate the various electrical feeders to equipment resulting in more distribution panels, additional branch and feeder circuits, which does nothing to improve the efficiency in the building.

CE225-16

CE228-16
IECC: C405.10 (New).

Proposed Change as Submitted

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/Nonresidential/Lighting_Controls_Bldg_Powe

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval was based on the action taken on CE296-16.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Eric Makela, representing Northwest Energy Codes Group (eric.makela@cadmusgroup.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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~~ and copying 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)~~ Split duplex receptacles shall be provided, such that half of the receptacle device is controlled, or a controlled receptacle shall be located within ~~72~~ 12 inches (~~1.8~~ 0.30 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~~ 465 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~~ that 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:

1. 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~~ 12 inches (1.8 m) of a controlled receptacle.

2. Non-controlled receptacles in a single modular workstation located not more than 72 inches from a controlled receptacle serving that workstation.

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. Alterations to receptacles in spaces identified in Section C405.10.

Commenter's Reason: This public comment modifies the requirement for the location of controlled receptacles in relation to non-controlled receptacles. The opponents argued that occupants of spaces that are required to have controlled receptacles would "daisy chain" power strips and extension cords from the non-controlled receptacles to their office equipment to avoid their equipment from being automatically turned off. Under the current proposal the uncontrolled receptacle could be located within 72" from the controlled receptacle creating the potential for daisy chaining, potentially creating an unintended hazard in the workplace. The proposed change, adopted by the Seattle Nonresidential Energy Code, would eliminate this issue by requiring that either a split receptacle be installed that would contain both a controlled and uncontrolled receptacle, or the uncontrolled receptacle be located no more than 12" from the controlled receptacle.

The proposed modification also exempts alterations to spaces that are identified in this proposal from needing to meet the controlled receptacle requirement. This removes a potential issue that was identified by the enforcement industry from this requirement.

Based on a report from the U.S. Department of Energy's Pacific Northwest National Laboratory, office equipment is one of the highest energy costs in typical buildings representing 29% of the total cost on a building (see link to report and also Figure 2).

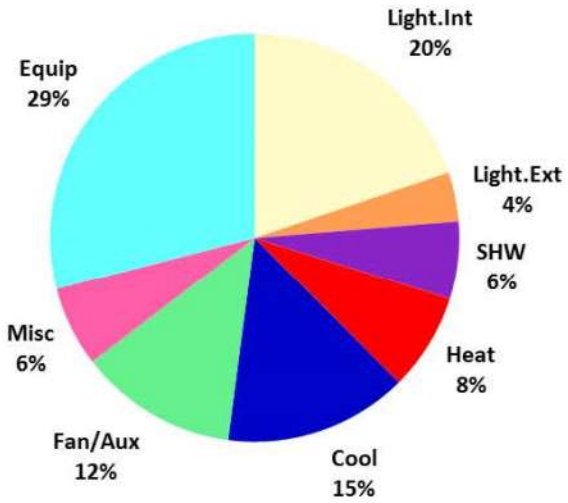


Figure 2. End-use cost for buildings in all U.S. climate zones

http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24043.pdf
(http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24043.pdf)

While the efficiency of office equipment is increasing it still represents a proportionally higher percentage of energy usage in buildings today.

Figure 2. End-use cost for buildings in all U.S. climate zones

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.

Additional First Cost:

Costs were estimated to be $0.26/ft2 in small office and $0.19/ft2 in large office. Primary source: 2013_CASE_NR_Plug_Load_Circuit_Control_Oct_2011.pdf. 2013 California Building Energy Efficiency Standards

CE228-16

CE229-16

IECC: C406 (New), C406.1 (New).

Proposed Change as Submitted

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 - CONNER13653

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This subject is not within the scope of the code. It is a feature related to vehicles, not the building construction.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Charles Foster (cfoster20187@yahoo.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C406.1 Electric vehicle charger ready. For parking lots and parking garages having more than ~~100~~ 200 vehicle parking spots, electrical raceways ~~conduit~~ or other wiring ~~method~~ methods shall be installed for the future installation of not less than ~~four Level 2 or 3~~ two electric vehicle ~~chargers~~ charging stations, with a rated input voltage of 220 or greater, for each increment of ~~100~~ 200 parking spots.

Commenter's Reason: The IECC should address transportation energy. Transportation accounts for nearly one quarter of all energy consumed in the world.
This public comment modifies (relaxes) the requirement in the original proposal by increasing the threshold from buildings with 100 parking spaces to buildings with 200 parking spaces. in addition, it reduces the number of chargers from four to two. Also, this public comment eliminates any confusion that might arise with respect to the phrase "Level 2 or Level 3 charger."

Public Comment 2:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C406.1 Electric vehicle charger ready. For parking lots and parking garages having more than ~~100~~ 500 vehicle parking spots, electrical raceways ~~conduit~~ or other wiring ~~method~~ methods shall be installed for the future installation of not less than ~~four Level 2 or 3~~ one electric vehicle ~~chargers~~ charging station ~~for each increment~~ with a rated input voltage of ~~100 parking spots~~ 220 or greater.

Commenter's Reason: The energy used to transport people, products, and services to buildings can be very significant. Infrastructure that allows more people to use alternative fueled vehicles will reduce the energy and emissions associated with the transportation of people and products to and from the building.
This public comment revises the proposal by increasing the minimum threshold to 500 parking spaces and requiring infrastructure for only 1 electric vehicle charger. Buildings that have 500 or more parking spots will always (or almost always) need to provide lighting for the vehicles, so electric conduits and wiring infrastructure will already be used. There will only be a small incremental cost to add infrastructure for a single EV charger.

According to the DOE's Alternative Fuels Data Center, there were 13,962 public EV charging stations and 34,464 charging outlets as of July 11, 2016. Nearly all of them have been installed at or near existing buildings. Some of these facilities have fewer than 100 parking spots (such as Walgreen's drug stores). Therefore, requiring infrastructure for one EV charger should not be a problem for buildings with at least 500 parking spaces.

Bibliography: DOE AFDC Alternative Fueling Station Locator
http://www.afdc.energy.gov/locator/stations/results?fuel=ELEC

Proponent : Keith Dennis (keith.dennis@nreca.coop) requests Approve as Submitted.

Commenter's Reason: Electric transporation is rapidly becoming common and the IECC should keep pace. This proposal, as submitted, is not onerous considering the energy and environmental benefits associated with the proposal.

CE229-16

CE231-16
IECC: C406, C406.1.

Proposed Change as Submitted

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 of renewable energy in accordance with Section C406.5.~~
4. On-site 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: If renewable energy is being provided, the building should be given credit for it in the IECC as currently stated in the text.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

SECTION C406 ADDITIONAL EFFICIENCY AND RENEWABLE ENERGY ~~SUPPLY~~ PRODUCTION 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 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.

Commenter's Reason: This modification now clarifies the language in this section. It now does not add a new requirement. It changes the word "supply" to "production", since the energy produced by the on-site renewable energy system may not only supply the building (some or all of it may be exported to an energy grid or to another building, and some or all of it may be stored for use at a later date).

CE231-16

CE232-16
IECC: C406.1.

Proposed Change as Submitted

Proponent : jim edelson (jim@newbuildings.org)

2015 International Energy Conservation Code

Revise as follows:

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: 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Wwithout a cost/ benefit analysis, it is unclear that the proposal provides energy savings.

Assembly Motion: **As Submitted**
Online Vote Results: **Failed**
Support: 23.87% (53) Oppose: 76.13% (169)
Assembly Action: **None**

Individual Consideration Agenda

Proponent : jim edelson, representing new building institute (jim@newbuildings.org) requests Approve as Submitted.

Commenter's Reason: The Section 406 packages provide maximum flexibility for increasing the energy savings in the IECC. The number of packages to choose from has been steadily increasing since first introduced in the 2012 IECC, and likely

approval of the CE 230 proposal in this cycle will increase this range of choices again. Some states, such as Washington, have already increased the requirement to two packages in their current code, and other states are considering it, because Section 406 provides the most straightforward approach to increase stringency within the regulatory scope of the IECC.

Proponent : Amanda Hickman, InterCode Incorporated, representing Air Movement Control Association International (amanda@intercodeinc.com) requests Disapprove.

Commenter's Reason: The Air Movement and Control Association International (AMCA) agrees with the ICC Technical Committee's recommendation on this proposal and also their rationale for the disapproval, "without a cost/ benefit analysis, it is unclear that the proposal provides energy savings."

Furthermore, some of the options listed are not appropriate for every region or climate zone of the country. Being that the IECC is used as a template for the entire country, going from requiring one option to two is inappropriate. For these reasons we recommend upholding the Committee's action for disapproval.

CE232-16

CE233-16
IECC: C202 (New), C406.1.

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This text belongs in a new Section 406 as opposed to in this list of requirements. There is concern for the lack of product safety standards for this technology. The text does not refer to some other text that will ensure code compliance. The code text should state the allowed source of the energy that is being stored and may need to specify minimum system efficiencies.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 energy savings, 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.~~

Commenter's Reason: This modification will make this proposal easier to enforce (in case the system is installed in an area that is not currently being served an ISO or RTO, or is not being controlled by a utility). It also requires that the building owner or designer calculate the energy savings associated with the system.

Proponent : Charles Foster (cfoster20187@yahoo.com) requests Approve as Submitted.

Commenter's Reason:
Energy storage is rapidly gaining recognition as an important component of the transition to reduced carbon energy sources. The Committee recognized its importance during the spring hearing and offered administrative suggestions of how they thought energy storage might fit into the IECC. This public comment attempts to address the Committee's thoughts by creating a new chapter in section 406.

Original reason in monograph:

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. 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/accesscontrol.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

CE233-16

CE236-16

IECC: C406.1.1, C503.7 (New), C505.2 (New).

Proposed Change as Submitted

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 in new core and shells that have not been occupied, shall comply with Section C406.5 where the entire building is in compliance.

Add new text as follows:

C503.7 Tenant spaces additional efficiency package Tenant spaces shall comply with Section C406.2, C406.3, C406.4, C406.6, or C406.7.

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.

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.

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-
MEDINA12991

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval was based on the action taken on CE235 and the fact that this text in C406 was never meant to apply to such spaces.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Hope Medina, representing self (hmedina@coloradocode.net) requests Approve as Submitted.

Commenter's Reason: When the new Chapter was created to address existing buildings this reqruiement was not brought over into the new Chapter.
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 building are not known when the core and shell are designed and built. When this section is called out by examiners the response is this is a core and shell, and these items will be addressed by the tenant finish when they submit for a permit. Then often the tenant finish applicant will state this should have been addressed by the core and shell. This change is to clarify when these reqruiements would be required.

CE236-16

CE238-16
IECC: C406.2.

Proposed Change as Submitted

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~~ 33 percent of the total building heating or cooling 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: 33% exceeds the original intended 10%. This won't be used for new innovative equipment, rather, it would allow one third of the heating to be provided by electric resistance equipment. The performance path has options for new innovative equipment.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Charles Foster (cfoster20187@yahoo.com) requests Approve as Submitted.

Commenter's 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.

CE238-16

CE239-16
IECC: C406.2.

Proposed Change as Submitted

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~~ 5 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by ~~10~~ 5 percent. *Variable refrigerant flow systems* shall exceed the energy efficiency provisions of ANSI/ASHRAE/IES 90.1 by ~~10~~ 5 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: 10% is easily achievable and the marketplace will provide such equipment. If the chosen equipment can't meet this requirement, then different options can be picked. One size does not fit all and there should be requirements for both small and large systems.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: As the energy efficiency standards increase for HVAC equipment, there are more situations where there is less than a 10% difference between the baseline efficiency equipment and the highest efficiency equipment. The original proposal creates a threshold that will work for all sizes of equipment. While certain smaller equipment can achieve a 10% increase, that would require that this particular section have a long list for different equipment from all of the equipment efficiency tables.

CE239-16

CE240-16
IECC: C406.2.

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This is already covered in Sections C102 and C407.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: Building owners and designers should be allowed to use other equipment to meet the criteria for additional energy efficiency without having to go to a full performance path option. This proposal allows the use of technologies such as zoned systems, radiant systems, chilled beam systems, combined space/water heating systems, thermal energy storage systems, and other advanced energy efficient technologies to improve the efficiency of the building. The current language is too restrictive and should be revised.

CE240-16

CE241-16
IECC: C406.3.

Proposed Change as Submitted

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~~ 95 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~~ 95 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval was based on the action taken on CE239-16. This proposal is premature, not knowing what is happening yet to the lighting power density tables.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: Based on the actions on lighting power density that have been approved for the newest version of ASHRAE 90.1 (ASHRAE 90.1-2016), along with the committee's approval of CE206, CE209, and CE210, the lighting power densities for interior lighting have been reduced significantly, due to the increase in the use of LED systems. In some cases, the lighting power densities have been reduced by over 20% compared to the previous values.
Therefore, this revision makes the requirement more achievable based on the higher baselines being established in the next version of the IECC.

CE241-16

CE244-16
IECC: C406.5.

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: It is hard to measure unregulated loads and they are often not present during the construction phase of the building. The current text provides something solid to which to refer.

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: There are many energy simulation software tools that model "unregulated" loads to a high degree of accuracy. Along with information from existing building studies, it is possible to verify that this requirement is being achieved. As the percentage of total energy usage from "unregulated" loads increases, it is more important to account for them in this section. Systems that can provide 3% of the energy used by the entire building will be of more value than systems that provide 3% of 50-60% (or less) of the energy used by the "regulated" loads in the building.

CE244-16

CE245-16
IECC: C406.6.

Proposed Change as Submitted

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°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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This is a model code that is not appropriate everywhere. The proposal is very prescriptive and should not be an option everywhere. Charging text is needed similar to what is in C406.7 to apply to certain climate zones.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Amanda Hickman, InterCode Incorporated, representing Air Movement Control Association International (amanda@intercodeinc.com) requests Disapprove.

Commenter's Reason: The IECC is adopted and used all over the country. Dedicated outdoor air systems were added to this list based on a small-scale study that only looked at the potential energy savings from small buildings in the Seattle metro area. That study contained many flaws, but even if the results are accepted, they only apply to places with the same low electrical energy cost and climate in Washington State.
This proposal will increase cost because it removes the ability to combine ventilation and heating/cooling in one system by use of a High Performance Air System. Moreover, the revised language does not at all address humidity control. It also seems to allow improperly ventilated spaces. We urge disapproval.

Public Comment 2:

Proponent : Eric Makela, representing Northwest Energy Codes Group (eric.makela@cadmusgroup.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C406.6 Dedicated outdoor air system. Buildings covered by Section C403 shall be equipped with 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 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 temper DOAS supply air to a temperature warmer than 60°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 actual occupancy of spaces served by the system is less than design occupancy.

3. ~~Equipment~~ Motors that serve DOAS systems and ~~controls~~ that are 1/12 horsepower or greater and less than 1 horsepower shall be ~~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~~ electronically commutated motors or ~~cooling in the zone.~~

   ~~**Exception:** Fans used for heating and cooling consuming~~ shall have a motor efficiency of not less than ~~0.1 Watts per cfm and used to provide destratification and air mixing in the space,~~ 70 percent when ~~space temperatures are within the setpoint deadband~~ rated in accordance with DOE 10 CFR 431. ~~Section 403.2.4.1.2.~~

Commenter's Reason: This Public Comment is being submitted to address concerns with the original dedicated outdoor air

systems (DOAS) proposal. The original proposal modifies the requirements for DOAS currently allowed as an option in the Additional Efficiency Package Options. In the IECC Code Development Hearings proposed new section C406.6(3) in the proposal was opposed due to the sequence of operation of the equipment and design that was proposed. This Public Comment removes that section. We have added a fan motor requirement for small motors used frequently in smaller DOAS systems that requires efficient motors. The applicable fan motor requirements are taken from ASHRAE Standard 90.1-2013 Section 6.5.3.5. This requirement along a new proposed Section C406.6(2) ensures that energy recovered from the exhaust air is recovered efficiently and energy is not wasted on inefficient fan motors. Note that Standard DOE 10 CFR 431 is currently referenced in Table C403.2.3(5) of the 2015 IECC.

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.

Additional First Cost:

None. Provision is already in the code and is listed in the Additional Efficiency Packages

CE245-16

CE247-16

IECC: C406, C406.1, C406.8 (New).

Proposed Change as Submitted

Proponent : Karen Hobbs (khobbs@nrdc.org); Ed Osann (eosann@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).

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code.

CE247-16 :
C406.8 (NEW)-
HOBBS11698

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed text is a mandatory requirement that belongs in the same section as shower heads as presented in CE175-16.

Assembly Motion: **As Submitted**
Online Vote Results: **Failed**
Support: 30.25% (72) Oppose: 69.75% (166)
Assembly Action: **None**

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code.

This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Individual Consideration Agenda

Public Comment 1:

Proponent : Hope Medina, representing self (hmedina@coloradocode.net) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

CHAPTER 6 Water Conservation and Efficiency

601.1 Scope The provisions of this chapter shall establish the means of conserving water and conserving energy associated with water use.

SECTION 602 Plumbing Fixture Efficiency

602.1 General The provisions of Section 602 shall govern the water consumption and efficiency of plumbing fixtures.

602.3 Lavatory faucets. The flow rate of a lavatory faucet shall not exceed 1.5 gpm at 60psi.

Commenter's Reason: All though the origional change does contain energy efficiency aspects I do feel they are a by product of this measure. This is a concept that should be visited. The placement of this change in the additional efficiency package isn't the correct section it belongs in, but there isn't really a section within the existing energy code that would best fit this requirement. The solution for this is to create a new chapter that deals with water conservation that contains energy efficiency measures.
This is an opportunity to acknowledge that there is a relationship between water conservation and the energy efficiency that is gained from this. A new chapter that is dedicated to water conservation that go hand and hand with energy efficiency is where this concept and other similar concepts should be placed.

Analysis: Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code. This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited

to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Public Comment 2:

Proponent : Ed Osann, Natural Resources Defense Council, representing Natural Resources Defense Council (eosann@nrdc.org) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

C404.12 Lavatory 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).

Commenter's Reason: The Technical Committee rejected the original proposal simply because it was placed in the wrong section (C406) instead of C404. This revision responds to the TC's concern by placing the proposal in Section C404. The wording of the text is unchanged, and all of the points made regarding energy savings in the original Reason Statement remain applicable to this Public Comment.

One opponent has questioned whether lower maximum flow rates for lavatory faucets achieve any hot water savings, since most lavatories are not opened to the full open position on a regular basis. EPA addressed this issue in 2007 in its *Supporting Statement* for the WaterSense High-Efficiency Lavatory Faucet Specification, upon which this code change proposal is based. Field studies in Seattle and the East Bay Municipal Utility District were reviewed by EPA, and pertinent findings demonstrated that residential faucets with lower maximum flow rates achieved savings, and that 70% of faucet water use was hot water.

A more recent study provides further documentation of the real world savings of faucets with maximum flow rates at the WaterSense level. In a 2011 report by DeOreo entitled *Analysis of Water Use in New Single-Family Homes*, three groups of homes were compared: homes built before 1995, homes built after 2001, and high-efficiency new homes built after 2006 to the equivalent of the WaterSense specifications. As might be expected, total indoor water use measured in gallons per household per day (gphd) declined in newer homes compared to the oldest group in the study. And more specifically, faucet water use declined very significantly, from 26.7 gphd in pre-1995 homes, to 25.23 gphd for typical post-2001 homes, to 18.1 gphd for WaterSense-level high efficiency homes. This clearly demonstrates the energy- and water-saving impact of reducing the maximum flow rate for faucets as proposed in this code change proposal.

Bibliography: [WaterSense High Efficiency Lavatory Faucet Specification Supporting Statement] [Version 1.0] [US EPA] [2007] [page 5]
[https:www3.epa.gov/watersense/docs/faucet_suppstat_final508.pdf]

[Analysis of Water Use in New Single-Family Homes] [Report/Document #] [DeOreo, William] [2011] [page 16]
[http://www.aquacraft.com/downloads/epa-new-home-water-use-study/]

Analysis: Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code. This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Hugo Aguilar, representing American Supply Association (haguilar@asa.net) requests Disapprove.

Commenter's Reason: Agree with the Committee to disapprove the proposal as flow rate requirements are not within the purview of the IECC. Fixtures such as faucets are already addressed in ASHRAE 189.1, IPC and the IRC. The IECC does not address any fixtures and including faucets in Section C406.8 will create confusion in the industry. There needs to be a distinction amongst the codes and having similar provisions in every code creates confusion in the industry and makes it difficult for AHJ's to enforce. Lastly, Section C101.3 (Intent) indicates that the code regulates the design and construction of buildings for the use and conservation of energy over the life of the building.

Analysis: Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing

Code. This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Matt Sigler, representing Plumbing Manufacturers International requests Disapprove.

Commenter's Reason: PMI **agrees** with the committee's action of **disapproved** for this item for the following reasons:

- As stated in the 2015 IECC Commentary (pg. C1-1): "The code addresses the design of energy efficient building envelopes, and the selection and installation of energy-efficient mechanical, service water-heating, electrical distribution and illumination systems and equipment in residential and commercial buildings alike." Nowhere within the IECC does it state that this code addresses water consumption requirements for plumbing fixtures or fittings.
- The bottom line is that the IECC has never addressed water consumption requirements for plumbing fixtures and fittings. Such requirements have always been addressed in the IGCC (now ASHRAE 189.1), IPC and IRC (Chapter 29).
- Proposals that dealt with water consumption requirements for plumbing fixtures and fittings in the ICC Codes were discussed during the Group A hearings and will be included in the 2018 IPC and/or IRC. If CE 247 is approved, it will conflict with the actions taken by the IPC Committee.
- The proponents used residential data to justify changes that impact commercial structures.
- The proposed text "High-efficiency faucets" is a term used by U.S. EPA WaterSense for private use lavatory faucets such as those found in residences and private restrooms in hotels and hospitals. It does not apply to commercial products such as metering faucets or lavatory faucets in public use (refer to: EPA WaterSense High-Efficiency Lavatory Faucet Specification, Section 1.0 Scope & Objective, pg. 1; https://www3.epa.gov/watersense/docs/faucet_spec508.pdf).
- The proposed text uses the word "dwelling". Again, Section C406 applies to commercial occupancies, not residential occupancies.

Analysis: Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code. This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Commercial Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

CE247-16

CE249-16
IECC: C407.2.1 (New).

Proposed Change as Submitted

Proponent : Duane Jonlin (duane.jonlin@seattle.gov)

2015 International Energy Conservation Code

Add new text as follows:

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.

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.

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The "heat loss" language may need to be "heat gain" instead. This is more of an "above-code" than performance based approach. The reference to Equation (4-2) is ambiguous. It is not as easy to put a UA threshold in the code as it is for duct insulation, for example. This counters the performance path approach. Designers should be able to use efficiency increases in HVAC and lighting to trade off against walls.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Approve as Submitted.

Commenter's Reason: This change limits the heat loss rate of the performance path to 110% of UA. The committee recommended denial.
The committee stated designers should be able to use efficiency increases in HVAC and lighting to trade off against walls. The reintroduction of the performance path tradeoff of envelope for equipment would be a mistake. We believe the committee should avoid giveaways or "free credit" for high-EE equipment that the market is already providing. Changes to the codes should prioritize passive design solutions for energy efficiency. We believe it is important to set tradeoff limits for long-lived thermal envelopes. Future cycles may also consider setting limits for fenestration SHGC tradeoffs.

The AIA recommends approval as submitted.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); William Prindle, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition requests Approve as Submitted.

Commenter's Reason: CE249 should be approved as submitted because it establishes a reasonable maximum UA for the thermal envelope, helping to ensure the long-term efficiency of the building. The UA is a reasonable measure, in this context, for the insulating value of the building thermal envelope. We agree with the proponent that trade-offs between thermal envelope efficiency and shorter-lived components such as lighting or mechanical equipment result in less-efficient buildings, and while the proposed 10% cap on trade-offs is very lenient, we think it is better than the current code (which has no backstop at all). While we believe a fenestration SHGC maximum would also be in order, we think this issue can be addressed in a future code cycle if CE249 is approved.

We disagree with the Committee Reason Statement about this approach being too complicated. We note that the residential Energy Rating Index has an integrated thermal envelope trade-off cap that has been adopted by every state that has adopted the 2015 IECC so far. If this can be achieved for residential buildings, it certainly can also be achieved for those who want to comply for commercial buildings under the simulated performance path approach. This proposal could easily be built into compliance software (like other mandatory measures) so that users would be able to make corrections where necessary to ensure a reasonably efficient building envelope.

CE249 correctly recognizes that the thermal building envelope can last the life of the building and can have a lasting impact on the building's energy savings. Approval as submitted will help raise the overall long-term efficiency of commercial buildings.

CE249-16

CE251-16
IECC: C407.3, C407.4.2.

Proposed Change as Submitted

Proponent : Anthony Floyd, Energy Code Specialist, City of Scottsdale, representing City of Scottsdale (afloyd@scottsdaleaz.gov); jim edelson (jim@newbuildings.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~~ 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

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (*proposed design)* be shown to have an annual energy cost that is less than or equal to the annual energy cost of the *standard reference design.* Energy prices shall be taken from a source *approved* by the *code official,* such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report. Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the *proposed design* associated with *on-site renewable energy* shall be not more than ~~10~~ 5% 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.

Committee Reason: This closes a loophole that would allow building envelope performance to be be traded away for PV renewable energy. Energy production should not be substituted for energy conservation measures. The Modification will align this text with the other path in C406 for renewables. 5% is still a sizable solar array, so this will not affect the solar industry.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Tom Zaremba, Roetzel & Andress, representing NSG Group/Pilkington North America and AGC Glass Company North America (tzaremba@ralaw.com) requests Approve as Submitted.

Commenter's Reason: We are requesting that you vote against the standing motion to approve CE251-16 *as modified*. If the standing motion fails, we will ask you to approve CE251-16 *as submitted.*
The original proposal sought to impose a 10% performance path cap on the use of on-site renewables. On its own initiative, the Committee arbitrarily modified the proposal by reducing it to 5%.

Even though the proposal as originally submitted failed to document any instance where on-site renewables were being over used to unreasonably reduce or eliminate other energy efficiencies, its Reason statement justified the proposed 10% cap: *"For the purposes of code compliance, the maximum 10% renewable 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 Committee's decision to reduce the 10% cap to just 5% was completely arbitrary. The Committee has offered no technical justification or support whatsoever for its unilateral reduction in the proposed 10% cap, either at the hearing or in its Reason statement.

While the 10% limit as originally proposed is a step backward from the incentives needed to reduce our dependence on the use of scarce fossil fuels through the use of on-site renewables, nevertheless, it will ensure that on-site renewables are not over used to the detriment of other energy efficiency measures. While a 10% cap can be considered a reasonable deterrent to the over use of renewables, a 50% reduction in that cap to just 5% would require substantial technical justification. And, frankly, there, simply, is none. Adopting the Committee's 5% cap would be completely arbitrary.

Finally, (although the Committee did not include this in its Reason statement), the 5% cap was discussed at the hearing as if it would somehow make the IECC consistent with ASHRAE 90.1. However, that is just not true. While Chapter 11 of ASHRAE 90.1 includes a 5% limit for on-site renewables, ASHRAE 90.1 actually has TWO separate performance paths. The second is found in Appendix G which is used far more frequently than the Chapter 11 path, since Appendix G is also the basis for LEED computations. Like LEED, ASHRAE 90.1's Appendix G performance path does NOT place ANY limit on the use of on-site renewables.

The Committee's modification of CE251-16 is completely arbitrary and would represent an excessive and unjustified step backward in the progress otherwise being made by the codes to conserve fossil fuels through the use of on-site renewables. As a result, we urge you to vote *against* the standing motion to approve *as modified* and then vote to *approve* CE251-16 *as submitted*.

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

Commenter's Reason: The original Proposal CE251-16 included a very stringent on-site renewable energy backstop with the provision that "on-site renewable energy shall be not more than 10% of the total energy cost." The modification to further constrain the on-site renewable energy backstop to not more than 5% of the total energy cost is overly restrictive. Architects and builders want flexibility to choose the most cost-effective solution for a project. Existing Section C407.3 recognizes the contribution of renewable energy as a synergy with the rest of the building energy efficiencies.The contribution of renewable energy to the overall performance model will be self-limiting. In some cases, photovoltaic system size is constrained by the allow able space on a rooftop, or otherwise constrained in some occupancies by relatively low demand for electricity.

As states and localities move toward Zero Net Energy (ZNE) buildings, rapid deployment of on-site renewable energy systems is integral to meet these goals. It is not possible to attain ZNE buildings without incorporating renewable energy systems. Therefore, renewable energy systems should obtain credit in the performance-based compliance methods to achieve the most cost-effective solutions and to give credit to builders for using renewables as a standard feature. Renewable energy systems provide for conservation of our nondepletable resources including traditional fossil-based fuels. Reducing power generation at conventional power plants reduces demand for water resources, and reduces emissions of pollutants.

The economics of renewable energy systems is rapidly changing as technology is rapidly improving. A PNNL report dated 2011 is already five years old. The economics of renewable energy systems has changed substantially during that five-year period, and will continue to change.

Proponent : Thomas Culp, representing the Glazing Industry Code Committee and Aluminum Extruders Council (culp@birchpointconsulting.com) requests Disapprove.

Commenter's Reason: This proposal places an undue and unfair restriction on one particular method for reducing building energy use: on site renewable energy. Whether building energy use is reduced by installing high performance HVAC equipment, better lighting, more insulation, or on-site renewable energy should not matter – all reduce the demand for energy use coming from power plants and fossil fuels. The code should not show favoritism for one method or bias against another. It should be noted that the Appendix G performance path of ASHRAE 90.1, which is used as a basis for green programs like LEED, places no arbitrary limit on on-site renewable energy. The committee reason statement also mistakenly says that the modified proposal "will align this text with the other path in C406 for renewables." However, C406 requires a *minimum* amount of renewable energy if that path is chosen, not a limit. Placing a restriction on on-site renewable energy sends the wrong message to designers, and heads in the direction opposite of the path to net-zero energy buildings. If anything, the energy and green codes should encourage, not discourage, the use of clean locally generated renewable energy. We ask for your Disapproval of CE251.

Proponent : Donald Surrena, National Association of Home Builders, representing National Association of Home Builders (dsurrena@nahb.org) requests Disapprove.

Commenter's Reason: In proposed C407.4.2, "Additional Documentation," the proponent has added item number 6 which states "Documentation of the reduction in energy use associated with on-site renewable energy." It is not possible to predict the amount of renewable energy that will be produced tomorrow or any other day in the future by an on-site energy source, such as solar PV. The future production can be affected by clouds, adjacent trees that are growing into the production zone and reducing the amount of sunlight that actually lands on the solar PV, along with snow cover that varies every winter and even proper cleaning of the surface of the solar PV array. There is no way to provide accurate documentation of the future reduction in energy use associated with on-site renewable energy. This is an unreasonable requirement and a wild guess that no one will use.

In the "Reason" statement provided by the proponent of this proposal, he references the 2011 PNNL report on "Integrating Renewable Energy into Building Codes" as the basis for his comment that "*for the purposes of code compliance, the maximum 10% (committee action changed to 5%) renewable energy cost reduction ensures that the buildings will meet improved energy performance...*, " but, the 261 page PNNL report does not contain any suggestions or recommendations for either a 5% or 10% cost reduction. So what data justifies this 5% or 10% noted in the code change proposal?

The committee "Reason" states that "the modification (from 10% to 5%) will align this text with the other path in C406 for renewables," but 2015 IECC Section C406 refers to C406.5 for "On-site renewable energy," but this section has no reference to a 5% or 10% percentage either. Section C406.5 only notes some minimum requirements for solar based on .50 watts per square foot of conditioned floor area or not less than 3% percent of the energy used....." How does the 5% align with anything in C406.5? It does not. There is still no verifiable data that recognizes 5% or 10% and we should not be changing a code section based upon opinions.

The original language in the 2015 IECC Section C407.3, "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" should remain as is in the code because it better serves the concept of how renewable energy sources can serve the design.

This proposal is not practical and should be disapproved.

CE251-16

CE253-16
IECC: C407.3.

Proposed Change as Submitted

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 energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.~~
> **Exception:** The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be an alternative for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

Reason: 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval was based on the action taken on CE252-16. This proposal lessens the code and there is no justification for deleting site energy.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Ted Williams, representing American Gas Association (twilliams@aga.org) requests Approve as Submitted.

Commenter's Reason:
The "Committee Reason" for disapproval, referring back to action of CE252, was unjustified since source energy multipliers are well embedded in Federal energy efficiency program metrics. As these multipliers change with changes in the source energy mix, the IECC multipliers can also change within code cycles. Site energy is useless for comparing energy form (e.g., electricity to gas, gas to renewables, etc.) and do not belong in a performance-based approach, except as a basis for calculating the source energy consumption. The change as originally proposed would bring 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. Thee "Committee Reason" does not speak to this issue or to the inconsistency that would remain from not making this change. The proposed change would 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

CE256-16
IECC: C407.5.1.

Proposed Change as Submitted

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	As proposed
	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.	
	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	As proposed
	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	

	U-factor: as specified in Table C402.4	As proposed
Skylights	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 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.	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 factors are provided than in the proposed design.	As proposed

	Economizer[d] : same as proposed, in accordance with Section C403.3.	As proposed
Service water heating[e]	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

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Approval was based on the proponent's published reason statements.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Amanda Hickman, InterCode Incorporated, representing MacroAir (amanda@intercodeinc.com) requests Approve as Submitted.

Commenter's Reason: Currently, the performance path does not allow for correct modeling of 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 code change proposal provides direction regarding setpoint and schedules requirements for modeling these systems correctly. The ICC technical committee agreed with this and recommended approval of this code change.

Using technology allows us to account for a complex world without complicating the lives of those who use it. With the specific case of comfort levels in ASHRAE 55, the Center for the Built Environment at UC Berkeley has developed an online tool to calculate the comfort level for various situations, including air speed, clothing, and activity level (http://comfort.cbe.berkeley.edu/ (http://comfort.cbe.berkeley.edu/)). Similar comfort tools are being incorporated into device controllers and building control systems. These tools allow for all involved (consumers, managers, builders, and code officials) to enjoy a more robust definition of comfort without complicating their lives.

Proponent : Christian Taber, representing Big Ass Fans (ctaber@bigassfans.com) requests Approve as Submitted.

Commenter's Reason: The changes proposed to Section C407 allows for the modeling of high efficiency HVAC strategies that provide comfort by controlling comfort factors other than dry bulb temperature and humidity such as radiant cooling, radiant heating, and elevated air speed. Those systems are not currently allowed to be modeled correctly in this optional compliance path.

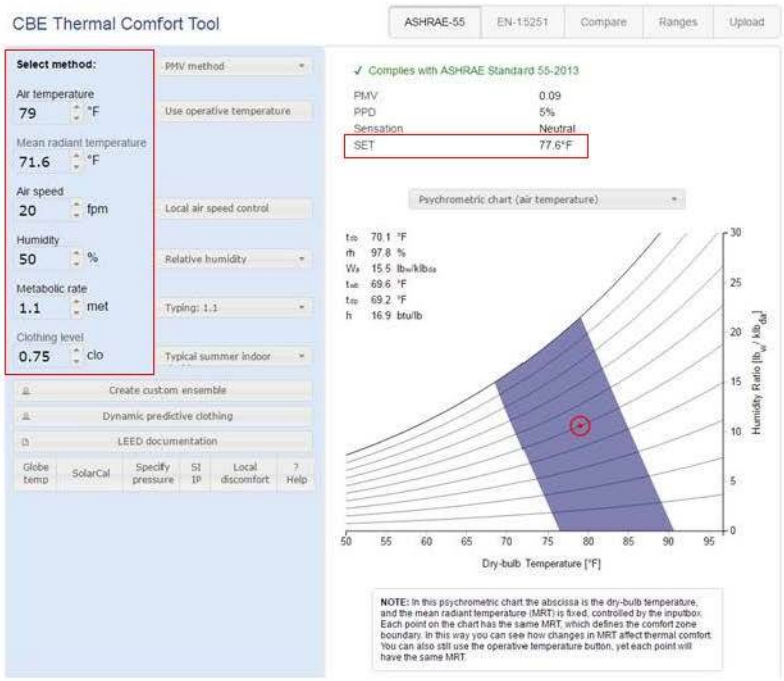
The required documentation for enforcement can be obtained using software such as the ASHRAE Thermal Comfort Tool or the CBE Thermal Comfort Tool. The CBE tool is a free, web based software program available from the University of California Berkeley. The comfort conditions for the are calculated for the Proposed Design, based on the design conditions in the proposed building.

An example of the six input factors used for the proposed design is shown.

The changes proposed to Section C407 allows for the modeling of high efficiency HVAC strategies that provide comfort by controlling comfort factors other than dry bulb temperature and humidity such as radiant cooling, radiant heating, and elevated air speed. Those systems are not currently allowed to be modeled correctly in this optional compliance path.

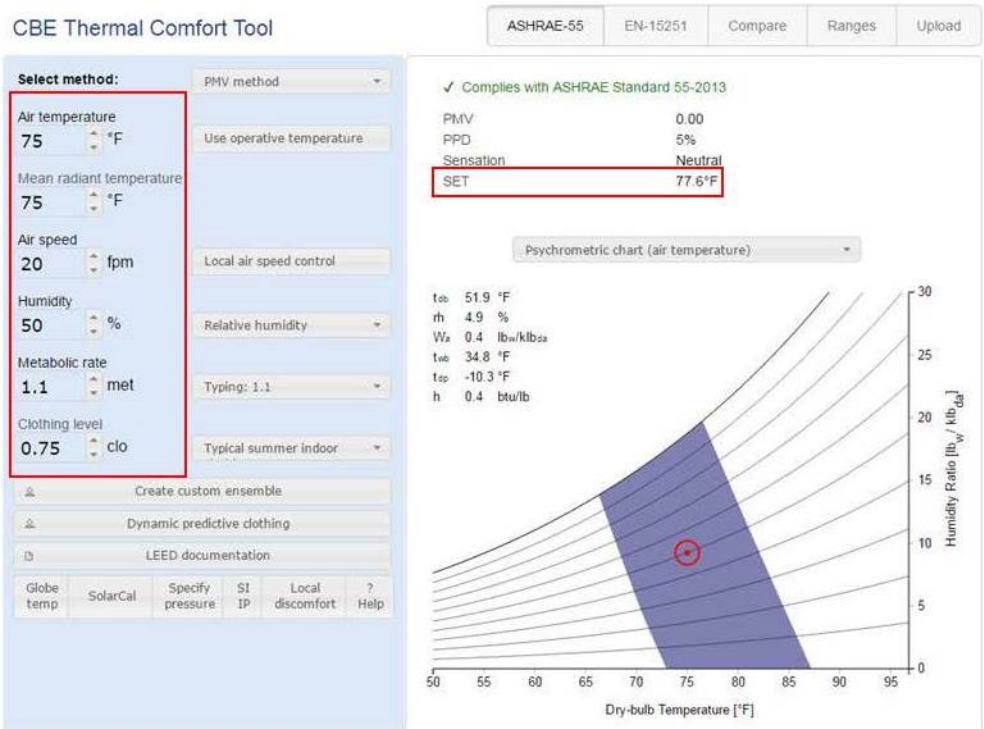
The required documentation for enforcement can be obtained using software such as the ASHRAE Thermal Comfort Tool or the CBE Thermal Comfort Tool. The CBE tool is a free, web based software program available from the University of California Berkeley. The comfort conditions for the are calculated for the Proposed Design, based on the design conditions in the proposed building.

An example of the six input factors used for the proposed design is shown below.



The conditions for the standard reference design would be based on a standard HVAC system. The dry bulb temperature and mean radiant temperature would be set equal, and the temperature would be increased or decreased until the same Standard Effective Temperature (SET) was equal to that in the proposed design.

For this example, the Standard Reference Design would be simulated with the HVAC maintaining 75F and 50% relative humidity.



The difference in the energy consumption for the proposed building with the radiant cooling system and the standard reference building with the traditional HVAC system.

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For this example, the Standard Reference Design would be simulated with the HVAC maintaining 75F and 50% relative humidity.

The difference in the energy consumption for the proposed building with the radiant cooling system and the standard reference building with the traditional HVAC system.

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

Commenter's Reason: ASHRAE Standard 55-2013 is not appropriate for use in a code. At the least the wrong parts of the standard are referenced in the code change.

The code change specifies the "Standard Effective Temperature" as calculated in Appendix B. However there is no mention or calculation of a "Standard Effective Temperature" in Appendix B. Rather Appendix B calculates a "Predicted Mean Vote" and a "Predicted Percentage of Dissatisfaction". The standard and the appendix require specification of representative occupant(s) including their "clothing insulation" and "metabolic rates".

The change makes part of the Standard Reference Design"" into a calculation. If a "Proposed Design" was some kind of alternative, the equation probably belongs under "Proposed Design".

ASHRAE Standard 55 used to be referenced in the residential IECC; however, it was removed because it was not usable in that role.

CE256-16

CE258-16
IECC: C407.5.1.

Proposed Change as Submitted

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	As proposed
	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.	
	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 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	
	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
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 factors are provided than in the proposed design.	As proposed
	Economizer[d] : same as proposed, in accordance with Section C403.3.	As proposed
Service water heating[e]	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 all 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 65% in 2015, 80% in 2020, and 100% 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Lighting controls are already identified as mandatory in Section C405.2, thus it is not necessary to repeat this in the table. How does one model the impact of lighting controls?

Assembly Action: **None**

Individual Consideration Agenda

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

Commenter's Reason: This proposal helps to improve the table by showing that lighting controls are in the standard reference design. The table also clarifies other parts of the standard reference design beyond going back to the referenced tables.
Many entities have modeled the impacts and energy savings associated with baseline and advanced lighting controls.

CE258-16

CE259-16 Part II

IECC-R: Table R405.5.2(1) [IRC Table N1105.5.2(1)]

Proposed Change as Submitted

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

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 R402.1.4	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 R402.1.4, 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 R402.1.4	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table R402.1.4	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 R402.1.4	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 R402.1.4	As proposed
	SHGC: as specified in Table R402.1.2 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: $ASKY_{adj}$ = ASKY * 0.15 * CFA/AF $ASKY_{adj}$ = 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 R402.1.4	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~~fenestration area:
$AF = A_S \times FA \times F$
where:
AF = Total ~~glazing~~fenestration area.
A_S = Standard reference design total ~~glazing~~fenestration area.
FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 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 Part II : N1105.5.2-RUTH13957

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: The Committee approved revised language in RE146 and this language needs to revised to integrate with those languages changes.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Julie Ruth, representing American Architectural Manufacturers Association (julruth@aol.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Residential Code

TABLE N1105.5.2 (1)
[R405.5.2(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 R402.1.4	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 R402.1.4, 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 R402.1.4	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table R402.1.4	As proposed
	Type: composition shingle on wood sheathing	As proposed

Roofs	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 R402.1.4	As proposed
Vertical fenestration(b) other than opaque doors	~~Total adjusted vertical fenestration area =~~ ~~(a) The proposedvertical fenestration area, where the proposed fenestration area is less than 15 percent of the conditioned floor area~~ The adjusted vertical fenestration area~~, where the proposed 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 R402.1.4	As proposed
	SHGC: as specified in Table R402.1.2 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	~~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 $_{adj}$ = ASKY * 0.15 * CFA/AF $ASKY_{adj}$ = Adjusted Skylight Area ASKY = Proposed Skylight Area CFA = Conditioned Floor Area AF = Proposed Total Fenestration Area	As proposed
Skylights	Orientation: As Proposed	As Proposed
Skylights	U-factor: As specified in Table R402.1.4	As Proposed
Skylights	SHGC: As specified in Table R402.1.2 including footnote (b) of that table, except that for climates with no requirement (NR): SHGC = 0.40	As Proposed
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.
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~~fenestration area:

$AF = A_S \times FA \times F$

where:

AF = Total ~~glazing~~fenestration area.

A_S = Standard reference design total ~~glazing~~fenestration area.

FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 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.

Commenter's Reason: CE259 addresses inconsistent treatment of skylights under performance based design, for both residential and commercial construction. Part I was Approved during the Committee Action Hearings in Louisville, Part II was Disapproved due to a potential conflict with another proposal (RE146) that was Approved prior to CE259, Part II coming to the floor. The resultant conflict was too complex to address in a floor modification.

This Public Comment addresses the conflict between CE259, Part II, as Submitted, and RE146, as Approved. CE259, Part II was based upon the existing language of the IECC - Residential that set the fenestration area to be assumed for standard design as "As Proposed" for up to 15% of conditioned floor area, and at 15% of conditioned floor area for any proposed area that was greater than that.

RE146 set the fenestration area to be assumed for standard design as 15% of conditioned floor area, regardless of the proposed area.

Although AAMA opposes RE146, and we have submitted a PC for its Disapproval, we are also submitting this Public Comment, which is based upon Approval of RE146. If the Approval of RE146 is upheld at the Pubic Comment Hearings we will seek Approval of CE259, Part II, As Modified by this Public Comment. If it is not upheld we will seek Approval of CE259, Part II as Submitted.

Skylights are treated inconsistently between the different compliance alternatives in the 2015 IECC - Residential. 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 currently equalts the proposed design up to 15% of the conditioned floor area,

The discrepancy is due, at least in part, to approved RE173-13, which changed "glazing" to "Vertical fenestration other than opaque doors" between the 2012 and 2015 IECC. This change thereby omitteed skylight area from consideration in the Standard Reference Design. .

Although Table R405.5.2(1) of 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. With its reference to "curbing" the first sentence in deleted footnore (a) also implied the inclusion of skylights within the more general term of "glazing":

"a. Glazing shall be defined as sunlight-tranmitting fenestration, including the area of sash, **curbing** or other framing elements, that enclose conditioned space. Glazing includes the area of sunlight-transmitting fenestratin assemlies in walls bounding conditioned basements. For doors...."

In the 2015 IECC the definition of "glazing" was replaced by a definition of "fenestration" that further separated the product into vertical glazing or skylights.

CE259, Part II, as submitted corrected this inconsistency within Table R405.5.2(1) by reinstating consideration of skylight area in the Standard Reference Design. It did so by adding the following:

a) Proposed provisions for skylight area, U-factor and shading that mirror the Vertical Fenestration provisions, wherever 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 equally 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 Public Comment addresses the potential conflict between the original proposal and RE146 by revising the proposed provisions for skylight area and vertical fenestration area to be assumed for standard design to ba a portion of the allotted 15% of conditioned floor area. The portion to be assigned to each is to be based upon their portion in the proposed design (i.e. ratio of vertical fenestration area to total fenestration area and ratio of skylight area to total fenestration area, as applicable).

The proposed change to footnote b of Table R405.5.2(1) from the original proposal is retained. The proposed change replaces reference to "glazing area" with "fenestration area". Footnote b is the only remaining use of the phrase "glazing area" in the IECC - Residential.

If the approval of RE146 is upheld we urge the approval of CE259, Part II, as modified by this Public Comment as well, so that skylights are addressed appropriately in the performance based design provisions of the IECC - Residential.

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

Commenter's Reason: CE259, Part I was Approved as Submitted.
CE259, Part II was Disapproved due to a potential conflict with RE146. RE146 was heard before CE259, Part II, and it was Approved.

A separate Public Comment has been submitted for the Disapproval of RE146. If RE146 is Disapproved no potential conflict with CE259, Part II in the IECC- Residential would exist.

CE259 corrects inconsistencies with regards to how skylights are dealt with under the Performance Based Compliance Path. These inconsistencies were inadvertently introduced into the IECC - Residential when "glazing area" was replaced with "fenestration area" and then "fenestration area" was split up into "Vertical fenestration area" and "skylight and sloped glazing area". CE259, Part II corrects these inconsistencies and restores the original intent of the IECC - REsidentail with regards to consideration of skylights and sloped glazing under Performance Based Design.

CE259-16 Part II

NOTE: PART I DID NOT RECEIVE A PUBLIC COMMENT AND IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY

CE259-16 Part I

IECC: C407.5.1.

Proposed Change as Submitted

Proponent : Julie Ruth, representing American Architectural Manufacturers Association (julruth@aol.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	As proposed
	1.The proposed ~~glazing~~ vertical fenestration area; where the proposed ~~glazing~~vertical fenestration area is less than 40 percent of above-grade wall area.	
	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
	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~~.	

Skylights	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.

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 Part I : C407.5.1-RUTH13956

Public Hearing Results

Part I

Committee Action: **Approved as Submitted**

Committee Reason: Approval was based on the proponent's published reason statements.

Assembly Action: **None**

CE262-16

IECC: C202 (New), C408.2, C408.2.1, C408.2.4, C408.3.1, C408.3.1.2.

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The committee needed to see what was in the proposed standard. The Registered Design Professional needs to be included.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Eric Makela, representing Northwest Energy Codes Group (eric.makela@cadmusgroup.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

CERTIFIED COMMISSIONING PROFESSIONAL An individual who ~~is certified~~ has a commissioning certification that has been accredited by ~~an~~ ANSI/ISO/IEC 17024 ~~accredited organization~~.

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 *certified commissioning professional* 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 ~~*certified commissioning*~~ *registered design professional* or *certified commissioning professional* 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.

C408.3.1 Functional testing. Prior to passing final inspection, the *registered design professional* or *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 professional* or *certified commissioning professional*.

Commenter's Reason: This Public Comment allows either a registered design professional or a certified commissioning professional to perform commissioning on an HVAC or lighting system. Allowing registered design professionals to provide commissioning was added at the recommendation of the IECC Code Development Committee and also at the urging of the opponents to the proposal.

ANSI/ISO/IEC 17024:2012 is a standard that provides a process for developing professional accrediting programs. ISO 17204 ensures that applicants have the required knowledge, skills, and competencies for the job Following the ISO 17024 process ensures that an accrediting program is developed based on a certain rigor, very similar to the ICC certification exam development process. Several U.S. government agencies rely on accreditation to ISO 17024 to ensure the quality of personnel certification. Examples include the:

- Department of Defense
- Occupational Safety and Health Administration
- Department of Energy
- Food and Drug Administration

ISO 17024 focuses on:

- Defining what it is you examine (the competencies)
- Defining the knowledge, skills and personal attributes
- Ensuring that the examination is independent

- Ensuring that the examination is a valid test of competence where competency is typically described as "the demonstrated ability to apply knowledge, skills and attributes".

Why is it Important to Follow the ISO 17024 Process for Certified Commissioning Professionals?

Providing commissioning service involve a broad knowledge set of building systems from mechanical and plumbing to lighting systems. Currently individual providing commissioning services 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.

CE262-16

CE263-16

IECC: 0, C408.2, C408.2.1, C408.2.4, C408.3.1.

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The committee preferred the superior language of CE262-16. The term introduced is not found in the other I-codes. The requirement to also be a professional engineer may be unnecessary in cases such as for the replacement of mechanical systems.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Eric Makela, representing Northwest Energy Codes Group (eric.makela@cadmusgroup.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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~~ that has been accredited by ANSI/ISO/IES 17024~~accredited agency~~, or hasnot less than two years experience in commissioning of projects of a similar scale and complexity and is a licensed professional engineer by the State.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:

Commenter's Reason: This Public Comment clarifies that the certification must be accredited by the ANSI/ISO/IEC 17024:2012 process and not the agency or organization that issues the certification. ANSI/ISO/IEC 17024:2012 is a standard that provides a process for developing professional accrediting programs. ISO 17204 ensures that applicants have the required knowledge, skills, and competencies for the job Following the ISO 17024 process ensures that an accrediting program is developed based on a certain rigor, very similar to the ICC certification exam development process. Several U.S. government agencies rely on accreditation to ISO 17024 to ensure the quality of personnel certification. Examples include the:

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Why is it Important to Follow the ISO 17024 Process for Certified Commissioning Professionals?

Providing commissioning service involve a broad knowledge set of building systems from mechanical and plumbing to lighting systems. Currently individual providing commissioning services 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.

Analysis: ANSI/ISO/IEC 17024-2012 was proposed for inclusion in the text proposed in code change proposal CE262-16. Copies of the standard were provided in accordance with CP28, paragraph 3.4. An analysis of the standard content with regard to CP#28 Section 3.6 can be found at http://media.iccsafe.org/codes/2015-2017/GroupB/CAH/Proposed-New-Standards-Analyses.pdf (http://media.iccsafe.org/codes/2015-2017/GroupB/CAH/Proposed-New-Standards-Analyses.pdf).

CE263-16

CE272-16 Part I

IECC: 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).

Proposed Change as Submitted

Proponent : Sean Denniston (sean@newbuildings.org)

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		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	≥ 4 Stories
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[g]	R-35ci	NA[g]	R-35ci
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[g]	R-30 + R-11 LS	NA[g]	R-30 + R-11 LS
Steel Truss ceiling[f]	R-38 or R-30+3ci or R-26+5ci		R-49 or R-38+3ci		R-49 or R-38+3ci		R-38+5ci		R-38+5ci		R-38+5ci		R-38+5ci		R-38+5ci	
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-49		R-49	
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-49	R-49	R-49	R-49
Walls, Above Grade																
Mass[j]	3/4	R-5.7ci[c]	4/6	R-7.6ci	8/13	R-9.5ci	8/13	R-11.4 ci	13/17	R-13.3 ci	15/20	R-15.2 ci	19/21	R-15.2 ci	19/21	R-25ci
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[g]	R-13+R-19.5ci	NA[g]	R-13+R-19.5ci
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+12.7ci or R-15+12.3ci or R-19+11.6ci or R-21+11.3ci or R-25+10.9ci	R-13+R-15.6 ci	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+R17.5ci
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 or R-21+5.9ci		R-0+14.0ci or R-13+7.7ci or R-15+7.1ci or R-19+6.3ci or R-21+5.9ci		R-0+14.0ci or R-13+7.7ci or R-15+7.1ci or R-19+6.3ci or R-21+5.9ci		R-13+11.5ci or R-15+10.9ci or R-19+10.1ci or R-21+9.7ci or R-25+9.1ci		R-13+11.5ci or R-15+10.9ci or R-19+10.1ci or R-21+9.7ci or R-25+9.1ci		R-13+11.5ci or R-15+10.9ci or R-19+10.1ci or R-21+9.7ci or R-25+9.1ci	
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+5 or R-13+10	R-13 + R-7.5ci or R-20 + R-3.8ci	R-20+5 or R-13+10	R13+R-15.6ci or R-20+R-10ci
Walls, Below Grade																
Below-grade wall[d, h]	NR	NR	NR	NR	5/13[l]	NR	10/13[l]	R-7.5ci	15/19[l]	R-7.5ci	15/19[l]	R-7.5ci	15/19[l]	R-10ci	15/19[l]	R-12.5ci

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-30	R-16.7 ci	R-30	R-16.7c i
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-30	R-38	R-30	R-38
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-30	R-30	R-30	R-30
Slab-on-grade floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 48" below	R-15 for 24" below	R-10 for 48" below	R-15 for 24" below	R-10 for 48" below	R-20 for 24" below
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 for 48" below	R-20 for 48" below	R-15 for 48" below	R-20 for 48" below

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	≥ 4 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	U-0.028
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		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		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]	U-0.061
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	U-0.039
Metal framed		U-0.077		U-0.064		U-0.064		U-0.064		U-0.064		U-0.057		U-0.052		U-0.045
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		U-0.036
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	C-0.092
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	U-0.051
Joist/framing		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
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]	F-0.40
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]	F-0.55

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			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	
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		0.32	0.29		0.32	
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		0.32	0.37		0.32	
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		0.32	0.77		0.32	
SHGC																							
Orientationa	**All**	**SEW**	**N**	**All**	**SEW**	**N**	**All**	**SEW**	**N**	**All**	**SEW**	**N**	**All**	**SEW**	**N**	All	**SEW**	**N**	**All**	**SEW**	**N**	**All**	**S**
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	0.53	NR	0.45	NR	NR	0
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	0.58	NR	NR	NR	NR	N
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	0.64	NR	NR	NR	NR	N
Opaque Doors																							
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		0.32	U-0.37		0.32	
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		0.55	0.5		0.55	
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	NR		NR	

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 thermal envelope shall be sealed to the drywall.	Recessed light fixtures installed in the 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 (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIR FLOW RATE MAXIMUM (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 thebuilding 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.

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

- Regulation by two different energy codes complicates both code compliance and code enforcement.
- Neither the Commercial nor the Residential code was crafted to address the unique characteristics of the multifamily building type.
- Advancing the energy code for multifamily is hindered by the necessity of pursuing changes simultaneously in two different codes, both of which are dominated by issues of building types other than multifamily.

- The presence of two different code baselines has made it very difficult to create above-code energy standards and efficiency programs that apply to all multifamily buildings.

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.

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.

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.

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.

Climate Zone	Representative City	High-Rise		Mid-Rise		Low-Rise	
		Ave. EUI Savings	Ave. EUI Savings	Net EUI Savings	Net EUI Savings	Ave. EUI Savings	Ave. EUI Savings
1A	Miami	0.0%	0.0%	0.0%	0.0%	1.5%	1.9%
1B	Riyadh	0.0%	0.0%	0.0%	0.0%	Zero Weights	Zero Weights
2A	Houston	0.0%	0.0%	0.0%	0.0%	1.9%	1.9%
2B	Phoenix	0.0%	0.0%	0.0%	0.0%	1.7%	2.8%
3A	Memphis	0.0%	0.0%	0.0%	0.0%	2.1%	1.9%
3B	El paso	0.0%	0.0%	0.0%	0.0%	1.9%	3.1%
3C	San_Francisco	0.0%	0.0%	0.0%	0.0%	1.9%	2.4%
4A	Baltimore	0.0%	0.0%	0.0%	0.0%	2.1%	2.8%
4B	Albuquerque	0.0%	0.0%	0.0%	0.0%	2.1%	2.7%
4C	Salem	0.0%	0.0%	0.0%	0.0%	2.1%	3.2%
5A	Chicago	0.0%	0.0%	0.0%	0.0%	2.2%	2.7%
5B	Boise	0.0%	0.0%	0.0%	0.0%	2.2%	2.1%
5C	Vancouver	0.0%	0.0%	0.0%	0.0%	Zero Weights	Zero Weights
6A	Burlington	0.0%	0.0%	0.0%	0.0%	2.7%	3.8%
6B	Helena	0.0%	0.0%	0.0%	0.0%	2.2%	4.1%
7	Duluth	0.0%	0.0%	0.0%	0.0%	2.2%	4.2%
8	Fairbanks	0.0%	0.0%	0.0%	0.0%	Zero Weights	Zero Weights
	Weighted Average	0.0%	0.0%	0.0%	0.0%	2.3%	2.9%

Climate Zone	Representative City	10-Story High-Rise	4-Story Mid-Rise	3-Story Mid-Rise	2-Story Mid-Rise
		EUI Savings	EUI Savings	EUI Savings	EUI Savings
1A	Miami	-3.0%	-4.3%	3.0%	3.0%
1B	Riyadh	2.8%	4.2%	4.7%	Zero Weights
2A	Houston	-3.5%	-4.9%	3.3%	2.7%
2B	Phoenix	-3.4%	-5.9%	3.5%	2.8%
3A	Memphis	-1.9%	-2.8%	3.2%	-3.3%
3B	El paso	-2.6%	-3.5%	4.0%	-2.9%
3C	San_Francisco	-3.0%	-3.9%	4.8%	-4.2%
4A	Baltimore	-1.4%	-2.4%	4.1%	-2.5%
4B	Albuquerque	2.2%	3.1%	3.5%	2.7%
4C	Salem	-2.3%	-2.9%	3.3%	-1.2%
5A	Chicago	-1.7%	-2.6%	2.4%	-2.1%
5B	Boise	2.1%	2.7%	3.3%	1.5%
5C	Vancouver	-2.0%	-2.5%	3.2%	Zero Weights
6A	Burlington	-0.4%	-0.6%	1.3%	-1.3%
6B	Helena	-0.8%	-1.0%	1.5%	-1.2%
7	Duluth	-0.8%	-1.3%	1.8%	-2.2%
8	Fairbanks	-1.6%	-2.0%	2.4%	Zero Weights
	Weighted Average	2.3%	2.7%	3.3%	2.3%

Climate Zone	Representative City	10-Story High-Rise		4-Story Mid-Rise		3-Story Mid-Rise	
		EUI Savings (Low Insulation)	EUI Savings (High Insulation)	EUI Savings (Low Insulation)	EUI Savings (High Insulation)	EUI Savings (Low Insulation)	EUI Savings (High Insulation)
1A	Miami	-2.7%	-4.0%	-1.0%	-1.5%	1.0%	1.0%
1B	Riyadh	-5.1%	-6.0%	-1.5%	-2.5%	Zero Weights	Zero Weights
2A	Houston	2.8%	2.7%	0.8%	0.8%	1.3%	0.8%
2B	Phoenix	-3.0%	-4.0%	-1.0%	-1.5%	1.0%	1.0%
3A	Memphis	-2.8%	-4.0%	-0.5%	-0.8%	0.5%	0.5%
3B	El paso	-1.5%	-2.0%	-0.5%	-0.8%	0.5%	0.0%
3C	San_Francisco	0.0%	1.0%	0.0%	0.0%	1.0%	0.0%
4A	Baltimore	2.8%	3.8%	0.5%	0.8%	1.0%	0.0%
4B	Albuquerque	1.3%	2.0%	0.5%	0.0%	1.5%	1.0%
4C	Salem	1.3%	2.1%	0.0%	0.0%	1.3%	0.0%
5A	Chicago	3.2%	4.0%	0.8%	0.8%	1.5%	1.0%
5B	Boise	-1.5%	-2.0%	0.0%	0.0%	0.5%	0.0%
5C	Vancouver	1.1%	2.1%	0.5%	0.8%	Zero Weights	Zero Weights
6A	Burlington	3.3%	4.3%	0.0%	0.0%	1.0%	1.0%
6B	Helena	-1.5%	-2.5%	-1.0%	-1.0%	1.0%	1.0%
7	Duluth	-1.8%	-2.4%	-1.5%	-2.5%	1.5%	0.0%
8	Fairbanks	2.5%	2.4%	0.0%	0.7%	Zero Weights	Zero Weights
	Weighted Average	-2.8%	-3.7%	-0.8%	-1.8%	1.0%	1.0%

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.

Cost Impact: 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 Part I : C501.1-DENNISTON13962

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: This proposal needs to be reworked and brought back. The code works now with the current division of Residential for 3 stories and less and Commercial for 4 stories and more with only one necessary cross reference for central mechanical systems. This proposal will create the need for many cross references between parts of the code. Industry has no issues with current code format. It is not clear what this proposal would accomplish because it does not address each building component based on the story level it is on. The traditional story designations have no known historical basis, yet they are continued in this proposal, perhaps missing an opportunity to address different types of buildings without categorizing them by number of stories.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Sean Denniston, New Buildings Institute, representing New Buildings Institute (sean@newbuildings.org); Steven Winter (sw@swinter.com) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

C101.2 Scope. This code applies to *commercial~~buildings~~* and *multifamily buildings* and the ~~buildings' sites~~*building sites,* and associated systems and equipment.

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~~ the IECC~~—Residential Provisions~~ for each occupancy.

C101.5 Compliance. *Residential buildings* shall meet the provisions of IECC—Residential Provisions. *Commercial ~~buildings~~* and *multifamily buildings* shall meet the provisions of IECC—Commercial Provisions.

SECTION 202 DEFINITIONS

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

COMMON AREA. For this code, all portions of a *multifamily building* that are not *dwelling units* or *sleeping units.*

MULTIFAMILY BUIDLING. For this code, all Group R-2 buildings.

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. The *alteration, repair, addition* and *change of occupancy* of existing *multifamily buildings* shall comply with Section C608.

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 C606.
3. The requirements of Section C607.

SECTION C602 BUILDING ENVELOPE REQUIREMENTS

C602.1 General. *Building* thermal envelope assemblies shall comply with the following:

1. The opaque portions of the *building* thermal envelope shall comply with Section C602.2.
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.

C602.2 Insulation requirements. The opaque portions of the thermal envelope of *multifamily buildings* with three or fewer stories above grade shall comply with Sections R402.1 and R402.2. The opaque portions of the thermal envelope of *multifamily buildings* with four or more stories above grade shall comply with Section C402.2 and Section C402.1.3, or Section C402.1.4, or Section C402.1.5.

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.

Exception: *Multifamily buildings* with three or fewer stories.

C602.4 Fenestration. *Multifamily buildings* with three or fewer stories above grade shall comply with Sections R402.3 and R402.5. *Multifamily buildings* with four or more stories above grade shall comply with Section C402.4.

C602.5 Air leakage-thermal envelope. The building thermal envelope of *multifamily buildings* with three or fewer stories above grade shall comply with R402.4. The building thermal envelope of *multifamily buildings* with four or more stories above grade shall comply with Section C402.5.

SECTION C603 BUILDING MECHANICAL SYSTEMS

C603.1 General. The following HVAC equipment serving only one zone in a single *dwelling unit* or *sleeping unit* and controlled by a single thermostat in the zone served shall comply with this section:

1. Unitary or packaged HVAC equipment listed in Tables C403.2.3(1) through C403.2.3(5)
2. Electric resistance heaters

All other mechanical systems and equipment serving the heating, cooling or ventilating needs of the *building* shall comply with Sections C403 and C408.2.

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), and C403.2.3(5) when tested and rated in accordance with the applicable test procedure.

C603.3 Controls. At least one thermostat shall be provided for each heating and cooling system.

C603.3.1 Programmable thermostat. The thermostat controlling the primary heating or cooling system serving a *dwelling unit* shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. 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 not higher than 70°F (21°C) and a cooling temperature set point not lower than 78°F (26°C).

C603.3.2 Heat pump supplementary heat. 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.

C603.4 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 and shall meet the requirements of C403.2.4.3 as applicable.

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.

TABLE C603.4.1
Mechanical Ventillation System Fan Efficiency

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIR FLOW RATE MAXIMUM (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 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. Supply and return ducts in other portions of the *building* shall be insulated to an R-value of not less than 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. Additional joint sealing is not required where air-impermeable spray foam products are applied to ducts.
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 not 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.

Exceptions:

1. Ducts and air handlers located entirely within the *building* thermal envelope.
2. Ducts in *multifamily buildings* that have four or more stories and that are built in accordance with C403.2.9.

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 required to be tested 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.

Exception: *Multifamily buildings* that are intended to comply with the code in accordance with the compliance path described in Item 3 of Section C601.2.

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 an R-value of not less than 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, Section C404.11, and Section C408.2.

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.

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 and maximum lighting power for interior applications of *dwelling units* and *sleeping units* shall comply with this section and Section C408.3. All other lighting system controls, maximum lighting power for interior and exterior applications and electrical energy consumption serving the building shall comply with Section C405 and Section C408.3.

Exception: Exterior lighting applications of multifamily buildings with three or fewer stories.

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 General. *Buildings* shall comply with at least one of the following:

1. More efficient HVAC performance in accordance with C606.2.
2. Reduced lighting power in accordance with Section C606.3.
3. Reduced air infiltration in accordance with Section C606.4
4. On-site supply of renewable energy in accordance with Section C606.5.
5. Enhanced envelope performance in accordance with Section C606.6.
6. High-efficiency service water heating in accordance with Section C406.7.

Exception: *Multifamily buildings* that have three or fewer stories.

C606.2 More Efficient HVAC Performance. HVAC equipment shall exceed the minimum efficiency requirements listed in Tables C403.2.3(1) through C403.2.3(4) by 10 percent, in addition to the requirements of Section C603. 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(4) shall be limited to 10 percent of the total building system capacity.

C606.3 Reduced lighting power. 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 exceed the efficacy (lumens per watt) of *high efficacy lamps* by not less than 10%.

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 ft^2 (25,000 m^2) of conditioned floor area shall be permitted to conduct air infiltration testing on representative above grade sections of the *building* provided that tested areas total not less than 25% of the conditioned floor area.

C606.5 Onsite renewable energy. The *building* shall be provided with an on-site supply of renewable energy in accordance with Section C406.5

C606.6 Enhanced Envelope Performance. The total UA of the building thermal envelope shall be not greater than eighty-five percent (85%) of the total UA of the building thermal envelope allowed in accordance with Section C602.1.4.

C606.6 Enhanced Water Heating Performance. Water heating shall be in accordance with Section C406.7.

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, C603.3, C603.5.2, C603.6, C603.4, C604 and C605 be met.

C607.3 Requirements. *Buildings* shall comply with one of the following:

1. Sections C407, C408.2 and C408.3, provided that the *building* has four or more stories. The *building* energy cost shall be equal to or less than 85 percent of the standard reference design building.
2. Section R405, provided that the *building* has three or fewer stories.
3. Section R406, provided that 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.

C608.1.1 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.

Exceptions: 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.

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.

C608.2.1 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 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.

Exception: Multifamily *buildings* with 3 or fewer stories.

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 C402.4.2 shall comply with Section C602.4. Additions that result in a total *building* skylight area exceeding that specified in Section C402.4.2 shall comply with Section C607.

Exception: Multifamily *buildings* with 3 or fewer stories.

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 Section 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 Section 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 not less conforming to the provisions of this code than the existing building or structure was prior to the alteration. Alterations to an existing building, building system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this code. Alterations shall not create an unsafe or hazardous condition or overload existing building systems.
Alterations complying with ANSI/ASHRAE/IESNA 90.1. need not comply with Sections C602, C603, C604 and C605.

Exception: The following alterations need not comply with the requirements for new construction, provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Surface-applied window film installed on existing single-pane fenestration assemblies reducing solar heat gain, provided 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 Section C602.2 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 C402.4.1 shall comply with Sections C602.4 and C401.2.1. Alterations that result in a total *building* vertical fenestration area exceeding that specified in Section C402.4.1 shall comply with Section C607.

Exception: *Multifamily buildings* with 3 or fewer stories.

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 C402.4.2 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.

Exception: *Multifamily buildings* with 3 or fewer stories.

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.

Commenter's Reason: This comment replaces the original CE272 proposal for clarity and ease of reading. The conceptual basis is essentially the same and the language is very similar.
During the Committee Action Hearings, testimony and committee members expressed concern that the proposal would have resulted in a change in stringency for some multifamily buildings. The improvements to the language in this comment makes more clear that the stringency impact of this comment will be minimal to none. The language has been improved by considerably simplifying it, especially the envelope section in C602, and by making it even clearer when provisions apply to low-rise multifamily buildings (3 stories or less) and when they apply to high-rise (4 stories or more).

During the hearings, some also expressed the opinion that there are no problems with the two different code baselines for multifamily in the current divided multifamily code, and that market confusion is not an issue. However, during the hearings, even Residential Committee members repeatedly demonstrated confusion about how to apply the code to R-occupancy buildings of various heights. This was a source of confusion and disagreement during the deliberation of multiple proposals in Louisville. If even committee members tasked with making decisions on code proposals struggled with application of the code, the problem is significant.

This Public Comment improves on the original proposal in several ways:

- The comment simplifies the original proposal in order to focus on three goals:
  - Improving clarity for applying the code by giving a clear road map for which code requirements from the residential and commercial sections apply to which multifamily buildings.
  - Simplifying the application to mixed-use buildings. Under the current code, it is not clear at what point the non-dwelling unit portions of multifamily buildings are considered a commercial occupancy. It is not clear at what point the addition of facilities like gyms, interior corridors, laundry facilities or even management offices constitute a mixed-use building. This structure makes it clear that newly-defined common areas are subject to the provisions of the commercial code (with the exception of envelope requirements, as those are building-wide measures based on total building height as in the current code).
  - Providing a framework for future code improvements that can be targeted to the unique needs of multifamily buildings rather than forcing multifamily buildings to fit in code frameworks developed primarily for commercial buildings and for single family homes. The framework creates a code structure so that references to residential and commercial provisions can be replaced with provisions tailored to multifamily buildings of all heights.
- **C602 Envelope:** The original proposal included an envelope section that was a hybrid of the commercial and residential requirements that apply to multifamily buildings. The resulting section was confusing, and gave the unintentional impression that stringency would be changed for some multifamily buildings. The comment replaces the code language with references to relevant envelope requirements for multifamily in the residential and commercial sections based on wether the subject building falls above or below the existing 3-story cutoff. This maintains the existing stringency status quo. The subsection structure is retained to allow the multifamily envelope section to be improved topic by topic in the future as provisions appropriate to multifamily buildings of all heights are developed. This approach will also ensure that the multifamily section remains in sync with whatever changes are made this code cycle to the commercial and residential envelope provisions.
- **C603.1 Mechanical:** The language has been improved for greater clarity. Section 603 applies to simple single zone packaged and unitary systems that serve individual dwelling and sleeping units. The language of 603 comes directly from the residential section as it is appropriate for these simple, residential-style applications. Multi-zone and central systems, as well as systems serving other portions of the multifamily building, are more complex and/or commercial-style and therefore directed to the commercial section and its more robust set of requirements. This mirrors what is currently required in the residential section where complex systems are referred to the commercial section in even low-rise multifamily buildings.
- **C605.1 Lighting:** The language has been improved for greater clarity in the same way as 603.1. Section 605 applies to the interior lighting of dwelling and sleeping units. The language of 605 comes directly from the residential section as it is appropriate for these residential-style applications. Exterior lighting, non-lighting electrical equipment and interior lighting in other portions of the building are all more commercial applications and are therefore directed to the commercial requirements.
- **C606 Additional Energy Efficiency Packages:** The section has been slightly restructured so that it provides a better framework for multifamily buildings. Each option from 606.1 has been given its own section instead of a simple reference to C406 provisions. This will allow the provisions to be more tailored to multifamily buildgins in the future.

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.

For example, Steven Winter Associates, Inc, a firm experienced in supporting multifamily buildings that fall under both residential and commercial code and a co-commentor on this comment attests:

> *This division in code has created a significant problem for the multifamily market. Not only do high performance building programs struggle with this split in code across this particular building type, it also affects the utilities that are trying to offer incentives to these building to achieve above-code energy savings. A multifamily building should not have its energy code requirements determined based on the number of stories. A 3 story multifamily building is not much different than a 4 story multifamily building, but each are subject to completely different sections of code. A 3 story building should also not be forced to follow the same requirements established for single family homes. This proposal brings about a much needed first step in creating a unified section in code that is dedicated to the growing multifamily sector. This change will positively impact multifamily building programs across the country and will enable future requirements to be developed that appropriately address this unique building type.*

This proposal and subsequent public comment isthe first step toward solving these problems by creating a single framework of requirements for all multifamily buildings and placing them in a dedicated chapter of the IECC.

If this comment is approved, 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

CE272-16 Part I

CE272-16 Part II

IECC-R R202 (New) [IRC N1106.1 (New)]

Proposed Change as Submitted

Proponent : Sean Denniston (sean@newbuildings.org)

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: 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.

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.

Cost Impact: 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 Part II :
R202 BUILDING-
DENNISTON13963

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: For commercial construction of multi-family residential occupancies, the identified "problem" is not actually a problem in the real world. Proponent indicated that the proposal was a work in progress. The requirements appear to be more stringent for the residential side and given that there was no cost data submitted, the cost impact statement of "will not increase the cost os construction" is not believable.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Sean Denniston, representing New Buildings Institute (sean@newbuildings.org) requests Approve as Submitted.

Commenter's Reason: This is the second part of a two-part comment that creates a single chapter for multifamily buildings in the commercial section of the code. All of the changes to the proposal are to the other part; therefore, this proposal only needs to be approved as originally submitted.

During the Committee Action Hearings, testimony and committee members expressed concern that this two-part proposal would have resulted in a change in stringency for some multifamily buildings. The improvements to the language in the comment to Part 2 addresses these issues by by making it more clear that the stringency impact of the comment will be minimal to none. The language has been improved by considerably simplifying it, especially the envelope section in C602, and by making it even clearer when provisions apply to low-rise multifamily buildings (3 stories or less) and when they apply to high-rise (4 stories or more).

During the hearings, some also expressed the opinion that there are no problems with the two different code baselines for multifamily in the current divided multifamily code, and that market confusion is not an issue. However, during the hearings, even Residential Committee members repeatedly demonstrated confusion about how to apply the code to R-occupancy buildings of various heights. This was a source of confusion and disagreement during the deliberation of multiple proposals in Louisville. If even committee members tasked with making decisions on code proposals struggled with application of the code, the problem is significant.

The Public Comment improves on the original proposal in several ways:

- The comment simplifies the original proposal in order to focus on three goals:
-
  - Improving clarity for applying the code by giving a clear road map for which code requirements from the residential and commercial sections apply to which multifamily buildings.
-
  - It also improves clarity by simplifying the application to mixed-use buildings. Under the current code, it is not clear at what point the non-dwelling unit portions of multifamily buildings are considered a commercial occupancy. It is not

clear at what point the addition of facilities like gyms, interior corridors, laundry facilities or even management offices constitute a mixed-use building. This structure makes it clear that newly-defined common areas are subject to the provisions of the commercial code (with the exception of envelope requirements, as those are building-wide measures based on total building height as in the current code).

-
  - Providing a framework for future code improvements that can be targeted to the unique needs of multifamily buildings rather than forcing multifamily buildings to fit in code frameworks developed primarily for commercial buildings and for single family homes. The framework creates a code structure so that references to residential and commercial provisions can be replaced with provisions tailored to multifamily buildings of all heights.

- **C602 Envelope:** The original proposal included an envelope section that was a hybrid of the commercial and residential requirements that apply to multifamily buildings. The resulting section was confusing, and gave the unintentional impression that stringency would be changed for some multifamily buildings. The comment replaces the code language with references to relevant envelope requirements for multifamily in the residential and commercial sections based on wether the subject building falls above or below the existing 3-story cutoff. This maintains the existing stringency status quo. The subsection structure is retained to allow the multifamily envelope section to be improved topic by topic in the future as provisions appropriate to multifamily buildings of all heights are developed. This approach will also ensure that the multifamily section remains in sync with whatever changes are made this code cycle to the commercial and residential envelope provisions.
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- **C605.1 Lighting:** The language has been improved for greater clarity in the same way as 603.1. Section 605 applies to the interior lighting of dwelling and sleeping units. The language of 605 comes directly from the residential section as it is appropriate for these residential-style applications. Exterior lighting, non-lighting electrical equipment and interior lighting in other portions of the building are all more commercial applications and are therefore directed to the commercial requirements.
- **C606 Additional Energy Efficiency Packages:** The section has been slightly restructured so that it provides a better framework for multifamily buildings. Each option from 606.1 has been given its own section instead of a simple reference to C406 provisions. This will allow the provisions to be more tailored to multifamily buildgins in the future.

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.
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- 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.

For example, Steven Winter Associates, Inc, a firm experienced in supporting multifamily buildings that fall under both residential and commercial code and a code commentor on the partner comment attests:

> *This division in code has created can attest to the significant problem. Not only do high performance building programs struggle with this split in code across this particular building type, it also affects the utilities that are trying to offer incentives to these building to achieve above-code energy savings. A multifamily building should not have its energy code requirements determined based on the number of stories. A 3 story multifamily building is not much different than a 4 story multifamily building, but each are subject to completely different sections of code. A 3 story building should also not be forced to follow the same requirements established for single family homes. This proposal brings about a much needed first step in creating a unified section in code that is dedicated to the growing multifamily sector. This change will positively impact multifamily building programs across the country and will enable future requirements to be developed that appropriately address this unique building type.*

The proposal and subsequent public comment will solve these problems by creating a single framework of requirements for all multifamily buildings and placing them in a dedicated chapter of the IECC.

If the comment is approved, 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
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- Multifamily code issues will no longer complicate the development of the Residential and Commercial codes

CE272-16 Part II

CE273-16
IECC: C101.2, C501.1.

Proposed Change as Submitted

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.
Exception: Buildings occupied not more than 100 hours per year shall not be required to comply with this code.

C501.1 Scope. The provisions of this chapter shall control the *alteration*, *repair*, *addition* and change of occupancy of existing buildings and structures.
Exception: Buildings occupied not more than 100 hours per year shall not be required to comply with this chapter.

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This does not increase energy efficiency and creates a loophole for certain owners. Such exceptions should be based on the energy consumption of the building, not the extent of occupancy..

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C501.1 Scope. The provisions of this chapter shall control the *alteration*, *repair*, *addition* and change of occupancy of existing buildings and structures.
Exception: Buildings occupied not more than 100 hours per year, as verified by the *code official*, shall not be required to comply with this chapter.

C101.2 Scope. This code applies to *commercialbuildings* and the buildings' sites and associated systems and equipment.
Exception: Buildings occupied not more than 100 hours per year, as verified by the *code official*, shall not be required to comply with this code.

Commenter's Reason: This modification will ensure that only those buildings that are verified by the code official as being occupied less than 100 hours per year are granted this exception. The new language will prevent any gaming of the code.

CE273-16

CE275-16 Part I
IECC: C501.6.

Proposed Change as Submitted

Proponent : Hope Medina (hmedina@coloradocode.net)

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.

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 Part I : C501.6-MEDINA13714

Public Hearing Results

Part I

Committee Action: **Disapproved**

Committee Reason: This proposal has problems regarding who reports to who and how the identified parties report to each other. Not all states have licensed contractors. The term "fabric" was not included in item # 1 as it is in item # 2.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Hope Medina, representing self (hmedina@coloradocode.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 that ~~one of the following applies:~~

~~1. A~~ a report has been submitted ~~to the code official and signed by the owner and a registered *design professional*~~, demonstrating ~~that compliance with that provision~~ what energy conservation modifications 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, a licensed contractor responsible for the work can 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 fore 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~~ report shall be obtained from the State Historic Preservation Office, or when applicable, the jurisdictional historic preservation authority ~~having jurisdiction provides documentation~~ , by the building owner or the building owner's authorized agent. The report shall be submitted with the construction documents 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~~ as part of the ~~building~~ application for permit process.

Commenter's Reason: During the committee hearings some enforcement and conflicts were brought to light. This public comment addresses these issues.
Historical buildings can be a difficult situation for those involved to gain complete compliance with the Energy code, but there are requriements that can be obtained. This proposal gives the flexability that some historical building require, with the understanding that there are still reqruiements that can be obtained.

CE275-16 Part I

CE275-16 Part II
R501.6 (IRC N1107.6)

Proposed Change as Submitted

Proponent : Hope Medina (hmedina@coloradocode.net)

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~~ 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, a licensed contractor responsible for the work can 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 ~~*building*~~ *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.

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 Part II :
R501.6-
MEDINA13715

Public Hearing Results

Part II

Committee Action: **Approved as Submitted**

Committee Reason: This language provides good guidance for rehabilitation of existing buildings and clarifies the chain of command between agencies.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Hope Medina, representing self (hmedina@coloradocode.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 that ~~one of the following applies:~~

~~1. A~~ a report has been submitted ~~to the code official and signed by the owner and a registered *design professional*,~~ demonstrating ~~that compliance with that provision~~ what energy conservation modifications 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, a licensed contractor responsible for the work can 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~~ report shall be obtained from the State Historic Preservation Office, or when applicable the jurisdictional historic preservation authority ~~having jurisdiction provides documentation~~ , by the building owner or the building owner's authorized agent. The report shall be submitted with the construction documents 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~~ code official as part of the ~~building.~~ application for permit process

Commenter's Reason: During the committee hearings some enforcement and conflicts were brought to light. This public comment addresses these issues.
Historical buildings can be a difficult situation for those involved to gain complete compliance with the Energy code, but there are requriements that can be obtained. This proposal gives the flexability that some historical building require, with the understanding that there are still reqruiements that can be obtained.

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

Commenter's Reason: CE275 came to the attention of SEHPCAC because of the inconsistency of action between the Commercial and Energy Code Development Committees. A key goal of the SEHPCAC is to minimize inconsistency between the two halves of the IECC where the same topic is being addressed. SEHPCAC also opposed this proposal at the Louisville hearings.

The SEHPCAC agrees with the Commercial Energy Committee reason for disapproval of Part I. This is not the proper approach to historic buildings. It doesn't establish proper authority roles for each play. There may be proposals submitted to try to improve this text, but the existing proposal is seriously flawed and needs to be disapproved.

In this case the SEHPCAC feels the best way to achieve consistency between IECC code halves is to disapprove Part II of CE275.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

CE275-16 Part II

CE277-16

IECC: C202, C503.1, C503.7 (New).

Proposed Change as Submitted

Proponent : Sean Denniston (sean@newbuildings.org)

2015 International Energy Conservation Code

Add new definition as follows:

LEVEL 3 ALTERATION An *alteration* where the *work area* exceeds 50 percent of the building area.

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 except as required by Section C503.7. *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:

C503.7 Level 3 alterations. *Buildings* undergoing *Level 3 alterations* shall comply with not less than two of the following:

1. The *building* thermal envelope shall comply with the requirements for "Walls, Above Grade" in Table C402.1.4.
2. The *building* thermal envelope shall comply with the requirements for "Roofs" in Table C402.1.4.
3. Fenestration shall comply with Table C402.4.
4. Where the *building* meets the conditions of Section C402.4.2.1, the *building* shall comply with Section C402.4.2.1.
5. The *building* shall comply with the air leakage testing requirement of Section C402.5.
6. The *building* shall comply with Section C403.2.9.
7. Where the *building* meets the conditions of Section C403.4.5, it shall comply with Section C403.4.5 without exceptions.
8. The *building* shall comply with Sections C405.2 and C405.3.
9. The *building* shall comply with Section C406.2.
10. The *building* shall comply with Section C406.3.
11. The *building* shall comply with Section C406.4.
12. The *building* shall comply with Section C406.5.
13. The *building* shall comply with Section C406.6.
14. The *building* shall comply with Section C406.7.

Exception: *Buildings* that demonstrate a 5 percent improvement of energy performance over the pre-alteration conditions using Section C407 or another *approved* method.

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: There is concern about how to comply with this text when the building element is outside of the work area. How far should the text be applied beyond the work area, such as for HVAC systems? The text refers to buildings, but should apply only to the work area. The list of options gives the illusion of increased energy savings, when such savings are not actually realized. Alterations may not actually involve the walls and ceiling even though the options refer to such elements.

Assembly Action: **None**

Public Comment 1:

Proponent : Sean Denniston, representing New Buildings Institute (sean@newbuildings.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

SECTION C202 DEFINITIONS

Work area
That portion or portions of a building consisting of all reconfigured spaces as indicated on the construction documents. Work area excludes other portions of the building where incidental work entailed by the intended work must be performed and portions of the building where work not initially intended by the owner is specifically required by this code.

C503.7 Level 3 alterations. In~~*Buildings*~~ *buildings* undergoing *Level 3 alterations,* the~~*Level 3 alterations*~~ *work area* shall comply with not less than two of the following:

1. The ~~*building*~~ *work area* thermal envelope shall comply with the requirements for ~~"~~ "Walls, Above Grade" in Table C402.1.4.
2. The *work area*~~*building*~~ thermal envelope shall comply with the requirements for "Roofs" in Table C402.1.4.
3. Fenestration in the *work area* shall comply with Table C402.4.
4. Where the *work area*~~*building*~~ meets the conditions of Section C402.4.2.1, the *work area*~~*building*~~ shall comply with Section C402.4.2.1.
5. The ~~*building*~~ *work area* shall comply with the air leakage testing requirement of Section C402.5.
6. The *work area*~~*building*~~ shall comply with Section C403.2.9.
7. Where the *work area*~~*building*~~ meets the conditions of Section C403.4.5, it shall comply with Section C403.4.5 without exceptions.
8. The *work area*~~*building*~~ shall comply with Sections C405.2 and C405.3.
9. The ~~*building*~~ *work area* shall comply with Section C406.2.
10. The ~~*building*~~ *work area* shall comply with Section C406.3.
11. The ~~*building*~~ *work area* shall comply with Section C406.4.
12. The ~~*building*~~ *work area* shall comply with Section C406.5.
13. The ~~*building*~~ *work area* shall comply with Section C406.6.
14. The ~~*building*~~ *work area* shall comply with Section C406.7.

Exception: *Buildings* that demonstrate a 5 percent improvement of energy performance over the pre-alteration conditions using Section C407 or another *approved* method.

Commenter's Reason: The primary concern expressed by the committee members and testimony during the hearings was over the scope of the requirements. In the original proposal, the entire building would have had to meet the requirements, regardless of the boundaries of the work area of the alteration. In order to address this concern, this public comment changes the boundary so that only the work area is subject to the requirement. It also adds the definition of "work area" from the International Existing Buildings Code.
The result is that the revised code language captures large (Level 3 as defined by the IEBC) alteration projects that are configured in a way that avoids triggering the energy code provisions. This new provision would ensure that all large alteration projects make energy improvements within the work area.

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 beyond. Even in large-scale alterations, it is possible to avoid triggering most or even all of the energy code provisions 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.

CE277-16

CE287-16
IECC: C503.3.1.

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This text needs to defer to the AHJ for determination or should specify a minimum R-value. The exception could be used as justification to do nothing to improve the roof insulation.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Wanda Edwards, RCI, Inc., representing RCI, Inc. (wedwards@rci-online.org); Jason Wilen AIA CDT RRO, representing National Roofing Contractors Association (NRCA) (jwilen@nrca.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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, where approved by the code official.

Commenter's Reason:

EDWARDS: The committee reason for disapproval was that the AHJ should have authority to specify the required R-value. By adding the that the AHJ would have to approve the use of the exception gives the authority to the code official for use of the exception and allows designers to provide information to the code official to decide whether to allow the exception. This would allow the use of the exception but with the approval of the AHJ.

WILEN: In response to concerns raised by The Commercial Energy Conservation Committee, we have added "When approved by the code official" to our original proposed language. Several members of the committee, as well as some of those speaking in opposition to this change, indicated they would be in support of the proposal with the added text.

CE287-16

CE289-16
IECC: C503.3.4 (New).

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposal adds complexity and sends the user outside of the code to the ASHRAE Handbook.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Mike Fischer, Kellen, representing the Plastic Glazing Coalition of the American Chemistry Council (mfischer@kellencompany.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 and the UA calculation shall be performed in accordance with Section C402.1.5.

Commenter's Reason: The proposal is intended to provide a prescriptive option for the inclusion of skylights as part of a roof replacement project as an alternative to compliance in accordance with Table C402.4. The proposal would require the combined roof and skylight area to have a UA equivalent to the opaque requirements for the roof area without skylights in order to use this option. It retains the current SHGC requirement in Table C402.4.
The IECC-C Committee recommended use of the UA calculation in the ***component performance alternative*** in Section C402.1.5; the public comment removes the reference to the ASHRAE book of fundamentals and replaces it with a reference to the UA option in C402.1.5.

CE289-16

CE290-16

IECC: C503.4.2 (New), C503.5.1 (New), C503.6.1 (New).

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This will add cost and delays to jobs and is not needed for small duct extensions. The thresholds are too low for some small alterations. The proposed sections need thresholds for applicability.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Sean Denniston, representing New Buildings Institute (sean@newbuildings.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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,~~ controls that serve them shall comply with Sections C408.2.2, C408.2.3 and C408.2.5.

Exceptions: The following systems are exempt:

1. Mechanical systems where the capacity of the total alteration of mechanical systems is less than 480,000 Btu/h (140.7 kW) cooling capacity or 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.*

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,~~ controls that serve them shall comply with Sections C408.2.2, C408.2.3 and C408.2.5

Exception: Service hot water systems where capacity of the total alteration of combined service water-heating and space heating systems is less than 600,000 Btu/h (175.8 kW).

C503.6.1 Commissioning. New lighting system components that are part of the alteration and the ~~existing systems to which they are connected~~ accesible components of the controls that serve them shall comply with Section C408.3.

Exception: Lighting systems where the power of the total alteration of connected lighting systems is less than 20 kW.

Commenter's Reason: During the Committee Action Hearings, to concerns with the original proposal were expressed in testimony and by the committee members:

- The requirement for commissioning did not have a size threshold
- It would be difficult to comply with this for portions of the existing system that may still be inaccessible.
- A small change to a system could trigger the commissioning of the entire system

This public comment addresses all of those concerns. It includes the same size threshold that is in the commissioning requirements for new construction and applies that threshold to the alteration instead of the building and also maintains the same exceptions. It also includes a provision limiting the requirements to only the new equipment and the controls serving the altered system and not the whole system.

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 clearly require that new equipment that is part of an alteration be commisssioned in accordance with Section 408. This proposal fixes that language. It also goes a step further and uses the equipment replacement to ensure that at least the controls serving the new equipment in the alteration are propery commissioned and functional. 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.

CE290-16

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).

Proposed Change as Submitted

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 (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 controls	If wattage is proposed to be increased then compliance should be 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			These projects are not ordinarily filed, and given the difficulty of demonstrating compliance for exterior lighting (see above) demonstrating compliance with

Reballast / relamp existing luminaire(s) with ≤ 10% increase in connected lighting power across the site		Lighting power and controls	current code would be a significant administrative burden for these small projects.
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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This text needs work as stated by the opponents and the proponent. The conflict referred to in the reason statements regarding the exception 7 of Section C503.1 and the exception to C503.6 is not evident. Proposed Section C503.6.1 would trigger changes to the lighting system even though such lighting is not affected by the alteration. The exception to proposed Section C503.6.2 is a "give-away" because the percentage is too low and would be hard to verify.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

~~**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**~~ **C503.6.1 Alteration of interior lighting power.** *No change to text.*

~~**C503.6.3**~~ **C503.6.2 Alteration of exterior lighting power** *No change to text.*

~~**C503.6.4**~~ **C503.6.3 Interior lighting controls** *No change to text.*

~~**C503.6.5**~~ **C503.6.4 Exterior lighting controls** *No change to text.*

Commenter's Reason:

1. Exception 7 to Section C503.1 allows up to 50% of luminaires in an altered space to be replaced provided there is no increase in installed lighting power. The Exception to Section C503.6 allows only 10% of luminaires to be replaced in an altered space provided there is no increase in installed lighting power. There is a clear discrepancy between 10% and 50%. Is the limit 10 or 50? This proposal eliminates both and provides a single exception.
2. The code development committee felt that Section C503.6.1 was too onerous. It is unclear what is the 'reconfigured' space. If, for example 5% of a large open office is made into a private office, it would seem that this section would require all 100% large office to be provided with complying lighting systems. Our modification removes the section. The remaining provisions adequately address where the revisions are happening.
3. The enforcement of the lighting provisions proposed here can be conducted in the same way as lighting provisions for new construction – plan review and field inspection. It is no more or less difficult.

While we believed the 20% exception is a good compromise between the 10 and 50% in the current code, we anticipate other public comments to address the change in percentage. Our public comment addresses the key concerns of the committee and makes the provision a reasonable approach to remodeling lighting systems.

This public comment 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 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

CE291-16

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).

Proposed Change as Submitted

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

a. Excluding places of religious worship.

b. Excluding laboratories.

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

a. Excluding courtrooms.
b. Excluding food sales.
c. Excluding laboratories.

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, Apartments, Residential Care/Assisted Living,Warehouse and Storage	13-31	A-3-Courtrooms, B, I-1, I-3, M, R-1, R-2, R-4, 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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproval is necessary to encourage the proponent to address all of the "fixes" that have been identified. There is concern for upgrading the efficiency requirements for systems that are not touched in existing buildings. There is concern for some occupancies falling through the cracks. There is concern for the increase in demand for fossil fuel that may no longer be addressed by the proposal. This text belongs in Section C406 based on occupancy type rather than based on a change in use. Some changes of occupancy may not trigger anything. The proposal needs to include all affected occupancies.

Assembly Action: **None**

Public Comment 1:

Proponent : Jennifer Senick, representing Rutgers University, Center for Green Building (jsenick@rutgers.edu) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

C505.1 General. Spaces undergoing a change in occupancy from ~~a~~ or to an F,H or U occupancy ~~to any other occupancy classification~~ shall comply with this code. Other spaces undergoing a change of occupancy shall comply with Sections C505.2 and C505.3. *Alterations* made concurrently with ~~the~~ any change of occupancy shall be in accordance with Section C503.

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~~ rank or results in the same energy intensity rank 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~~ rank or results in the same energy intensity rank 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 Rank ~~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-3, R-4
3. Low	A-3-Places of Religious Worship, R-1, R-2, S-1, S-2

a. Excluding places of religious worship.
b. Excluding laboratories.
c. Buildings three stories or less in height above grade plane shall comply with Section R505.

C505.3.2 Lighting Where the change of occupancy or use results in an increase in energy intensity ~~classifcation~~ rank or results in the same energy intensity rank 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.
.

TABLE C505.3.2
Lighting

Energy Intensity Rank ~~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-3[d], R-4, S-1, S-2
3. Low	A-1, A-3[a], A-4, E

a. Excluding courtrooms.
b. Excluding food sales.
c. Excluding laboratories.
d. Buildings three stories or less in height above grade plane shall comply with Section R505.

C505.3.3 Service Water Heating. Where the change of occupancy or use results in an increase in energy intensity ~~classification~~ rank or results in the same energy intensity rank 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 Rank~~Classification~~	**IBC Occupancy Classifcation and Use**
1. High	A-2, I-1, I-2, R-1, R-3[a], R-4
2. Low	All other occupancies and uses

a. Buildings three stories or less in height above grade plane shall comply with Section R505.

Commenter's Reason: PROPOSAL CE-292, A sensible approach to the change of occupancy requirements in the IECC.

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 difficult to enforce (Clinton et al, 2016). One reason is that there is no simple compliance evaluation method other than energy modeling, which is an unnecessary burden and beyond the capabilities of most permit applicants. As depicted in our survey findings and community-based pilot research, building officials often require energy efficiency equipment upgrades, such as lighting or HVAC, in buildings undergoing a change of occupancy. This proposal seeks to provide clarity to that approach by providing a simple breakdown of energy intensity by building occupancy type.

The proposed code change draws on a tradition of rehabilitation "smart codes," uses lookup tables, is more consistent with the intent of the IECC, presents no cost increase, and incorporates extensive stakeholder input.

This proposal uses energy intensity/square foot as the metric for energy demand and the trigger for code compliance. Specifically, the proposal is based on national databases that document energy usage in real buildings: the Commercial Buildings Energy Consumption Survey (CBECS) and the Building Performance Database (BPD) for commercial buildings, Residential Energy Consumption Survey (RECS) for residential buildings, and the Manufacturing Energy Consumption Survey (MECS) for industrial buildings. These databases make it possible to rank building occupancies in the order of their energy intensities. 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 in order to align with the current breakdown of IECC requirements: space conditioning, lighting, and water heating. This makes it possible to trigger code compliance of specific sections of the IECC when there is no decrease in intensity for the use regulated by those sections.

There are exceptions to these requirements: 1) an applicant can demonstrate, with analysis, that a specific change will not impact energy intensity, 2) small buildings or spaces. Tables have been developed for each end use that group occupancy classifications in descending order from high to low energy intensities. (Tables 1-3). Since F, H and U buildings are not designed primarily for occupant comfort and safety, it was decided that a change from or to F, H or U to any other occupancy

should comply with the code. When occupancy is being changed either from one energy intensity rank to a higher energy intensity rank or remains within the same energy intensity rank, this proposal would require that specific end-use to comply with the code.

Table 1. Change of Occupancy Scale for Space Conditioning

Table 1. Change of Occupancy Scale—Space Heating, Cooling, and Ventilation

Energy Intensity Rank	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 Public Order and Safety, Office, Service, Health Care (outpatient), Retail, Residential Care/Assisted Living	34-75	A-1, A-3, A-4, A-5, B, E, I-1, I-3, M, R-3, 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 for Lighting

Change of Occupancy Scale—Lighting

Energy Intensity Rank	CBECS Building Type	EI Range kBTU/sq.ft	IBC Occupancy 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, Apartments, Residential Care/Assisted Living, Warehouse and Storage	13-31	A-3-Courtrooms, B, I-1, I-3, M, R-1, R-2, R-3, R-4, 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 for Water Heating

Change of Occupancy Scale—Water Heating

Energy Intensity Rank	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-3, R-4
2. Low	All the rest	0-15	All the rest

Bibliography: Clinton J. Andrews, David Hattis, David Listokin, Jennifer A. Senick, Gabriel B. Sherman & Jennifer Souder (2016): Energy-Efficient Reuse of Existing Commercial Buildings, *Journal of the American Planning Association.* doi. 10.1080/01944363.2015.1134275

CE292-16

CE293-16
IECC: CA101.1 (New).

Proposed Change as Submitted

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 (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-PETRIE11953

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposal needs more work and should be brought back in a public comment. The proposal does not indicate that the energy generated is used by the building or the site.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Kathleen Petrie, representing Seattle Department of Construction and Inpsections (kathleen.petrie@seattle.gov) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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~~ Btu 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 renewable energy generation required this section shall be in addition to that required by Section ~~C406~~ C406.5.

Exception: ~~Approved~~ One additional energy efficiency package option selected from the list in Section C406.1 is an alternative ~~approaches that~~ to ~~achieve~~ the on-site renewable energy ~~requirements~~ system required by this section.

Commenter's Reason:

This exception provides an alternate but comperable path toward achieving a reduction in building energy use when the installation of a renewable on-site energy system is not a viable option. In cases where shadow projection or roof obstructions become a hinderance, this revision allows for design flexibility. In addition, by pointing back toward the code, the code official is no longer in the position of having to determine if the alternate path is equal to the original renewable requirement

CE293-16

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).

Proposed Change as Submitted

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-CAIN13525

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: The proposal provides guidance for those who want solar-ready guidance.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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 (1.524 m) 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~~-~~ other roof mounted equipment.

XA103.5 Roof loads and documentation. A collateral dead load of not less than 5 pounds per square foot (5 psf) (24.41 kg/m^2) 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, or space heating system.

Commenter's Reason: The proposed modifications provide clarification for some of the sections, and provides the addition that solar thermal energy can be used for space heating as well as water heating in a building.

CE294-16

CE296-16
IECC: C405.7 (New).

Proposed Change as Submitted

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

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: There is safety concern for the increased use of extension cords and relocatable power taps and the overloading of circuits. Users will connect all loads to the one receptacle that remains powered. There is no requirement for the distribution of receptacle outlets in office spaces.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Marilyn Williams, NEMA, representing National Electrical Manufacturers Association (mar_williams@nema.org) requests Approve as Submitted.

Commenter's Reason: Rationale:
Research of controlled receptacles impact on energy conservation shows overwhelmingly the benefit of their use. No adverse safety impact was noted in any of the studies listed below. Besides, the NEC mandates overcurrent protection that would preclude overloading any branch circuit.

Examples include

1. A CASE initiative study utilized for the CA T24-2013 inclusion of receptacle control found:
2. Smaller, 10,000 sqft office buildings, annual electrical savings was 4,900kwh/yr and a demand savings of 1.97kw. Based on installed costs and utilization of lighting control system elements already installed to support the plug load control, simple payback was 4.2 years.
3. Larger 175,000 sqft office building, annual electrical savings was 107,000kwh/yr and demand savings of 23.6kw with a simple payback calculated at 2.4 years
4. Miscellaneous Energy Loads in Buildings report number A133 of June 2013 by ACEEE extensively studied the growing energy consumption and demand which receptacle loads will play in the future as other energy efficiency of lighting, HVAC, envelope continues to be driven down by codes and advancement in technology. It states "After space conditioning, MELS are the biggest category of energy use in buildings."..."For instance, saving 50% of the energy from MELSs is approximately equivalent to eliminating U.S. oil imports from the Middle East." Regardless of the known benefits of receptacle control requirements in ASHRAE 90.1, California Title 24 and the state of Washington code, the IECC has no requirements to address this growing energy consumption category. Proven receptacle control technologies and payback should be implemented if it is to address this growing energy consumption category. The study highlights a move to more efficient products on the market would make a substantial impact, yet building energy efficiency codes are limited in driving consumer purchases and overcoming first costs of less efficient products in many cases. Therefore receptacle control is a safety net for efficiency and reduces energy consumption on efficient and less efficient receptacle powered devices alike.
5. GSA Green Proving Ground Program study conducted in 8 buildings with monitored receptacle control through market available plug strips found "Results underscored the effectiveness of schedyukle-based functionality, which reduce plug loads at workstations by 26%, even through advanced computer power management was already in place, and nearly 50% in printer room and kitchens." In the study buildings Receptacle loads averaged 21% of building energy use and monitored more than 295 devices over three different test periods to validate the findings. It found payback through timer scheduled control of kitchens of 0.7 years, printer rooms of 1.1 years and miscellaneous devices in 4.1 years. At workstations, payback was 7.8 years.
6. Study done on "office Space Plug Load Profiles and Energy Savings Interventions" at the University of Idaho and presented at the ACEEE summer Study in 2012 found that average savings of 0.60 kWh/SF Yr with plug strip control interventions. This study provided guidance for utility programs to assist with development of plug load efficiency measures and was based on a more detailed report, "Plug Load Profiles" (Acker, B. et. al. 2012)
7. The DOE Better Buildings program issued a December 2015 "Decision Guides for Plug and Process Loads Controls" to help educate and guide decision processes for effective receptacle based load control. It highlights that "Plug and Process Loads" account for 33% of the total energy consumed by commercial buildings. It sites seven decision strategies including that of Integrated plug load controls with other building systems as one of the largest for energy savings across most building types for whole-building retrofit and new construction categories.

CE296-16