CE2D-2-23

Original Proposal

IECC CE: SECTION 202

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

SUBSTANTIAL IMPROVEMENT. Any *repair*, reconstruction, rehabilitation, *alteration*, *addition* or other improvement of a *building* or structure, the cost of which equals or is more than 50 percent of the market value of the structure before the improvement. Where the structure has sustained substantial damage, as defined in the International Building Code, any repairs are considered *substantial improvement* regardless of the actual *repair* work performed. *Substantial improvement* does not include the following:

1. Improvement of a building <u>ordered by the *code official*</u> ~~required~~ to correct health, sanitary or safety code violations~~ordered by the *code official*~~.
2. *Alteration* of a *historic building* where the *alteration* will not affect the designation as a *historic building*.

Reason: Edited for clarity.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Editorial.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The proponent is correct that the existing sentence structure implies the code official may have ordered the violations.

Final Hearing Results

CE2D-2-23	AS

CE2D-4-23

Original Proposal

IECC CE: 202 (New)

Proponents: Daniel Carroll, New York State, Department of State (daniel.carroll@dos.ny.gov); Hendrik Shank, NYS Dept. of State, NYS Dept. of State (hendrikus.shank@dos.ny.gov)

2024 International Energy Code[CE Project] R3

Revise as follows:

202 . 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~~ measured on a scale from 0 to 1, where a value of 1 indicates perfect release of thermal radiation.

Reason: Possible Errata: This definition was changed in the residential provisions and should be coordinated in the commercial provisions.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial Coordination/Errata

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies definition and correlates with proposal passed at IECC-R.

Final Hearing Results

CE2D-4-23	AM

CE2D-5-23

Original Proposal

IECC CE: SECTION 202

Proponents: Eric Tate, Atmos Energy, Atmos Energy (eric.tate@atmosenergy.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

HIGH-CAPACITY GAS-FIRED WATER ~~HEATER~~HEATERS. Gas-fired instantaneous water heaters listed to CSA/ANSI Z21.10.3 and having input ratings with a rated inputgreater than 200,000 Btu/h (58.6 kW). and not less than 4,000 Btu/h per gallon (310 W per litre) of stored water~~,~~. ~~and~~ Also, gas-fired storage water heaters with a rated input both greater than 105,000 Btu/h (30.8 kW) and less than 4,000 Btu/h per gallon (310 W per litre) of stored water.

Reason: This definition should be fully consistent with North American consensus standards (Z21.10.3) and not impose the proposed additional requirements that would restrict product availability.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The definition language is clarifying and for consistency with available listed water heating products.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Provide clarification for definition.

Final Hearing Results

CE2D-5-23 AM

CE2D-7-23

Original Proposal

IECC CE: TABLE C402.1.3

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

TABLE C402.1.3 OPAQUE BUILDING 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 buildings[b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-25 + R-11 + 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-49	R-49	R-49	R-49	R-49	R-49	R-60	R-60	R-60	R-60
Walls, above grade																
Mass[f]	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-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-17ci	R-13 + R-19.5ci	R-13 + R-19.5ci	R-13 + R-19.5ci
Metal framed[h,i]	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-15.2ci or R-13 + R-10ci or R-20 + R-9ci	R-0 + R-15.2ci or R-13 + R-10ci or R-20 + R-9ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-21ci or R-13 + R-15.6ci or R-20 + R-14.3ci	R-0 + R-24ci or R-13 + R-18.8ci or R-20 + R-17.5ci	R-0 + R-24ci or R-13 + R-18.8ci or R-20 + R-17.5ci
Wood framed and other[h,i]	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 +R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 + R-27.5ci or R-13 + R-18.8ci or R-20 + R-14ci	R-0 + R-27.5ci or R-13 + R-18.8ci or R-20 + R-14ci
Walls, below grade																
Below-grade wall[d]	NR	NR	NR	NR	NR	NR	R-7.5ci	R-10ci	R-7.5ci	R-10ci	R-10ci	R-15ci	R-15ci	R-15ci	R-15ci	R-15ci
Floors																
Mass[e]	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-14.6ci	R-16.7ci	R-14.6ci	R-16.7ci	R-16.7ci	R-16.7ci	R-20.9ci	R-20.9ci	R-23ci	R-23ci
Joist/framing	R-13	R-13	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-38	R-38	R-38	R-38	R-38	R-38
Slab-on-grade floors																
Unheated slabs	NR	NR	NR	NR	NR	R-10 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-20 for 24″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 48″ below	R-25 for 48″ 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

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/IES 90.1 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 C402.1.2.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted not less than 32 inches on center vertically and not less than 48 inches 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 R-value requirements for above-grade mass walls .

e. “Mass floors” shall be in accordance with Section C402.1.3.6.

f. “Mass walls” shall be in accordance with Section C402.1.3.6.

g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation and full-slab insulation components shall be installed in accordance with Section C402.2.4 .

h. The first value is *cavity insulation*; the second value is *continuous insulation*. Therefore, “R-0+R-12ci” means R-12 *continuous insulation* and no *cavity insulation*; “R-13+R-3.8ci” means R-13 *cavity insulation* and R-3.8 *continuous insulation*; “R-20” means R-20 *cavity insulation* and no *continuous insulation*. R-13, R-20, and R-27 *cavity insulation* as used in this table apply to a nominal 4-inch (101 mm), 6-inch (152 mm), and 8-inch (203 mm) deep wood or cold-formed steel stud cavities, respectively.

i. Where the required R-value in Table C402.1.3 is met by using continuous insulation such that cavity insulation is not required, ~~the wall assembly framing is permitted to be spaced at any spacing~~ the R-value is applicable to any wall framing spacing.

Reason: Framing is permitted to be spaced at any distance regardless of what the energy code says. This footnote is meaningless.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
no fiscal impact.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies application of insulation to any wall framing configuration.

Final Hearing Results

CE2D-7-23 AM

CE2D-8-23

Original Proposal

IECC CE: C402.2.1.3

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C402.2.1.3 Minimum thickness of tapered insulation. The ~~minimum~~ thickness of tapered above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be not less than 1 inch (25 mm).

Reason: "Minimum" is redundant with "not less than."

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Editorial.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Removes redundancy; “minimum” is redundant with “not less than.”

Final Hearing Results

CE2D-8-23	AS

CE2D-9-23

Original Proposal

IECC CE: C402.6.1.3, C402.6.2, C406.2.1.3

Proponents: Theresa Weston, The Holt Weston Consultancy, Air Barrier Association of America (ABAA) (holtweston88@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C402.6.2 Air leakage compliance. *Air leakage* of the *building* thermal envelope shall be tested by an *approved* third party in accordance with C402.6.2.1. The measured air leakage shall not be greater than 0.35 cfm/ft (1.8 L/s x m) of the *building* thermal envelope area at a pressure differential of 0.3 inch water gauge (75 Pa) with the calculated *building* thermal envelope surface area being the sum of the above- and below-grade *building* thermal envelope.

Exceptions: Add optional paragraph text here

1. Where the measured *air leakage* rate is greater than 0.35 cfm/ft^2 (1.8 L/s x m^2) but is not greater than 0.45 cfm/ft^2 (2.3 L/s x m^2), the *approved* third party shall perform a diagnostic evaluation using smoke tracer or infrared imaging. The evaluation shall be conducted while the *building* is pressurized or depressurized along with a visual inspection of the *air barrier* in accordance with ASTM E1186. All identified leaks shall be sealed where such sealing can be made without damaging existing *building* components. A report specifying the corrective actions taken to seal leaks shall be deemed to establish compliance with the requirements of this section where submitted to the *code official* and the *building owner*. Where the measured *air leakage* rate is greater than 0.45 cfm/ft^2 (2.3 L/s x m^2), corrective actions must be made to the *building* and an additional test completed for which the results are 0.45 cfm/ft^2 (2.3 L/s x m^2), or less.
2. Buildings in *Climate Zone* 2B.
3. Buildings larger than 25,000 square feet (2300 m^2) floor area in Climate Zones 0 through 4, other than Group R and I occupancies, that comply with C402.6.2.3
4. As an alternative, buildings or portions of *building*, containing Group R-2 and I-1 occupancies, shall be permitted to be tested by an *approved* third party in accordance with C402.6.2.2. The reported *air leakage* of the *building* thermal envelope shall not be greater than 0.27 cfm/ft^2 (1.4 L/s x m^2) of the *testing unit enclosure area* at a pressure differential of 0.2 inch water gauge (50 Pa).

~~**C402.6.2 Reserved (Potentially move C40213 Air leakage compliance here).**~~ ~~Reserved.~~

C406.2.1.3 E03 Reduced air leakage. Energy credits shall be achieved where tested *building air leakage* is not less than 10 percent less than the maximum leakage permitted by Section ~~C402.5.2~~ C402.6.2 provided the *building* is tested in accordance with the applicable method in Section ~~C402.5.2~~ C402.6.2. Energy credits achieved for measure E03 shall be determined as follows:

$$EC_{E03} = EC_B \text{ X } EC_{adj} \qquad \textbf{(Equation 4-13)}$$

EC_{E03}= Energy ~~effi ciency~~ efficiency credits achieved for envelope leakage reduction
EC_B= C406.2.1.3 credits from Tables C406.2(1) through C406.2(9)
EC_{adj}= Ls/EC_a
Ls = Leakage savings fraction: the lessor of [(Lr-Lm)/Lr] or 0.8
Lr = Maximum leakage permitted for tested *buildings*, by occupancy group, in accordance with Secction ~~C402.5.2~~ C402.6.2
Lm = Measured leakage in accordance with Section ~~C402.5.2.1~~ C402.6.2.1 or ~~C402.5.2.2~~ C402.6.2.2
EC_a= Energy Credit alignment factor: 0.37 for whole *building* tests in accordance with Section ~~C402.5.2.1~~ C402.6.2.1 or 0.25 for dwelling and *sleeping unit* enclosure tests in accordance with Section ~~C402.5.2.2~~ C402.6.2.2.

Reason: This is errata on the numbering of sections related to air leakage:

- Renumbers the current (in draft) Section C402.6.1.3 to C402.6.2. In the draft C402.6.2 is titled "Reserved" and it is stated that "potentially move C402.1.3 Air leakage compliance her". The correct numbering is to move C402.6.1.3 to this place.

- corrects the air leakage section numbers referenced in Section C406.2.1.3

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is errata on section numbering only.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Corrects section numbering.

Final Hearing Results

CE2D-9-23	AS

CE2D-10-23

Original Proposal

IECC CE: C402.6.2.3, C405.13.5, C407.5.1.2

Proponents: Shane Hoeper, SEHPCAC, SEHPCAC

2024 International Energy Code[CE Project] R3

Revise as follows:

C402.6.2.3 Building thermal envelope design and construction verification criteria. Where Section C402.6.2.1 and C402.6.2.2 are not applicable the installation of the continuous *air barrier* shall be verified by the *code official*, a *registered design professional* or *approved*agency in accordance with the following:

1. A review of the *construction documents* and other supporting data shall be conducted to assess compliance with the requirements in Section C402.6.1.
2. Inspection of continuous *air barrier* components and assemblies shall be conducted during construction to verify compliance with the requirements of Section C402.6.2.3.1 or C402.6.2.3.2. The *air barrier* shall ~~remain accessible~~ be provided with access for inspection and *repair*.
3. A final inspection report shall be provided for inspections completed by the*registered design professional* or *approved*agency. The inspection report shall be provided to the *building owner* or *owner*'s authorized agent and the *code official*. The report shall identify deficiencies found during inspection and details of corrective measures taken.

C405.13.5 Graphical energy report. A permanent and readily ~~accessible~~ available reporting mechanism ~~with ready access~~ shall be provided in the *building* ~~that is accessible has~~ for access by *building* operation and management personnel. The reporting mechanism shall have the capability to graphically provide the electrical energy consumption for each end-use category required by Section C405.13.2 not less than every hour, day, month and year for the previous 36 months. The graphical report shall incorporate natural gas interval data or the ability to enter gas utility bills into the report.

C407.5.1.2 Testing required by software vendors. Prior to approval, software tools shall be tested by the software vendor in accordance with ASHRAE Standard 140, except Sections 7 and 8. During testing, hidden inputs that are not normally ~~accessible~~ available to the user shall be permitted to avoid introducing source code changes strictly used for testing. Software vendors shall publish, on a publicly available website, the following ASHRAE Standard 140 test results, input files, and modeler reports for each tested version of a software tool:

1. Test results demonstrating the software tool was tested in accordance with ASHRAE Standard 140 and that meet or exceed the values for "The Minimum Number of Range Cases within the Test Group to Pass" for all test groups in ASHRAE Standard 140, Table A3-14.
2. Test results of the performance analysis tool and input files used for generating the ASHRAE Standard 140 test cases along with the results of the other performance analysis tools included in ASHRAE Standard 140, Annexes B8 and B16.
3. The modeler report in ASHRAE Standard 140, Annex A2, Attachment A2.7. Report Blocks A and G shall be completed for results exceeding the maximum or falling below the minimum of the reference values shown in ASHRAE Standard 140 Table A3-1 through Table A3-13, and Report Blocks A and E shall be completed for any omitted results.

Reason: Because the term 'accessible' is most commonly understood as requiring access for persons with disabilities we are making the changes to delete the word accessible from the remaining codes and replace it with other words, defined terms or phrases that are not attributed to requiring access for the physically disabled. Many of the codes use the defined term 'access (to)' or 'ready access (to)' for access by maintenance and service personnel or fire departments. This proposal provides clarity and consistency in the remaining codes where those coordination modifications missed or came in as part of new code changes.

This a correlation piece for proposals over the last couple of cycles. This effort was started by the CACs in 2015/16 code change cycle, and continued in 2018/19. This proposal is to provide coordination with the action taken with -P84-15, M2-15, RB2-16, F12-16, CE137-16 Part 1, CE29-19 Part 1 and 2 . G1-21 Part 1 was disapproved; however Part 2 through 7 were approved

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial. Will not change the cost of construction

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: the word “accessible” should remain reserved for uses associated with accessibility requirements for disabled persons as suggested by the proponent.

Final Hearing Results

CE2D-10-23	AS

CE2D-11-23

Original Proposal

IECC CE: C403.3

Proponents: Richard Lord, Carrier Corporation, Carrier Corporation (richard.lord@carrier.com)

2024 International Energy Code[CE Project] R3

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

Reason: This is just editorial changes to the tables that were not modified in the public review but do need some fixing.

The requirements for before 1/1/2023 should be deleted because the date has already passed and just show the after 1/1/2023 requirements.

Also for footnote c the following change should be made.

c. DOE 10 CFR 430 Subpart B Appendix M1 includes the test procedure updates effective 1/1/2023 ~~that will be incorporated~~ are documented in AHRI 210/240–2023.

Bibliography: Current table aligns with ASHRAE 90.1-2022 but the IECC will be published in 2022 so there is no need to shown the before 2023 requirements.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial. No cost impact.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The requirements for before 1/1/2023 in tables C403.3.2(1) and (2) should be deleted because the date has already passed and just show the after 1/1/2023 requirements.

Final Hearing Results

CE2D-11-23	AM

CE2D-12-23

Original Proposal

IECC CE: C403.3.2
Proponents: Eric Tate, Atmos Energy, Atmos Energy (eric.tate@atmosenergy.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C403.3.2 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2(16) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of AHRI 400. 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. ~~Efficiency values and metrics in tables shall be equal to the values and metrics shown in ASHRAE 90.1-2022~~.

Reason: Table values should stand alone and not require the AHJ to enforce ASHRAE appliance and equipment standards as implied by the new language. Regardless, the DOE federal minimum efficiencies, adopted through ASHRAE Standard 90.1 should serve as the table minimums and do not need to be referenced back to ASHRAE.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The deleted language is superfluous to meeting federally-regulated efficiency requirements and is, therefore, redundant.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: statement is no longer needed.

Final Hearing Results

CE2D-12-23 AS

CE2D-13-23

Original Proposal

IECC CE: C403.3.2

Proponents: Richard Lord, Carrier Corporation, Carrier Corporation (richard.lord@carrier.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C403.3.2 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2(16) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of AHRI 400. 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. ~~Efficiency values and metrics in tables shall be equal to the values and metrics shown in ASHRAE 90.1-2022~~.

Reason: The note c in table C403.3.2(1) is incorrect and needs the following editorial correction.

c. DOE 10 CFR 430 Subpart B Appendix M1 includes the test procedure updates effective 1/1/2023 ~~that will be incorporated~~ documented in AHRI 210/240–2023.

The AHRI 210/240-2023 has already been published in 2022. The -2023 is the name of the standard and not the year of publication. This is confussing.

Bibliography: AHRI 210/240-2023 was published in 2022. The -2023 just means the standard goes into effect on 1/1/2023

The AHRI approach to call the standard AHRI 210/240-2023 is confusing as the standard was published in 2022 and the 2023 is the effective date or name of the standard.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No impact on cost.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: AHRI 210/240-2023 has already been published in 2022. The -2023 is the name of the standard and not the year of publication. Note that the underline language in C403.3.2 is not a part of the proposal. The proposal is stated within the reason statement.

Final Hearing Results

CE2D-13-23	AS

CE2D-15-23

Original Proposal

IECC CE: C403.3.2

Proponents: Richard Lord, Carrier Corporation, Carrier Corporation (richard.lord@carrier.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C403.3.2 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2(16) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of AHRI 400. 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. ~~Efficiency values and metrics in tables shall be equal to the values and metrics shown in ASHRAE 90.1-2022~~.

Reason: I see that the staff is going to harmonize with ASHRAE 90.1-2022 which was modified to improve readability. In addition to these changes also eliminate any requirements for before 1/1/2023 as the date is in the past.

Bibliography: Just an editorial suggested change.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No cost impact.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Good idea to remove references to outdated dates. Note that the underline language in C403.3.2 is not a part of the proposal. The proposal is stated within the reason statement.

Final Hearing Results

CE2D-15-23	AS

CE2D-16-23

Original Proposal

IECC CE: C403.3.2

Proponents: Richard Lord, Carrier Corporation, Carrier Corporation (richard.lord@carrier.com)

2024 International Energy Code[CE Project] R3

C403.3.2 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2(16) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of AHRI 400. 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. <u>Efficiency values and metrics in tables shall be equal to the values and metrics shown in ASHRAE 90.1-2022</u>.

Reason: In table C403.3.2(1) the requirements for before 1/1/2023 are shown. There is no need to show these requirements as the date has already passed.

Bibliography: Table as currently written alligns with ASHRAE 90.1, but no need to show the before 1/1/2023

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No impact on cost

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Remove all 2023 date references because it is the 2024 IECC

Final Hearing Results

CE2D-16-23	AS

CE2D-17-23

Original Proposal

IECC CE: TABLE C403.3.2(13), TABLE C403.3.2(12)

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

TABLE C403.3.2(13) ELECTRICALLY OPERATED D X-DOAS UNITS, SINGLE-PACKAGE AND REMOTE CONDENSER, WITH ENERGY RECOVERY—MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]		
Air cooled (dehumidification mode)	—	5.0 ISMRE2	AHRI 920		
Air-source heat pumps (dehumidification mode)	—	5.0 ISMRE2	AHRI 920		
Water cooled (dehumidification mode)	Cooling tower condenser water	5.1 ISMRE2	AHRI 920		
	Air-source heat pump (heating mode)	—		3.2 ISCOP2	AHRI 920
Water-source heat pump (dehumidification mode)	Ground source, closed and open loop[b]	5.0 ISMRE2	AHRI 920		
	Water source	4.6 ISMRE2			
	Water-source heat pump (heating mode)	Ground source, closed and open loop[b]		3.5 ISCOP2	AHRI 920
Water source		4.04 ISCOP2			

a. Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

b. ~~For minimum efficiency compliance purposes~~, ~~open~~ Open loop systems ~~shall be~~ are rated using closed-loop test conditions.

TABLE C403.3.2(12) ELECTRICALLY OPERATED DX-DOAS UNITS, SINGLE-PACKAGE AND REMOTE CONDENSER, WITHOUT ENERGY RECOVERY—MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]		
Air cooled (dehumidification mode)	—	3.8 ISMRE2	AHRI 920		
Air-source heat pumps (dehumidification mode)	—	3.8 ISMRE2	AHRI 920		
Water cooled (dehumidification mode)	Cooling tower condenser water	4.7 ISMRE2	AHRI 920		
	Air-source heat pump (heating mode)	—		2.05 ISCOP2	AHRI 920
Water-source heat pump (dehumidification mode)	Ground source, closed and open loop[b]	4.6 ISMRE2	AHRI 920		
	Water source	3.8 ISMRE2			
	Water-source heat pump (heating mode)	Ground source, closed and open loop[b]		2.13 ISCOP2	AHRI 920
Water source		2.13 ISCOP2			

a. Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

b. ~~For minimum efficiency compliance purposes~~, ~~open~~ Open loop systems ~~shall be~~ are rated using closed-loop test conditions.

Reason: Footnote should not contain requirements. The purpose of the tables are to identify 'minimum efficiency,' so it does not need to be repeated in the footnote.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Footnote should not contain requirements. The purpose of the tables are to identify 'minimum efficiency,' so it does not need to be repeated in the footnote.

Final Hearing Results

CE2D-17-23	AS

CE2D-18-23

Original Proposal

IECC CE: C403.3.2

Proponents: Richard Lord, Carrier Corporation, Carrier Corporation (richard.lord@carrier.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C403.3.2 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2(16) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of AHRI 400. 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. ~~Efficiency values and metrics in tables shall be equal to the values and metrics shown in ASHRAE 90.1-2022~~.

Reason: In the table C403.3.2(3) the capacity range for the water cooled electrically operated centrifugal is missing and ≥150 and <300 tons needs to be added

Bibliography: Just an editorial to add the missing capacity category for water cooled centrifugals.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Just an editorial correction

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: In the table C403.3.2(3) the capacity range for the water cooled electrically operated centrifugal is missing and ≥150 and <300 tons needs to be added. Just an editorial to add the missing capacity category for water cooled centrifugals. Note that the underline language in C403.3.2 is not a part of the proposal. The proposal is stated within the reason statement.

Final Hearing Results

CE2D-18-23	AS

CE2D-19-23

Original Proposal

IECC CE: TABLE C403.3.2(6)

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

TABLE C403.3.2(6) GAS- AND OIL-FIRED BOILERS—MINIMUM EFFICIENCY REQUIREMENTS[i]

EQUIPMENT TYPE[b]	SUBCATEGORY OR RATING CONDITION	SIZE CATEGORY (INPUT)	MINIMUM EFFICIENCY	EFFICIENCY AS OF 3/2/2022	TEST PROCEDURE[a]
Boilers, hot water	Gas fired	< 300,000 Btu/h[g, h] for applications outside US	82% AFUE	82% AFUE	DOE 10 CFR 430 Appendix N
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	80% E_t[d]	80% E_t[d]	DOE 10 CFR 431.86
		> 2,500,000 Btu/h[b]	82% E_c[c]	82% E_c[c]	
	Oil fired[f]	< 300,000 Btu/h[g,h] for applications outside US	84% AFUE	84% AFUE	DOE 10 CFR 430 Appendix N
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	82% E_t[d]	82% E_t[d]	DOE 10 CFR 431.86
		> 2,500,000 Btu/h[b]	84% E_c[c]	84% E_c[c]	
Boilers, steam	Gas fired	< 300,000 Btu/h[g] for applications outside US	80% AFUE	80% AFUE	DOE 10 CFR 430 Appendix N
	Gas fired–all, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	79% E_t[d]	79% E_t[d]	DOE 10 CFR 431.86
		> 2,500,000 Btu/h[b]	79% E_t[d]	79% E_t[d]	
	Gas fired–natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	77% E_t[d]	79% E_t[d]	
		> 2,500,000 Btu/h[b]	77% E_t[d]	79% E_t[d]	
	Oil fired[f]	< 300,000 Btu/h[g] for applications outside US	82% AFUE	82% AFUE	DOE 10 CFR 430 Appendix N
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	81% E_t[d]	81% E_t[d]	DOE 10 CFR 431.86
		> 2,500,000 Btu/h[b]	81% E_t[d]	81% E_t[d]	

For SI: 1 British thermal unit per hour = 0.2931 W.

a. Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

b. 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.

c. E_C = Combustion efficiency (100 percent less flue losses).

d. E_t = Thermal efficiency.

e. Maximum capacity—minimum and maximum ratings as provided for and allowed by the unit's controls.

f. Includes oil-fired (residual).

g. Boilers shall not be equipped with a constant burning pilot light.

h. A boiler not equipped with a tankless domestic water-heating coil shall be equipped with an automatic means for adjusting the temperature of the water such that an incremental change in inferred heat load produces a corresponding incremental change in the temperature of the water supplied.

i. ~~Prior to March 2, 2022, for natural draft very large gas-fired steam commercial packaged boilers, a minimum thermal efficiency level of 77 percent is permitted and meets Federal commercial packaged boiler energy conservation standards~~

Reason: "*Very large*" is poor code language. What is 'very? What is large? Similarly, '*minimum*' has minimal acceptable application in code.

Whether the equipment meets "*Federal commercial packaged boiler energy conservation standards*" is commentary and not a requirement and should be deleted.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial

Public Hearing Results

Committee Action **As Modified**

Committee Reason: this footnote isn't applicable anymore since it is for older equipment.

Final Hearing Results

CE2D-19-23	AM

CE2D-20-23

Original Proposal

IECC CE: C403.3.2

Proponents: Richard Lord, Carrier Corporation, Carrier Corporation (richard.lord@carrier.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C403.3.2 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2(16) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of AHRI 400. 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. ~~Efficiency values and metrics in tables shall be equal to the values and metrics shown in ASHRAE 90.1-2022~~.

Reason: Staff has noted that the table needs to be updated. There are errors in the existing table with duplicate IEER values.

When adopting the 90.1 table 6.8.1-8 eliminate the requirements before 1/1/2023 and also the 2014 AHRI 1230-2014 addendum 1 reference because the new AHRI 1230-2021 goes into effect on 1/1/2024 which will be the effective date for the IECC 2024 standard.

Bibliography: Suggest changes as the table is need of update.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No cost impact.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: to eliminate dates prior to the publication of 2024 IECC, to harmonize with ASHRAE 90.1 and regulations. Note that the underline language in C403.3.2 is not a part of the proposal. The proposal is stated within the reason statement.

Final Hearing Results

CE2D-20-23	AS

CE2D-21-23

Original Proposal

IECC CE: C403.3.2

Proponents: Richard Lord, Carrier Corporation, Carrier Corporation (richard.lord@carrier.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C403.3.2 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2(16) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of AHRI 400. 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. ~~Efficiency values and metrics in tables shall be equal to the values and metrics shown in ASHRAE 90.1-2022~~.

Reason: Staff has noted that the table needs to be updated. There are errors in the existing table with duplicate IEER values.

When adopting the 90.1 table 6.8.1-9 eliminate the requirements before 1/1/2023 and also the 2014 AHRI 1230-2014 addendum 1 reference because the new AHRI 1230-2021 goes into effect on 1/1/2024 which will be the effective date for the IECC 2024 standard.

Bibliography: Editorial updates

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No cost impact

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: to eliminate dates prior to the publication of 2024 IECC, to harmonize with ASHRAE 90.1 and regulations. Note that the underline language in C403.3.2 is not a part of the proposal. The proposal is stated within the reason statement.

Final Hearing Results

CE2D-21-23	AS

CE2D-23-23

Original Proposal

IECC CE: C403.7.1

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C403.7.1 Demand control ventilation. Demand control *ventilation* (DCV) shall be provided for the following:

1. Spaces with *ventilation* provided by single-zone systems where an air-side economizer is provided in accordance with Section C403.5.
2. Spaces larger than 250 square feet (23.2 m^2) in climate zones 5A, 6, 7, and 8 and spaces larger than 500 square feet (46.5 m^2) in other climate zones which have a design occupant load of 15 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 are served by systems with one or more of the following:
   - 2.1 An air-side economizer.
   - 2.2 Automatic modulating control of the outdoor air damper.
   - 2.3 A design outdoor airflow greater than 3,000 cfm (1416 L/s)

Exceptions:

1. Spaces served by systems with energy recovery in accordance with Section C403.7.4.2 and that have a floor area less than:
   - 1.1 6000 square feet (2600 m^2) in climate zone 3C.
   - 1.2 2000 square feet (190 m^2) in climate zones 1A, 3B, and 4B.
   - 1.3 1000 square feet (90 m^2) in climate zones 2A, 2B, 3A, 4A, 4C, 5 and 6.
   - 1.4 400 square feet (40 m^2) in climate zones 7 and 8.
2. Multiple-zone systems without direct digital control of individual zones communicating with a central control panel.
3. Spaces served by multiple-zone systems with a system design outdoor airflow less than 750 cfm (354 L/s).
4. Spaces where more than 75 percent of the space design outdoor airflow is required for makeup air that is exhausted from the space or transfer air that is required for makeup air that is exhausted from other spaces.
5. Spaces with one of the following occupancy classifications as defined in Table 403.3.1.1 of the*International Mechanical Code*: correctional cells, education laboratories, barber, beauty and nail salons, and bowling alley seating areas.
6. Spaces where the *registered design professional* demonstrates an engineered *ventilation* system design that ~~complies with the following~~:
   - 6.1 ~~It prevents~~ Prevents the maximum concentration of contaminants from ~~exceeding~~ being more than that obtainable by the required rate of outdoor air *ventilation*, and
   - 6.2 ~~It allows~~ Allows the required minimum design rate of outdoor air to be reduced by no less than 15 percent.

Reason: This may require further edits with SME input.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial

Public Hearing Results

Committee Action **As Modified**

Committee Reason: editorial

Final Hearing Results

CE2D-23-23	AM

CE2D-24-23

Original Proposal

IECC CE: C403.7.8

Proponents: Michael Jouaneh, Lutron Electronics Co., Inc., Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C403.7.8 Occupied standby controls. The following spaces shall be equipped with occupied~~Occupied~~ standby controls~~,~~ in accordance with C403.7.8.1, ~~shall be required~~ for each ventilation *zone* ~~of a system that complies with the following~~:

1. ~~All spaces served by the *zone* are required to have occupant sensor lighting controls in accordance with C405.2.1~~.
2. ~~ASHRAE Standard 62.1 Ventilation Rate Procedure allows the ventilation air to be reduced to zero in all spaces served by the zone during occupied standby mode. Spaces meeting these criteria include:~~
   - ~~2.1~~ Post-secondary classrooms/lecture/training rooms
   - ~~2.2~~ Conference/meeting/multipurpose rooms
   - ~~2.3~~ Lounges/breakrooms
   - ~~2.4~~ Enclosed offices
   - ~~2.5~~ Open plan office areas
   - ~~2.6~~ Corridors

Exception: Zones that are part of a Multiple zone system without*automatic* zone flow control dampers.

Reason: This suggestion provides clarity for the project team to determine which spaces that are the ones where occupied standby controls would be required by simply listing the spaces not referring to another standard and another section of this code for the project team to determine which spaces would need this functionality. Also changing within 5 minutes to within 20 minutes aligns with the lighting control requirements. If the timeout periods are aligned, it will make it easier for the mechanical system to use the information from the lighting control system if needed.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No change to cost effectiveness.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: To provide clarity and align with the lighting control requirements.

Final Hearing Results

CE2D-24-23 AM

CE2D-26-23

Original Proposal

IECC CE: TABLE C404.2

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

TABLE C404.2 MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	DRAW PATTERN	PERFORMANCE REQUIRED[a]	TEST PROCEDURE[b]
Electric Table-top water heaters[c]	≤12 kW	≥ 20 gal ≤ 120 gal[d]	Very small Low Medium High	UEF ≥ 0.6323 - (0.0058 × Vr) UEF ≥ 0.9188 - (0.0031 × Vr) UEF ≥ 0.9577 - (0.0023 × Vr) UEF ≥ 0.9884 - (0.0016 × Vr)	DOE 10 CFR Part 430 App. E
Electric Storage water heaters[e,f]: resistance and heat pump	≤12 kW	≥ 20 gal ≤ 55 gal[f]	Very small Low Medium High	UEF ≥ 0.8808 - (0.0008 × Vr) UEF ≥ 0.9254 - (0.0003 × Vr) UEF ≥ 0.9307 - (0.0002 × Vr) UEF ≥ 0.9349 - (0.0001 × Vr)	DOE 10 CFR Part 430 App. E
	≤12 kW	> 55 gal ≤120 gal[f]	Very small Low Medium High	UEF ≥ 1.9236 - (0.0011 × Vr) UEF ≥ 2.0440 - (0.0011 × Vr) UEF ≥ 2.1171 - (0.0011 × Vr) UEF ≥ 2.2418 - (0.0011 × Vr)	DOE 10 CFR Part 430 App. E
Electric Storage water heaters[e,f,l]	> 12 kW	-	-	(0.3 + 27/Vm), %h	DOE 10 CFR 431.106 App B
Grid-enabled water heaters[g]	-	>75 gal d	Very small Low Medium High	UEF ≥ 1.0136 - (0.0028 × Vr) UEF ≥ 0.9984 - (0.0014 × Vr) UEF ≥ 0.9853 - (0.0010 × Vr) UEF ≥ 0.9720 - (0.0007 × Vr)	10 CFR 430 Appendix E
Electric Instantaneous water heaters[h]	≤12 kW	< 2 gal[d]	Very small Low Medium High	UEF ≥ 0.91 UEF ≥ 0.91 UEF ≥ 0.91 UEF ≥ 0.92	DOE 10 CFR Part 430
	>12 kW & ≤ 58.6 kW[i]	≤ 2 gal & ≤180ºF	All	UEF ≥ 0.80	DOE 10 CFR Part 430
Gas Storage water heaters[e,l]	≤ 75,000 Btu/h	≥20 gal & ≤ 55 gal[d]	Very small Low Medium High	UEF ≥ 0.3456 - (0.0020 × Vr) UEF ≥ 0.5982 - (0.0019 × Vr) UEF ≥ 0.6483 - (0.0017 × Vr) UEF ≥ 0.6920 - (0.0013 × Vr)	DOE 10 CFR Part 430 App. E
	≤ 75,000 Btu/h	> 55 gal & ≤ 100 gal[d]	Very small Low Medium High	UEF ≥ 0.6470 - (0.0006 × Vr) UEF ≥ 0.7689 - (0.0005 × Vr) UEF ≥ 0.7897 - (0.0004 × Vr) UEF ≥ 0.8072 - (0.0003 × Vr)	DOE 10 CFR Part 430 App. E
	> 75,000 Btu/h and ≤ 105,000 Btu/h [j,k]	≤ 120 gal & ≤180ºF	Very small Low Medium High	UEF ≥ 0.2674-0.0009 x Vr UEF ≥ 0.5362-0.0012 x Vr UEF ≥ 0.6002-0.0011 x Vr UEF ≥ 0.6597-0.0009 x Vr	DOE 10 CFR Part 430 App. E
	> 105,000 Btu/h[k]	-	-	80% Et SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106

Gas Instantaneous water heaters[i]	> 50,000 Btu/h and < 200,000 Btu/h[k]	< 2 gal[d]	Very small Low Medium High	UEF ≥ 0.80 UEF ≥ 0.81 UEF ≥ 0.81 UEF ≥ 0.81	DOE 10 CFR Part 430 App. E
	≥ 200,000 Btu/h[k]	< 10 gal	-	80% Et	DOE 10 CFR 431.106
	≥ 200,000 Btu/h[k]	≥10 gal	-	80% Et SL ≤ (Q/800 +110√V), Btu/h	
Oil Storage water heaters[e,l]	≤ 105,000 Btu/h	≤ 50 gal[d]	Very small Low Medium High	UEF = 0.2509 - (0.0012 × Vr) UEF = 0.5330 - (0.0016 × Vr) UEF = 0.6078 - (0.0016 × Vr) UEF = 0.6815 - (0.0014 × Vr)	DOE 10 CFR Part 430
	> 105,000 Btu/h and ≤ 140,000 Btu/h[l]	≤ 120 gal & ≤180ºF	Very small Low Medium High	UEF ≥ 0.2932-0.0015 x Vr UEF ≥ 0.5596-0.0018 x Vr UEF ≥ 0.6194-0.0016 x Vr UEF ≥ 0.6740-0.0013 x Vr	DOE 10 CFR Part 430 App. E
	>140,000 Btu/h	All	-	80% Et SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Oil Instantaneous water heaters[h,l]	≤ 210,000 Btu/h	< 2 gal	-	80% Et EF ≥ 0.59 - 0.0005 x V	DOE 10 CFR Part 430 App. E
	> 210,000 Btu/h	< 10 gal	-	80% Et	DOE 10 CFR 431.106
	> 210,000 Btu/h	≥ 10 gal	-	78% Et SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Hot water supply boilers, gas and oil[h]	≥300,000 Btu/h and < 12,500,000 Btu/h	< 10 gal	-	80% Et	DOE 10 CFR 431.106
Hot water supply boilers, gas[i,l]	≥300,000 Btu/h and < 12,500,000 Btu/h	≥ 10 gal	-	80% Et SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Hot water supply boilers, oil[h,l]	≥300,000 Btu/h and < 12,500,000 Btu/h	≥ 10 gal	-	78% Et SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Pool heaters, gas[d]	All	_[f]	-	82% Et	DOE 10 CFR Part 430 App. P
Heat pump pool heaters	All	50°F db 44.2°F wb outdoor air 80.0°F entering water	-	4.0 COP	DOE 10 CFR Part 430 App. P
Unfired storage tanks	All	-	-	Minimum insulation requirement R-12.5 (h-ft2-°F)/Btu	(none)

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m^2, °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. Thermal efficiency (Et) is a minimum requirement, while standby loss is a maximum requirement. In the standby loss equation, V is the rated volume in gallons and Q is the nameplate input rate in Btu/h. Vm is the measured volume in the tank in gallons. Standby loss for electric water heaters is in terms of %/h and denoted by the term "S," and standby loss for gas and oil water heaters is in terms of Btu/h and denoted by the term "SL" Draw pattern (DP) refers to the water draw profile in the Uniform Energy Factor (UEF) test. UEF and Energy Factor (EF) are minimum requirements. In the UEF standard equations, Vr refers to the rated volume in gallons.
b. Chapter 6 contains a complete specification, including the year version, of the referenced test procedure.
c. A tabletop water heater is a storage water heater that is enclosed in a rectangular cabinet with a flat top surface not more than three feet (0.91 m) in height and has a ratio of input capacity (Btu/h) to tank volume (gal) < 4000.
d. Water heaters or gas pool heaters in this category are regulated as consumer products by the USDOE as defined in 10 CFR 430.
e. Storage water heaters have a ratio of input capacity (Btu/h) to tank volume (gal)<4000.

f. Efficiency requirements for electric storage water heaters ≤ 12 kW apply to both electric resistance and heat pump water heaters. There are no minimum efficiency requirements for electric heat pump water heaters greater than 12kW or for gas heat pump water heaters.

g. 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 (284 L).
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 a 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."

h. Instantaneous water heaters and hot water supply boilers have an input capacity (Btu/h) divided by storage volume (gal) ≥ 4000 Btu/h-gal.

i. Electric instantaneous water heaters with input capacity >12 kW and ≤58.6 kW that have either (1) a storage volume >2 gal(7.6L); or (2) is designed to provide outlet hot water at temperatures greater than 180°F(82ºC); or (3) uses three-phase power has no efficiency standard.

j. Gas storage water heaters with input capacity >75,000 Btu/h (21.98 kW) and ≤105,000 Btu/h (30.77 kW) must comply with the requirements for the >105,000 Btu/h (30.77 kW) if the water heater either (1) has a storage volume >120 gal (454L); (2) is designed to provide outlet hot water at temperatures greater than 180°F (82ºC); or (3) uses three-phase power.

k. Refer to Section C404.2.1 for additional requirements for gas storage and instantaneous water heaters and gas hot-water supply boilers.l. Oil storage water heaters with input capacity>105,000 Btu/h (30.77 kW) and ≤140,000 Btu/h (41.03 kW) must comply with the requirements for the >140,000 Btu/h (41.03 kW) if the water heater either (1) has a storage volume > 120 gal(454L); (2) is designed to provide outlet hot water at temperatures greater than 180ºF (82ºC); or (3) uses three-phase power.

l. Water heaters and hot water supply boilers ~~having~~ with more than 140 gallons (530L) of storage capacity need not meet the standby loss requirement ~~if~~ where: (1) The tank surface area is thermally insulated to R-12.5 or more; (2) ~~a~~ there is no standing pilot light ~~is not used~~; and (3) for gas or oil-fired storage water ~~heaers~~ heaters, ~~they have~~ the heater is equipped with a fire damper or fan-assisted combustion

Reason: Editorial.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Editorial.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: editorial

Final Hearing Results

CE2D-26-23 AM

CE2D-29-23

Original Proposal

IECC CE: C405.13.8, C405.13, C105.6.2 (New)

Proponents: BRYAN P HOLLAND, National Electrical Manufacturers Association (NEMA), National Electrical Manufacturers Association (NEMA) (bryan.holland@nema.org)

2024 International Energy Code[CE Project] R3

Delete without substitution:

~~**C405.13.8 Plan for disclosure.** The plan for annual energy use data gathering and disclosure shall include the following:~~

1. ~~Property information including:~~
    ~~1.1 Address~~

    ~~1.2 Gross floor area~~

    ~~1.3 Year occupied~~

    ~~1.4 Occupancy classifications, with respective floor areas~~
2. ~~Total annual *building site* energy use by unit area as collected or documented through Section C405.13.5 and Section C405.13.6 sources, separated by energy type and fuel type~~.
3. ~~Annual site generated renewable energy by unit area~~ .

Revise as follows:

C405.13 Energy monitoring. New buildings with a gross *conditioned floor area* of not less than 10,000 square feet (929 m^2) shall be equipped to measure, monitor, record and report energy consumption data in compliance with Sections C405.13.1 through C405.13.5.~~A plan for quantifying annual energy type and end-use disclosure in compliance with Sections C405.13.1 through C405.13.8 shall be submitted with the *construction documents*~~.

Exceptions:

1. *Dwelling units* in R-2 occupancies
2. Individual tenant spaces are not required to comply with this section provided that the space has its own utility services and meters and has less than 5,000 square feet (464.5 m^2) of *conditioned floor area* .

C105.6.2 Compliance documentation. Energy code compliance documentation and supporting calculations shall be delivered in one document to the building owner as part of the project record documents or manuals, or as a standalone document. This document shall include the specific energy code edition utilized for compliance determination for each system, documentation demonstrating compliance with Section C303.1.3 for each fenestration product installed, and the interior lighting power compliance path, building area or space-by-space, used to calculate the lighting power allowance.For projects complying with Item 2 of Section C401.2, the documentation shall include:

1. The envelope insulation compliance path.
2. All compliance calculations including those required by Sections C402.1.4, C403.8.1, C405.3 and C405.5.
3. <u>A plan for annual energy use data gathering and disclosure as specified in Section C405.13</u>.

For projects complying with Section C407, the documentation shall include that required by Sections C407.3.1 and C407.3.2.

Reason: Plan for disclosure section does not belong in the Energy Monitoring section because it has nothing to do with how energy is monitored. It is more appropriate to be in in the General (C401) section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is an editorial change.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: A plan for quantifying annual energy type and end-use disclosure requirement is best located in Chapter 1 versus C405.13.

Final Hearing Results

CE2D-29-23	AM

CE2D-33-23

Original Proposal

IECC CE: C405.13, C405.13.1 (New), C405.13.2, TABLE C405.13.2, C405.13.3, C405.13.5, C405.13.6, C405.13.7, C405.13.7 (New), C405.13.8 (New), TABLE C405.13.8 (New), C405.13.9 (New), C405.13.10 (New), C405.13.11 (New)

Proponents: Renee Lani, American Public Gas Association, American Public Gas Association (rlani@apga.org)

2024 International Energy Code[CE Project] R3

Revise as follows:

C405.13 Energy monitoring. New buildings with a gross *conditioned floor area* of not less than 10,000 square feet (929 m^2) shall be equipped to measure, monitor, record and report energy consumption ~~data~~ in ~~compliance~~ accordance with Sections C405.13.1 through C405.13.~~5~~6 for load categories indicated in Table C405.13.2 and Section C405.13.7 through C405.13.11 for end-use categories indicated in Table C405.13.8.A plan for quantifying annual energy type and end-use disclosure in compliance with Sections C405.13.1 through C405.13.8 shall be submitted with the *construction documents*.

Exceptions:

1. *Dwelling units* in R-2 occupancies
2. Individual tenant spaces are not required to comply with this section provided that the space has its own utility services and meters and has less than 5,000 square feet (464.5 m^2) of *conditioned floor area* .

C405.13.1 Electrical energy metering. For ~~all~~ electrical energy supplied to the building and its associated site, including but not limited to site lighting, parking, recreational facilities and other areas that serve the building and its occupants, meters or other measurement devices shall be provided to collect energy consumption data for each end-use category required by Section C405.13.2.

C405.13.2 End-use electric metering categories. Meters or other *approved* measurement devices shall be provided to collect energy use data for each end-use category indicated in Table C405.13.2. Where multiple meters are used to measure any end-use category, the data acquisition system shall total all of the energy used by that category. Not more than 5 percent of the ~~measured~~ design load for each of the end-use categories indicated in Table C405.13.2 shall be permitted to be from a load that is not within that category.

Exceptions:

1. HVAC and water heating equipment serving only an individual*dwelling unit* shall not require end-use metering.
2. End-use metering shall not be required for fire pumps, stairwell pressurization fans or any system that operates only during testing or emergency.
3. End-use metering shall not be required for an individual tenant space having a floor area not greater than 2,500 square feet (232 m^2) where a dedicated source meter complying with Section C405.13.3 is provided.

TABLE C405.13.2 ELECTRICAL ENERGY USE CATEGORIES

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	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 but not limited to data centers, manufacturing equipment and commercial kitchens.

Electric vehicle charging	*Electric vehicle* charging loads that are powered through the *building*'s electrical service.
Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools,in-ground spas and snow-melt systems.
Electric hot water heating for uses other than space conditioning	Electricity used to generate hot water. **Exception:** Electric water heating with design capacity that is less than 10 percent of building service rating

C405.13.3 Electrical Meters. Meters or other measurement devices required by this section shall be configured to automatically communicate energy consumption data to the data acquisition system required by Section C405.13.4. Source meters shall be allowed to be any digital-type meter. Lighting, HVAC or other *building* systems that can self-monitor their energy consumption shall be permitted instead of meters. Current sensors shall be permitted, provided that they have a tested accuracy of ±2 percent. Required metering systems and equipment shall have the capability to provide at least hourly data that is fully integrated into the data acquisition system and graphical energy report in accordance with Sections C405.13.4 and C405.13.5.Non-intrusive load monitoring (NILM) packages that extract energy consumption data from detailed electric waveform analysis shall be permitted to substitute for individual meters if the equivalent data is available for collection in Section C405.13.4 and reporting in Section C405.13.5.

C405.13.5 Graphical energy report. A permanent and readily accessible reporting mechanism shall be provided in the *building* that is accessible by *building* operation and management personnel. The reporting mechanism shall have the capability to graphically provide the electrical energy consumption for each end-use category required by Section C405.13.2 not less than every hour, day, month and year for the previous 36 months. ~~The graphical report shall incorporate natural gas interval data or the ability to enter gas utility bills into the report~~.

Delete without substitution:

~~**C405.13.6 Non-electrical energy.** Consumption of non-electrical fuel or energy sources including district heating or cooling shall be metered in accordance with Section C405.13.2 and C405.13.3.~~

Revise as follows:

~~C405.13.7~~C405.13.6 Renewable energy. On-site renewable energy sources shall be metered with not less frequency than non-renewable energy systems in accordance with Section C405.13.3.

Add new text as follows:

C405.13.7 Non-electrical energy submetering. For all non-electrical energy supplied to the building and its associated site that serves the building and its occupants, submeters or other measurement devices shall be provided to collect energy consumption data for each end-use category required by Section C405.13.8.

Exceptions:

1. HVAC and water heating equipment serving only an individual dwelling unit shall not require end-use submetering.
2. End-use submetering shall not be required for fire pumps, stairwell pressurization fans or any system that operates only during testing or emergency.
3. End-use submetering shall not be required for an individual tenant space having a floor area not greater than 2,500 square feet (232 m^2) where a dedicated source meter complying with Section C405.13.9 is provided.
4. Equipment powered primarily by solid fuels serving loads other than building heating and service water heating loads.

C405.13.8 End-use non-electrical submetering categories. Submeters or other approved measurement devices shall be provided to collect energy use data for each end-use category indicated in Table C405.13.8. Where multiple submeters 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 design load for each of the end-use categories indicated in Table C405.13.8 shall be permitted to be from a load that is not within that category.

TABLE C405.13.8 Non-electrical energy use categories

END-USE CATEGORY	DESCRIPTION OF END USE
TOTAL HVAC SYSTEM	Heating and cooling systems, including but not limited to boilers, chillers and furnaces. District heating and cooling energy entering the buildings distribution system shall, be monitored at the point of entry to the building distribution system.
Process loads	Any single load that is not included in the HVAC or service water heating categories where the rated fuel gas or fuel oil input of the load and that is not less than 5 percent of the sum of the rated fuel gas or fuel oil input of all monitored equipment, including but not limited to manufacturing equipment, process equipment, commercial kitchens, and commercial laundry equipment.
Other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to fireplaces, swimming pools, spas, gas lighting, and snow-melt systems.
Service water heating	Fuel used to heat potable water Exception:Water heating with design capacity that is less than 10 percent of the sum of the rated fuel gas or fuel oil input of all monitored equipment.

C405.13.9 Non-electrical submeters. Submeters or other measurement devices required by this section shall be configured to automatically communicate energy consumption data to the data acquisition system required by Section C405.13.10. Source submeters shall be allowed to be any digital-type meter that can provide a digital output to the data acquisition system. Required submetering systems and equipment shall be fully integrated into the data acquisition system and graphical energy report that updates at least hourly in accordance with Sections C405.13.10 and C405.13.11.

C405.13.10 Non-electrical energy data acquisition system. A data acquisition system shall have the capability to store the data from the required submeters and other sensing devices for not less than 36 months. The data acquisition system shall have the capability to store real-time energy consumption data and provide hourly, daily, monthly and yearly logged data for each end-use category required by Section C405.13.8. The data acquisition system shall have the capability of providing building total non-electrical peak demand and the time(s) of day and time(s) per month at which the peak occurs. Where applicable as determined by the AHJ, peak demand shall be integrated over the same time period as the underlying whole building meter reading rate.

C405.13.11 Graphical energy report. A permanent and readily accessible reporting mechanism shall be provided in the building that is accessible by building operation and management personnel. The reporting mechanism shall have the capability to graphically provide the non-electrical energy consumption for each end-use category required by Section C405.13.8 not less than every hour, day, month and year for the previous 36 months. The graphical report shall incorporate natural gas interval data from the submeter or the ability to enter gas utility bills into the report.

Reason: APGA appreciates the opportunity to provide IECC-C Committee this input. APGA is the national trade association for approximately 1,000 communities across the U.S. that own and operate their own retail natural gas distribution entities. They include municipal gas distribution systems, public utility districts, county districts, and other public agencies, all locally accountable to the citizens they serve. Public gas systems focus on providing safe, reliable, resilient, and affordable natural gas service to their customers. APGA members serve their communities by providing sustainable and clean energy to be used for cooking, clothes drying, and space and water heating, as well as for various commercial and industrial applications.

APGA is very concerned with this proposal, as it assumes that all natural gas utilities have the same metering capabilities. APGA represents utilities of all shapes and sizes, and most of our members have not deployed advanced metering technology that can meter in the way the IECC hopes to collect data. Furthermore, because of their small size, APGA's members may not have the resources to help implement such metering programs. Instead, APGA suggests that the metering be limited to electric metering only, as advanced electric metering technology is much more prevalent these days.

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

This proposal will decrease the cost of construction, as it will not reduce the cost of metering equipment that may not even be permitted by law/regulation or useable by the local utility.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: this proposal would add the word “electrical” to the title of Section C405.13.3 and the associated table.

Final Hearing Results

CE2D-33-23	AM

CE2D-38-23

Original Proposal

IECC CE: C405.16.2.4

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

2024 International Energy Code[CE Project] R3

Revise as follows:

C405.16.2.4 ESS-ready minimum system capacity. Compliance with ESS-ready requirements in Sections C405.16.2.1 through C405.16.2.3 shall be based on a minimum total energy capacity and minimum rated power capacity as follows:

1. ESS rated energy capacity (kWh) ≥ gross *conditioned floor area* of the three largest floors (ft^2) x 0.0008 kWh/ft^2
2. ESS rated power capacity (~~kWh~~ kW) ≥ gross *conditioned floor area* of the three largest floors (ft^2) x 0.0002 ~~kWh~~ kW/ft^2

Reason: This proposed change corrects the units used in the equation (kW is the correct unit for power, as kWh is the unit of energy).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is only an editorial correction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Editorial correction of the equation.

Final Hearing Results

CE2D-38-23	AS

CE2D-40-23

Original Proposal

IECC CE: C405.2.10.1, C405.2.10.2

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C405.2.10.1 Sleeping units and dwelling units in hotels, motels, and vacation timeshare properties. Sleeping units and dwelling units in hotels, motels and vacation timeshare properties shall be provided with the following:

1. ~~At least~~ Not less than two 125V, 15- and 20- amp switched receptacles ~~per~~ in each room, except for bathrooms, kitchens, foyers, hallways, and closets.
2. Lighting controls that automatically turn off all lighting and switched receptacles within 20 minutes after all occupants have left the unit.

   Exception: *Automatic* shutoff is not required where *captive key override* controls all lighting and switched receptacles in units with 5 or fewer permanently installed lights and switched receptacles.

C405.2.10.2 Sleeping units in congregate living facilities. Sleeping units in congregate living facilities shall be provided with the following controls:

1. Lighting in bathrooms shall be controlled by an *occupant sensor control* that automatically turns lights off within 20 minutes after all occupants have left the space.
2. Each unit shall have a *manual* control by the entrance that turns off all lighting and switched receptacles in the unit, except for lighting in bathrooms and kitchens. The *manual* control shall be clearly *labeled*.

Reason: Item 1 = editorial. Item 2 = mitigating a hazardous condition.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No additional requirements proposed.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: These are editorial changes that help to clarify the language

Final Hearing Results

CE2D-40-23	AS

CE2D-41-23

Original Proposal

IECC CE: C405.2.10.2

Proponents: BRYAN P HOLLAND, National Electrical Manufacturers Association (NEMA), National Electrical Manufacturers Association (NEMA) (bryan.holland@nema.org)

2024 International Energy Code[CE Project] R3

Revise as follows:

C405.2.10.2 Sleeping units in congregate living facilities. Sleeping units in congregate living facilities shall be provided with the following controls:

1. Lighting in bathrooms shall be controlled by an*occupant sensor control* that automatically turns lights off within 20 minutes after all occupants have left the space.
2. Each unit shall have a *manual* control by the entrance that turns off all lighting and switched receptacles in the unit, except for lighting in bathrooms. The *manual* control shall be ~~clearly labeled~~ marked to indicate its function.

Reason: The term “labeled” is a defined term that is not used in this context. Changing to “permanently marked” is consistent with other codes in identifying the purpose of a device’s function. This fixes the issue of the subjectivity of using the word “clearly”.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change is editorial in nature.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Replaces a vague term and defined term with an enforceable marking requirement.

Final Hearing Results

CE2D-41-23	AM

CE2D-44-23

Original Proposal

IECC CE: C405.2.8

Proponents: Tim Peglow, UT MD Anderson Cancer Cetner, self (tpeglow@mdanderson.org)

2024 International Energy Code[CE Project] R3

Revise as follows:

C405.2.8 Demand responsive lighting controls. Interior general lighting in group B, E, M, and S occupancies shall have demand responsive controls complying with C405.2.8.1 in not less than 75 percent of the interior floor area.

Exceptions:

1. Where the combined interior floor area of group B, E, M, and S occupancies is less than 10,000 square feet.
2. *Buildings* where a *demand response signal* is not available from a controlling entity other than the *owner*.
3. Parking garages
4. <u>Ambulatory Care Facilities</u>
5. <u>Outpatient clinics</u>
6. <u>Physician or dental offices</u>

Reason: Ambulatory care facilities by the nature of the care delivered should be exempt from demand response programs for lighting. Ambulatory surgery lighting should not be reduced due to a demand response event.

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

This added exemption will reduce cost of construction in an ambulatory surgery facility.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proponent identified an important safety concern in medical occupancies within Group B Buildings. This is further modified to capture all medical occupancies that will be found in Group B buildings with the scope of the exception.

Final Hearing Results

CE2D-44-23	AM

CE2D-45-23

Original Proposal

IECC CE: C405.2.8, C405.2.8.1

Proponents: Harold Jepsen, Legrand, Legrand (harold.jepsen@legrand.us)

2024 International Energy Code[CE Project] R3

Revise as follows:

C405.2.8 Demand responsive lighting controls. Interior *general lighting* in group B, E, M, and S occupancies shall have *demand responsive controls* complying with C405.2.8.1 in not less than 75 percent of the interior floor area.

Exceptions:

1. Where the combined interior floor area of group B, E, M, and S occupancies is less than 10,000 square feet (929 m^2).
2. *Buildings* where a *demand response signal* is not available from a controlling entity other than the *owner*.
3. Parking garages

C405.2.8.1 Demand responsive lighting controls function. *Demand responsive controls for* lighting ~~controls~~ shall be capable of the following:

1. Automatically reducing the output of ~~demand responsive~~ controlled lighting to 80 percent or less of full power or light output upon receipt of a *demand response signal*.
2. Where *high-end trim* has been set, automatically reducing the output of controlled lighting to 80 percent or less of the *high-end trim* set point upon receipt of a *demand response signal*.
3. Dimming controlled lights gradually and continuously over a period of not longer than 15 minutes to ~~get to~~ achieve their demand response setpoint.
4. Returning controlled lighting ~~lights~~ to ~~their~~ its normal operational settings at the end of the *demand response period* ~~event~~.

Exception: Storage rooms and warehouse storage ~~Warehouse and retail *building* storage *building*~~ areas shall be permitted to switch off 25 percent or more of *general lighting* power rather than dimming.

Reason: These changes are editorial to provide greater clarity to the provision requirements. These changes align language with defined terms, removes language redundancy, italicizes defined terms, and improves parallel language structure for clarity. The stringency, intent or application of the code is not altered with these changes.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These changes are editorial and for greater clarity.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Editorial changes provide clarity and alignment with defined terms.

Final Hearing Results

CE2D-45-23 AM

CE2D-47-23

Original Proposal

IECC CE: C405.3.1

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C405.3.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-9.

$$TCLP = [LVL + BLL + LED + TRK + Other] \quad \textbf{(Equation 4-9)}$$

where:

TCLP = Total connected lighting power (watts).*LVL* = For luminaires with lamps connected directly to*building* power, such as line voltage lamps, the rated wattage of the lamp.*BLL* = For luminaires incorporating a ballast or transformer, the rated input wattage of the ballast or transformer when operating that lamp.*LED* = For light-emitting diode luminaires with either integral or remote drivers, the rated wattage of the luminaire.*TRK* = For lighting track, cable conductor, rail conductor, and plug-in busway systems that allow the addition and relocation of luminaires without rewiring, the wattage shall be one of the following:

1. The specified wattage of the luminaires, but not less than 8 W per linear foot (25 W/lin m).
2. The wattage limit of the permanent current-limiting devices protecting the system.
3. The wattage limit of the transformer supplying the system.

Other = The wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data supplied by the manufacturer or other *approved* sources.

The connected power associated with the following lighting equipment and applications is not included in calculating total connected lighting power.

1. Emergency lighting that is automatically off during normal operations.
2. Lighting in spaces specifically designed for use by occupants with special lighting needs, including those with visual impairment and other medical and age-related issues.
3. Mirror lighting in makeup or dressing areas used for video broadcasting, video or film recording, or live theatrical and music performance.
4. Task lighting for medical and dental purposes that is in addition to*general lighting*.
5. Display lighting for exhibits in galleries, museums and monuments that is in addition to*general lighting*.
6. Lighting in any location that is specifically used for video broadcasting, video or film recording, or live theatrical and music performance.
7. Lighting for photographic processes.
8. Lighting integral to equipment or instrumentation and installed by the manufacturer.
9. Task lighting for plant growth or maintenance.
10. Advertising signage or directional signage.
11. Lighting for food warming.
12. Lighting equipment that is for sale.

13. Lighting demonstration equipment in lighting education facilities.
14. Lighting *approved* because of safety considerations.
15. Lighting in retail display windows, provided that the display area is enclosed by ceiling-height partitions.
16. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
17. Exit signs.
18. Antimicrobial lighting used for the sole purpose of disinfecting a space.
19. Lighting in sleeping units and dwelling units.
20. For exit access and exit stairways, ~~exit stairways and their~~ including landings, where the applicable ~~building~~ code ~~or life safety code~~ requires ~~a minimum~~ an illuminance of 10 footcandles or more on the walking surface, the power in excess of the allowed power calculated according to C405.3.2.2, is not included.

Reason: Edited for clarity.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Editorial.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Provides clearer language for applying the exception of lighting power.

Final Hearing Results

CE2D-47-23	AS

CE2D-48-23

Original Proposal

IECC CE: C405.3.3

Proponents: Michael Jouaneh, Lutron Electronics Co., Inc., Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C405.3.3 Lighting power for sleeping units and dwelling units. Sleeping units in Group I-2 occupancies that are patient rooms shall comply with C405.3.1 and C405.3.2. For all other sleeping units and dwelling units, permanently installed lighting including lighting integrated into range hoods and exhaust fans, shall be provided by lamps capable of operating with an efficacy of not less than 65 lm/W or luminaires capable of operating with an efficacy of not less than 45 lm/W.

Exceptions:

1. Lighting integral to other appliances.
2. Antimicrobial lighting used for the sole purpose of disinfecting.
3. Luminaires with an input rating of less than 3W.

Reason: Efficacy changes in most light sources depending on the setting the lighting is operating in. Most lighting is dimmable (changes in intensity), and some allow for changes in color temperature and/or hue (e.g., color tunable lighting that can change the lighting from white light to red or blue etc.). Efficacy of the lighting changes depending on these settings. Particularly with color tunable lighting, which can meet the efficacy thresholds when operating in white but may be below the threshold when operating in a specific color like blue. So, this added phrase "capable of operating" allows dynamic lighting to comply especially color tunable lighting. Also, this change will make the commercial code consistent with the residential code for this same requirement.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Adds “capability of operating” before the efficacy requirements. Addresses color tuning / changing light sources.

Final Hearing Results

CE2D-48-23	AS

CE2D-51-23

Original Proposal

IECC CE: TABLE C406.1.1(2), C406.1.1, C406.1.1.1, C502.3.7, C502.3.7.1

Proponents: Laura Petrillo-Groh, AHRI, Air-Conditioning, Heating, and Refrigeration Institute (lpetrillo-groh@ahrinet.org); Vladimir Kochkin, NAHB, NAHB (vkochkin@nahb.org); Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com); Andrew Klein, A S Klein Engineering, PLLC, BOMA International (andrew@asklein.com); Robert Ross, Austin ISD, Self (robertross1952@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

TABLE C406.1.1(2) LIMIT TO ENERGY EFFICIENCY CREDIT CARRYOVER FROM RENEWABLE AND LOAD MANAGEMENT CREDITS

-	CLIMATE ZONE																		
BUILDING OCCUPANCY GROUP	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, AND I-1	5	5	5	5	5	5	5	~~5~~24	~~5~~19	5	~~5~~22	~~5~~18	5	5	~~5~~19	5	5	5	5
I-2	16	14	11	8	6	5	5	~~5~~10	~~5~~6	~~5~~8	~~5~~14	~~5~~10	~~6~~17	1526	1829	1021	1421	1022	2539
R-1	7	5	8	5	19	5	1332	2040	2041	~~5~~24	2041	2042	~~5~~17	1637	1841	5	~~5~~24	~~5~~15	~~5~~22
B	7	5	5	8	6	6	~~5~~14	1026	1431	~~5~~23	2139	1534	~~5~~19	1635	2645	5	~~5~~19	~~5~~17	~~9~~27
A-2	18	16	14	15	13	9	~~5~~11	~~5~~23	1132	5	~~5~~23	~~5~~23	5	5	~~7~~26	5	5	5	5
M	5	5	5	5	5	5	5	5	~~5~~20	5	5	5	5	5	5	5	5	5	5
E	13	13	18	16	17	14	~~6~~21	2035	2540	~~9~~25	2643	1329	~~7~~23	1532	1027	~~5~~11	~~5~~17	~~9~~25	5
S-1 AND S-2	5	5	5	5	5	5	5	5	~~5~~13	5	~~5~~17	~~5~~20	5	1435	~~5~~23	5	5	~~5~~11	1740
All Other	5	5	5	5	5	5	5	~~5~~7	~~5~~17	5	~~5~~10	~~5~~7	5	~~5~~6	~~5~~11	5	5	5	5

C406.1.1 Additional energy efficiency credit requirements. *Buildings* shall comply with measures from C406.2 to achieve not less than the number of required efficiency credits from Table C406.1.1(1) based on *building* occupancy group and *climate zone* including any energy credit adjustments in accordance with C406.1.1.1. Where a project contains multiple occupancies, the total required energy credits ~~in Table C406.1.1(1)~~ from each *building* occupancy shall be weighted by the gross *conditioned floor area* to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.

Exceptions:

1. Portions of buildings devoted to manufacturing or industrial use.

2. Where a *building* achieves more renewable and load management credits in Section C406.3 than are required in Section C406.1.2, surplus credits shall be permitted to reduce the required energy efficiency credits as follows:

$$EEC_{red} = EEC_{tbl} - \{the\ lesser\ of: (SRLM_{lim}, \quad SRLM_{adj} \times [RLM_{ach} - RLM_{req}])\}$$

EEC_{red} = Reduced required energy efficiency credits
EEC_{tbl} = Required energy efficiency credits~~from Table C406.1.1(1)~~
$SRLM_{lim}$ = Surplus renewable and load management credit limit from Table C406.1.1(2)
$SRLM_{adj}$ = 1.0 for all-electric or all-renewable buildings (excluding emergency generation) 0.7 for buildings with fossil fuel equipment (excluding emergency generation)
RLM_{ach} = Achieved renewable and load management credits from Section C406.3
RLM_{req} = Required renewable and load management credits from Section C406.1.2

C406.1.1.1 Buildings without heat pumps. The number of efficiency credits required by Section C406.1.1 shall be multiplied by 1.25 for the following:

1. Buildings using purchased energy that is not electricity for space heating or service water heating,
2. Buildings with electric storage water heaters that are not heat pumps
3. Buildings with total heat pump space heating capacity less than the space heating load at heating design conditions calculated in accordance with Section C403.1.1

~~*Buildings* using *purchased energy* that is not electricity for space heating or *service water heating, buildings* with electric storage water heaters that are not heat pumps and buildings with total heat pump space heating capacity less than the space heating load at heating design conditions calculated in accordance with Section C403.1.1 shall comply with measures from C406.2 to achieve not less than 1.25 multiplied by the number of required efficiency credits from Table C406.1.1 based on *building* occupancy group and *climate zone*. Where a project contains multiple occupancies, credits in Table C406.1.1 from each *building* occupancy shall be multiplied by 1.25 and weighted by the gross *conditioned floor area* to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.~~

Exceptions:

1. Portions of *buildings* devoted to manufacturing or industrial use.
2. *Buildings* complying with all of the following:
   2.1 The *building's* peak heating load calculated in accordance with Section C403.1.1 is greater than the *building's* peak cooling load calculated in accordance with Section C403.1.1.
   2.2 The *building's* total heat pump space heating capacity is not less than 50 percent of the *building's* space heating load at heating design conditions calculated in accordance with Section C403.1.1.
   2.3 Any energy source other than electricity or *on-site renewable energy* is used for space heating only when a heat pump cannot provide the necessary heating energy to satisfy the *thermostat* setting.
   2.4 Electric resistance heat is used only in accordance with Section C403.4.1.1.
3. Low-energy buildings complying with Section C402.1.1.1.
4. Portions of buildings in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, or High-Hazard Group H.

C502.3.7 Additional energy efficiency credits. *Additions* shall comply with measures from Sections C406.2 and C406.3 to achieve not less than 50 percent the number of required efficiency credits from Table C406.1.1 based on *building* occupancy group and *climate zone*. Where a project contains multiple occupancies, credits in Table C406.1.1 from each *building* occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of this section. *Alterations* to the existing *building* that are not part of an *addition*, but permitted with an *addition*, ~~may~~ shall be permitted to be used to achieve the required credits.

Exceptions:

1. *Buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, High-Hazard Group H.
2. *Additions* less than 1,000 ft^2 (~~92~~ 93 m^2) and less than 50 percent of existing floor area.
3. *Additions* that do not include the *addition* or replacement of equipment covered by Tables C403.3.2(1) through C403.3.2(16) or Section C404.2.
4. *Additions* that do not contain *conditioned space*.
5. Where the *addition* alone or the existing *building* and *addition* together comply with Section C407.

C502.3.7.1 Additions not served by heat pumps. The number of efficiency credits required by C502.3.7 shall by multiplied by 1.25 for the following:

1. *Additions* using purchased energy that is not electricity for space heating or *service water heating*,
2. *Additions* served by electric storage water heaters that are not heat pumps
3. *Additions* served by total heat pump space heating capacity less than the peak space heating load at heating design conditions calculated in accordance with Section C403.1.1

~~*Additions* using *purchased energy* that is not electricity for space heating or *service water heating*, *additions* served by electric storage water heaters that are not heat pumps and *additions* served by total heat pump space heating capacity less than the peak space heating load at heating design conditions calculated in accordance with Section C403.1.1 shall comply with measures from Sections C406.2 and C406.3 to achieve not less than 67.5 percent of the number of required efficiency credits from Table C406.1.1 based on *building* occupancy group and *climate zone*. Where a project contains multiple occupancies, credits in Table C406.1.1 from each *building* occupancy shall be weighted by the gross *conditioned floor area* to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of this section. *Alterations* to the existing *building* that are not part of an *addition*, but permitted with an *addition*, may shall be permitted to be used to achieve the required credits.~~

Exceptions:

~~1. Buildings in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, or High-Hazard Group H~~.

~~2. Additions less than 1,000 ft² (92 m²) and less than 50 percent of existing floor area.~~

~~3. Additions that do not include the *addition* or replacement of equipment covered by Tables C403.3.2(1) through C403.3.2(16) or Section C404.2.~~

~~4. Additions that do not contain *conditioned space*.~~

~~5. Where the *addition* alone or the existing *building* and *addition* together comply with Section C407~~.

~~6.~~ Additions complying with all of the following:

~~6.1~~ The *addition*'s peak heating load calculated in accordance with Section C403.1.1 is greater than the *addition*'s peak cooling load calculated in accordance with Section C403.1.1.

~~6.2~~ The *addition*'s total heat pump space heating capacity serving the *addition* is not less than 50 percent of the *addition*'s space heating load at heating design conditions calculated in accordance with Section C403.1.1.

~~6.3~~ Any energy source other than electricity or *on-site renewable energy* is used for space heating serving the *addition* only when a heat pump cannot provide the necessary heating energy to satisfy the *thermostat* setting.

~~6.4~~ Electric resistance heat serving the *addition* is used only in accordance with Section C403.4.1.1.

~~7. Low-energy buildings complying with Section C402.1.1.1~~.

Reason: This proposal modifies TABLE C406.1.1(2) Limit to Energy Efficiency Credit Carryover from Renewable and Load Management

Credits to ensure that IECC 2024 has a pathway for minimum efficiency products in the event Sections C406.1.1.1 and C502.3.7.1 are not deleted.

In response to IECC Public Comment Draft Ballot #1 and #2, AHRI and its members, respectfully opposed the Proposed Revisions to Section C406.1.1.1 of the Energy Code, requiring new buildings using fossil fuels for space or water heating equipment, with certain exemptions, to increase the total energy credits required by 1.25. AHRI also opposed the additions to Section C502.3.7.1, requiring additions using fossil fuels for space or water heating equipment, with certain exemptions, to achieve 67.5 percent of the number of efficiency credits (a higher threshold than was proposed in Public Draft 1).

Increasing the base energy credits in TABLE C406.1.1(1)*Energy Credit Requirements by Building Occupancy Group* without appropriately increasing offsets in TABLE C406.1.1(2) *Limit to Energy Efficiency Credit Carryover from Renewable and Load Management Credits*, creates the same federal preemption problem that necessitated the creation of TABLE C406.1.1(2), in the first place (in CED1-190-22). This proposal rectifies the creation of a legally invalid code by increasing the surplus table to offset the impact of the 1.25x multiplier.

To establish values in this table, the spreadsheet created by Pacific Northwest National Laboratory (PNNL) during the development of CED1-190-22 was modified to calculate the impact of the 1.25 multiplier. The surplus credit table numbers were modified to ensure that energy efficiency credit requirements could be met without using higher efficiency Energy Policy Act-covered (EPACT) equipment. This methodology ensures a pathway for preempted equipment in the 2024 IECC – a critical legal requirement.

Details on AHRI's concerns with the creation of a legally invalid code created by CECD-18-22, were submitted in code proposal 1643. The calculation worksheet has been provided to ICC staff. Refer to the table starting on cell B96 (highlighted green) on the tab title "Carry-overCurrentPC-1.25x."

Additional supporting information posted at the following link https://www.iccsafe.org/wp-content/uploads/Proposal-IECC-C-1726-supporting-documentation-ahri.xlsx

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

This proposal will help offset the cost compliance for buildings which need fossil fuel space and/or water heating equipment.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal modifies TABLE C406.1.1(2) Limit to Energy Efficiency Credit Carryover from Renewable and Load Management Credits to ensure that IECC 2024 has a pathway for minimum efficiency products in the event Sections C406.1.1.1 and C502.3.7.1 are not deleted.

Final Hearing Results

CE2D-51-23 AM

CE2D-57-23

Original Proposal

IECC CE: C406.1.1.1

Proponents: Richard Lord, Carrier Corporation, Carrier Corporation (richard.lord@carrier.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C406.1.1.1 Buildings without heat pumps. Buildings using purchased energy that is not electricity for space heating or service water heating, buildings with electric storage water heaters that are not heat pumps and buildings with total heat pump space heating capacity less than the space heating load at heating design conditions calculated in accordance with Section C403.1.1 shall comply with measures from C406.2 to achieve not less than 1.25 multiplied by the number of required efficiency credits from Table C406.1.1 based on building occupancy group and climate zone. Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be multiplied by 1.25 and weighted by the gross conditioned floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.

Exceptions:

1. Portions of buildings devoted to manufacturing or industrial use.
2. Buildings complying with all of the following:
   - 2.1. Enter text
   - 2.2. The building's peak heating load calculated in accordance with Section C403.1.1 is greater than the building's peak cooling load calculated in accordance with Section C403.1.1.
   - 2.3. Any energy source other than electricity or on-site renewable energy is used for space heating only when a heat pump cannot provide the necessary heating energy to satisfy the thermostat setting.
   - 2.4. Electric resistance heat is used only in accordance with Section C403.4.1.1.
3. Low-energy buildings complying with Section C402.1.1.1.
4. Portions of buildings in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, or High-Hazard Group H.
5. <u>Buildings located in climate zones 0A, 0B, 1A, 1B, 2A and 2B</u>.

Reason: Heat pumps have a 5 to 10% lower cooling efficiency due to 4 way valve, accumulator and charge optimization losses and would actual result in increased energy in cooling dominated climates. Heat pumps should not be required in these climates for commercial buildings that are dominated by cooling.

Bibliography: Th economic models for credits were not shared by PNNL so we could not easily model the energy use, but some quick analysis we did shows that this will result in energy savings for commercial buildings.

Also it seems like the 1.25 should vary by climate zone and decrease in warmer climates.

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

This actual will be a cost reduction and an energy savings so payback will be instantaneous.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Additional heat pump credits in warm climate zones. Heat pump cooling efficiency are lower than AC efficiency. Detailed slide presentation. Requiring HPs in warm climates increases energy.

Final Hearing Results	
CE2D-57-23	AM

CE2D-58-23

Original Proposal

IECC CE: C406.1.2

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Code[CE Project] R3

Revise as follows:

C406.1.2 Additional renewable and load management credit requirements. Buildings shall comply with measures from C406.3 to achieve not less than the number of required renewable and load management credits from Table C406.1.2 based on *building* occupancy group and *climate zone*. Where a project contains multiple occupancies, credits in Table C406.1.2 from each*building* occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.

Exception: Where a *building* achieves more energy efficiency credits in Section C406.2 than are required in Section C406.1.1, the renewable and load management credits required in Table C406.1.2 shall be permitted to be reduced by the amount of surplus energy efficiency credits~~, not to exceed a 30 percent reduction~~.

Reason: This proposal addresses two issues in the exception to Section C406.1.2: (1) to allow or permit reduction in required renewable and load management credits but not require it as currently written if there are surplus efficiency credits available, and (2) remove the limit on using excess efficiency credits to reduce the renewable and load management credit requirements. Energy efficiency or conservation of renewable and non-renewable primary energy sources is the back-bone of an energy conservation code. This is particularly so in an environment where transition to renewables and low-carbon energy sources is already occurring at a rapid pace due to other major policies that are focused on upstream energy sources rather than attempting to control them at the building project level. Also, use of renewable energy or load management measures does not reduce the net energy demand of the building so it is unclear how these credits can be considered on equivalent basis of energy efficiency credits. To the awareness of this proponent, there did not appear to be a rationale provided to justify inclusion of the 30 percent reduction limit.

ALTERNATE PROPOSAL: As an alternative solution, energy efficiency credits and renewable/load management credits should be treated separately (delete the exception in C406.1.2 and exception 2 in C406.1.1). Coordinating changes should be considered for Appendices CD and CF as well.

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

By adding additional flexibility in the use of surplus energy efficiency credits to offset required credits for renewables and load management, this should tend to reduce cost by providing the user with more options to satisfy the requirements of Section C406.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal removes the 30% limitation on renewable and load management credits. Removing the 30% limitation provides flexibility in achieving credit compliance, and a clear rationale was not presented for the 30% reduction.

Final Hearing Results

CE2D-58-23	AS

CE2D-61-23

Original Proposal

IECC CE: C406.2, C406.2.2.1

Proponents: Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Lab (michael.tillou@pnnl.gov)

2024 International Energy Code[CE Project] R3

Revise as follows:

C406.2 Additional Energy Efficiency Credits Achieved. Each energy efficiency credit measure used to meet credit requirements for the project shall have efficiency that is greater than the requirements in Sections C402 through C405. Measures installed in the project that meet the requirements in Sections C406.2.1 through C406.2.7 shall achieve the base credits listed for the measure and occupancy type in Tables C406.2(1) through C406.2(9) or, where calculations required by Sections C406.2.1 through C406.2.7 create or modify the table credits, the credits achieved shall be based upon the calculations. Energy credits achieved for measures shall be determined by one of the following, as applicable:

1. The measure's energy credit shall be the base energy credit from Tables C406.2(1) through C406.2(9) for the measure where no adjustment factor or calculation is included in the description of the measure in Section C406.2.
2. The measure's energy credit shall be the base energy credit for the measure adjusted by a factor or equation as stated in the description of the measure in Section C406.2. Where adjustments are applied, each measure's energy credit shall be rounded to the nearest whole number.
3. The measure's energy credit shall be calculation as stated in the measures description in Section C406.2, where each individual measure credit shall be rounded to the nearest whole number.

Energy credits achieved for the project shall be the sum of the individual measure's energy credits. Credits are available for the measures listed in this Section. Where a project contains multiple *building* occupancy groups:

1. Credits achieved for each occupancy group shall be summed and then weighted by the*conditioned floor area* of each occupancy group to determine the weighted average project energy credits achieved.
2. Improved envelope efficiency (E01 through E06), HVAC Performance (H01), and lighting reduction (L06) measure credits shall be determined for the *building* or permitted *conditioned floor area* as a whole. Credits for other measures shall be determined for each occupancy separately. Credits shall be taken from applicable tables or calculations for each occupancy and weighted by the *building* occupancy group floor area.

C406.2.2.1 H01 HVAC Performance (TSPR). H01 energy credits shall be earned where systems are permitted to use Section C409 and where the savings (TSPRs) based on the proposed TSPR (TSPRp) compared to the target ~~exceeds the minimum~~TSPR (TSPRt) ~~requirement~~ is 5 percent or more. If ~~improvement~~ savings is greater than 5 percent, determine H01 earned credits using Equation 4-14. Energy credits for H01 shall not be combined with energy credits from HVAC measures H02, H03 or H05.

EC_{TSPR} = EC_{BASE} x ~~TSPRa~~ $AREA_{TSPR}$ x TSPRs / 0.05 **(Equation 4-14)**

where:

EC_{TSPR} = Energy credits achieved for H01

EC_{BASE} = H01 base energy credits from Tables C406.2(1) through C406.2(9)

TSPRs = ~~TSPRa x~~ [the lessor of 0.20 and (1-(TSPRt / TSPRp))]

~~TSPRa~~$AREA_{TSPR}$ = [floor area served by systems ~~permitted to use~~included in TSPR] / [total building*conditioned floor area*]

TSPRp = HVAC TSPR of the proposed design calculated in accordance with Sections C409.4, C409.5 and C409.6.

TSPRt = TSPRr / MPF

TSPRr = HVAC TSPR of the reference *building* design calculated in accordance with Sections C409.4, C409.5 and C409.6.

MPF = Mechanical Performance Factor from Table C409.4 based on*climate zone* and *building* use type

Where a *building* has multiple *building* use types, MPF shall be area weighted in accordance with Section C409.4

Reason: Review and testing of the formula for TSPRs found three issues that this proposal corrects:

1. The subscript TSPRx is inccorect and changed to TSPRs for TSPRsavings

2. TSPRp and TSPRt were reversed in the formula for TSPRs resulting in a negative result and a fraction representing improvement in TSPR rather than the savings indicated by the improvement in TSPR. The corrected core formula for TSPRsavings is: 1 - (TSPRt / TSPRp)

As an example, for a typical improvement case, the current TSPRs formula would return -12.6% savings when the TSPR improvement was 12.6%, and the actual savings in site energy use was 11.2%. The corrected formula returns 11.2%.

3. The adjustment for building area included in the TSPR calculation (TSPRa) was moved to the main formula so that TSPRs can be properly referenced to be in the range of 0.05 to 0.20 for setting measure eligibility limits.

Two symbols were added for the base and earned energy credits to match the format of other measure adjustment formulas.

In addition, charging language was clarified to indicate the minimum 5% is a savings from TSPR improvement rather than the TSPR improvement itself. Also, the mixed-use section was modified to include measure H01 with those measures that are calculated for the project as a whole.

NOTE: CDPaccess did not retain strikeout and underline for many of the proposed corrections, a file is attached that shows all the proposed changes from the second round IECC posting.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There is no cost impact from this correction to match the intended 5% savings basis for measure H01.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Change the TSPRa to AREAtspr. Not substantive. Simple change in two places. Does not affect the stringency.

Final Hearing Results

CE2D-61-23	AM

CE2D-64-23

Original Proposal

IECC CE: C406.2.5.5

Proponents: Jack Bailey, ONE LUX STUDIO, INTERNATIONAL ASSOCIATION OF LIGHTING DESIGNERS (jbailey@oneluxstudio.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C406.2.5.5 L05 Residential light control. In *buildings* with Group R-2 occupancy spaces, interior lighting systems shall comply with the following:

1. In common area, the following space types shall have occupant sensor controls that comply with the requirements of Section C405.2.1.1 :
   - 1.1 Laundry/washing areas,
   - 1.2 Dining areas,
   - 1.3 Food preparation areas,
   - 1.4 Seating areas,
   - 1.5 Exercise areas,
   - 1.6 Massage spaces
2. In dwelling units, not less than one receptacle in each living room and each sleeping room shall be controlled by a switch in that room.
3. ~~Each *dwelling unit* shall have a switch by the main entrance that turns off all the lighting and all switched receptacles in the *dwelling unit*.~~ Lights and switched receptacles in bathrooms and kitchens shall be controlled by an occupant sensor complying with Section C405.2.1.1. All other lights and switched receptacles in each dwelling unit shall be controlled by a switch at the main entrance.The switch shall be ~~clearly labeled~~ marked to indicate its function.**Exception:** Lighting and switched receptacles controlled by an occupant sensor complying with Section C405.2.1.1 are not required to be controlled by the switch at the main entrance.

Reason: Legitimate safety concerns were raised during the consensus committee hearing related to elderly or disabled people being unable to safely find their way to the main switch in the event that someone else inadvertently shut the lights off on them. Equivalent energy savings will be achieved through the use of occupant sensors, while eliminating the safety concern.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

An occupant sensor is more expensive than a switch, but providing one is optional.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Legitimate safety concerns were raised during the consensus committee hearing related to elderly or disabled people being unable to safely find their way to the main switch in the event that someone else inadvertently shut the lights off on them. Equivalent energy savings will be achieved through the use of occupant sensors, while eliminating the safety concern.

Final Hearing Results

CE2D-64-23 AM

CE2D-66-23

Original Proposal

IECC CE: C408.3.1.4, C408.3.1.5

Proponents: Harold Jepsen, Legrand, Legrand (harold.jepsen@legrand.us)

2024 International Energy Code[CE Project] R3

Revise as follows:

C408.3.1.4 High-end trim controls. Where lighting controls are configured for*high-end trim*, verify the following:

1. *High-end trim* maximum level has been set.
2. The calibration adjustment equipment is located for *ready access* only by authorized personnel.
3. Lighting controls with *ready access* for users cannot increase the lighting power above the maximum level established by the*high-end trim* controls.

C408.3.1.5 High end trim lighting control verification for Additional Efficiency Credit L02. For the qualifying spaces associated with the project receiving additional efficiency credits in Section C406.2.5.2, the following shall be documented while daylight responsive controls are not reducing lighting power:

1. The maximum setting for power or light output for each control group of*general lighting* luminaires.
2. The *high-end trim* setting for power or light output for each control group of*general lighting* luminaires.
3. For projects with seven or fewer claimed qualifying spaces, the reduction in lightoutput ~~level~~ or reduction in power due to *high-end trim* shall be tested in all spaces and shown to reduce the *general lighting* power or light output ~~level~~ to not greater than 85 percent of full power or light output. For projects with more than seven claimed qualifying spaces, the reduction in light output ~~level~~ or reduction in power due to *high-end trim* shall be tested in not less than 10 percent of spaces, and no less than seven spaces, and shown to reduce *general lighting* power or light output ~~level~~ to not greater than 85 percent of full power or light output. Where more than 30 percent of the tested spaces fail, the remaining qualifying spaces shall be tested.
4. Summarize the reduction in *general lighting* power or light output resulting from the *high-end trim* setting for each qualifying space and the floor area of each qualifying space.
5. Summarize the fraction of total floor area for spaces where*high-end trim* reduces *general lighting* power or light output to not greater than 85 percent of full power or light output.

Reason: Some of these shown changes are to restore language from PC Proposal CECD1-4-22, which were left out of the PC DRAFT1 version.

Other changes are editorial to provide greater clarity to the requirements. These changes align language with defined terms,and identifies lighting output reduction as a method to verify functional operation as already identified in three earlier sections of this section. The stringency, intent orapplication of the code is not altered with these changes.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These changes are to correct proposal language which was left out of the PC Draft1 version as well as for editorial and clarity reasons.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Provides clarity for functional testing of high-end trim lighting controls.

Final Hearing Results	
CE2D-66-23	AM

CE2D-67-23

Original Proposal

IECC CE: C408.3.1.6

Proponents: Harold Jepsen, Legrand, Legrand (harold.jepsen@legrand.us)

2024 International Energy Code[CE Project] R3

Revise as follows:

C408.3.1.6 Demand responsive lighting controls G01. For spaces associated with the project receiving Renewable and Load Management Credits in Section C406.3.2, the following procedures shall be performed:

1. Confirm the maximum set point upon receipt of the *demand response signal* has been established for each space.
2. For projects with seven or fewer spaces ~~rooms~~ with controls, each space ~~room~~ shall be tested.
3. For projects with more than seven spaces ~~rooms~~ with controls, testing shall be done for each unique space type. Where multiple spaces ~~rooms~~ of each space type exist, not less than 10 percent and in no case fewer than one space ~~room~~, of each space type shall be tested unless the *code official* requires a higher percentage to be tested. Where 30 percent or more of the tested controls fail in a space type, all remaining identical space types shall be tested.
4. For demand responsive controls to be tested, verify the following:
   - 4.1 Where *high-end trim* controls are used, the *high-end trim* shall be set before testing.
   - 4.2 Turn off all non-*general lighting* in the space ~~room~~.
   - 4.3 Set *general lighting* to its maximum illumination level. Where *high-end trim* is set, this will be the maximum illumination level at the *high-end trim* setpoint.
   - 4.4 An illumination measurement shall be taken in an area of the space ~~room~~ not controlled by daylight responsive controlled lighting. If there is not an area without daylight responsive controls the daylight responsive controls shall be overridden from reducing the lighting level during the test.
   - 4.5 Measure and document the space ~~room~~ maximum illumination level.
5. Simulate a *demand response signal* and measure the illumination level at the same location as for the measurement in C408.3.1.5.(4.5). Verify the illumination level has been reduced to no greater than 80 percent of the maximum illumination level documented in C408.3.1.5.(4.5).
6. Simulate the end of a demand event by turning off the *demand response signal*, confirm controls automatically return to their normal operational settings at the end of the demand response event.

Reason: These changes are editorial to provide greater clarity to the requirements by changing the term "room" for that of "space". Using the term space is consistent with other functional testing requirements in this section. The stringency, intent or application of the code is not altered with these changes.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These changes are editorial and for greater clarity.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Provides clarity for functional testing of demand responsive controls within a space.

Final Hearing Results	
CE2D-67-23	AS

CE2D-69-23

Original Proposal

IECC CE: C503.2.1

Proponents: Glen Clapper, National Roofing Contractors Association, National Roofing Contractors Association (gclapper@nrca.net)

2024 International Energy Code[CE Project] R3

Revise as follows:

C503.2.1 Roof, ceiling, and attic alterations. Insulation complying with Section C402.1 and Section C402.2.1, or an *approved* design that minimizes deviation from the insulation requirements, shall be provided for the following alterations:

1. An *alteration* of roof-ceiling construction other than refroofing where existing insulation located below the roof deck or on an attic floor above *conditioned space* does not comply with Table C402.1.2.
2. *Roof replacement* .or a roof *alteration* that includes removing and replacing the *roof covering*, where the *roof assembly* includes insulation entirely above the *roof* deck.

    Exceptions: Where compliance with Section C402.1 cannot be met due to limiting conditions on an existing roof, an *approved* design shall be submitted with the following:

    1. *Construction documents* that include a report by a *registered design professional* or an *approved* ~~third party~~ *source* documenting details of the limiting conditions affecting compliance with the insulation requirements.
    2. *Construction documents* that include a roof design by a *registered design professional* or an *approved* ~~third party~~ *source* that minimizes deviation from the insulation requirements.

3. Conversion of unconditioned attic space into *conditioned space*.
4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling construction.

Reason: This proposal restores the newly (2024) defined term, approved as modified in the first Public Input Initial Draft. The use of a defined term versus an undefined term reduces a potential conflict for the building/code official with regard to the entity providing the required information.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: revising the terminology used provides consistency with residential code.

Final Hearing Results

CE2D-69-23 AS

CE2D-70-23

Original Proposal

IECC CE: C503.5.1

Proponents: Shane Hoeper, SEHPCAC, SEHPCAC

2024 International Energy Code[CE Project] R3

Revise as follows:

C503.5.1 Interior lighting and controls. Alterations to interior spaces, lighting, or controls shall comply with the following:

1. Where an alteration ~~the area~~ of an interior ~~spaces is altered, those spaces~~ space includes the addition or relocation of full height partitions, the space shall comply with ~~the lighting power requirements of Section~~ Sections C405.2, C405.3 and C408.3. ~~those spaces shall comply with the lighting control requirements of Sections C405.2 and C408.3~~.
2. Where the lighting within interior spaces is altered, those spaces shall comply with~~the lighting power requirements of~~ Sections C405.2, C405.3 and C408.3. ~~those spaces shall comply with the lighting control requirements of C405.2 and C408.3~~.
3. Where the lighting controls within interior spaces are altered, those spaces shall comply with~~the lighting control requirements of~~ Sections C405.2 and C408.3.

Exception: Compliance with Section C405.2.~~9~~8 is not required for alterations.

Reason: These recommended revisions are mainly editorial in nature to add clarity, conciseness, and enforceability to the section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These changes do not impact the cost effectiveness nor the original technical merit or intent of the requirement.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal clarifies what constitutes an alteration in space area.

Final Hearing Results

CE2D-70-23	AS

CE2D-71-23

Original Proposal

IECC CE: C503.5.2

Proponents: Shane Hoeper, SEHPCAC, SEHPCAC

2024 International Energy Code[CE Project] R3

Revise as follows:

C503.5.2 Exterior lighting and controls. Alterations to exterior lighting and controls shall comply with the following:

1. Where the connected exterior lighting power is increased by more than 400 Watts, all exterior lighting, including lighting which is not proposed to be altered, shall comply with ~~lighting power requirements of~~ Section C405.5.
2. Where the combined power of added and replacement luminaires is more than 400 Watts, all lighting which is added or altered shall be controlled in accordance with Sections C405.2 and C408.3.

   Exception: Individual luminaires less than 50 Watts~~which~~ provided they pass functional tests verifying ~~that lights are automatically~~ automatic shut off where daylight is present.

3. Where portions of exterior lighting controls are added or altered, those portions ~~of the lighting control system which are added or altered~~ shall comply with Sections C405.2 and C408.3.

Reason: These recommended revisions are mainly editorial in nature to add clarity, conciseness, and enforceability to the section. These changes do not impact the cost effectiveness nor the original technical merit or intent of the requirement.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These changes do not impact the cost effectiveness nor the original technical merit or intent of the requirement.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: These recommended revisions are mainly editorial in nature to add clarity, conciseness, and enforceability to the section. These changes do not impact the cost effectiveness nor the original technical merit or intent of the requirement.

Final Hearing Results

CE2D-71-23	AS

CE2D-75-23

Original Proposal

IECC CE: CG103.2.6

Proponents: Jennifer Kane, Trane Technologies, Trane Technologies

2024 International Energy Code[CE Project] R3

Revise as follows:

CG103.2.6 Pre-heating of outdoor air. Hydronic systems without energy recovery ventilation and that do not use freeze protection fluids shall be permitted to utilize electric resistance to temper air to not more than 40°F (4.5°C). All systems ~~Systems~~ with energy recovery ventilation shall be permitted to utilize electric resistance to preheat outdoor air for defrost or temper air entering the energy recovery device and shall comply with one of the following:~~. The electric resistance used to preheat outdoor air for the energy recovery device shall not preheat outdoor air greater than 5F; if the space is mechanically humidified or has a process application that will maintain the space above 30% relative humidity, the preheat may not preheat outdoor air greater than 25F. The electric resistance used to preheat outdoor air for heating only applications with sensible heat recover exchangers shall not preheat air greater than 25F.~~

1. When the space is mechanically humidified or has a process application that will maintain the space above 30 percent relative humidity when the outdoor temperature is not greater than 25ºF (-4ºC) and the system recovers latent energy, the outdoor air shall not be preheated to greater than 25ºF (-4ºC);
2. For sensible-only heat recovery exchangers, outdoor air shall not be preheated to greater than 25ºF (-4ºC);
3. For all other systems, outdoor air shall not be preheated outdoor air to greater than 5ºF (-15ºC).

Reason: See attachment.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
See attachment.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: it ensures excessive electric resistance energy is not applied when energy recovery devices are employed.

Final Hearing Results

CE2D-75-23 AM

CE2D-76-23

Original Proposal

IECC CE: ASTM Chapter 06

Proponents: Theresa Weston, The Holt Weston Consultancy, Air Barrier Association of America (ABAA) (holtweston88@gmail.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

ASTM

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

E283/E283M-2019)~~:~~	Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen
E1186-2022	Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
E2357–202~~2~~3:	Standard Test Method for Determining Air Leakage of Air Barriers Assemblies
E3158-201~~9~~8:	Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building

Reason: This proposal is eratta. It corrects the dates on referenced standards.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This corrects errata in the noted dates of reference standards. It makes no technical changes.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Corrects reference year on standards.

Final Hearing Results

CE2D-76-23 AS

CE2D-77-23

Original Proposal

IECC CE: SECTION C404; IECC RE: TABLE C404.10 (New); IECC CE: AHRI Chapter 06 (New)

Proponents: Bryan Ahee, Bradford White Corporation, Bradford White Corporation (bahee@bradfordwhite.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C404.10 Demand responsive water heating.. Electric storage water heaters with a rated water storage volume of 40 gallons (150L) to 120 gallons (450L) and a nameplate input rating equal to or less than 12kW shall be provided with demand responsive controls in accordance with Table C404.10 ~~or another equivalent *approved* standard~~.

Exceptions:

1. Water heaters that provide a hot water delivery temperature of 180°F (82°C) or greater.
2. Water heaters that comply with Section IV, Part HLW or Section X of the ASME Boiler and Pressure Vessel Code.
3. Water heaters that use 3-phase electric power.

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE C404.10 DEMAND RESPONSIVE CONTROLS FOR WATER HEATING

Equipment Type	Controls	
-	Manufactured before 7/1/2025	Manufactured on or after 7/1/2025
Electric storage water heaters	AHRI Standard 1430 or ANSI/CTA-2045-B Level 1 and also capable of initiating water heating to meet the temperature set point in response to a demand response signal.	AHRI Standard 1430 ANSI/CTA-2045-B Level 2, except "Price Stream Communication" functionality as defined in the standard.

2024 International Energy Code[CE Project] R3

Add new standard(s) as follows:

AHRI

Air-Conditioning, Heating, & Refrigeration Institute
~~2111~~ 2311 Wilson Blvd, Suite ~~500~~ 400
Arlington, VA 22201

1430 AHRI 1430 (I-P): Demand Flexible Electric Storage Water Heaters

Reason: AHRI 1430 has been published, this standard was intended to replace the language 'or another equivalent approved standard' in section C404.10, which was a placeholder while AHRI 1430 was finalized. This will align the demand response language with the residential code R403.5.5 and Table R403.5.5 which already reflect these changes.

Bibliography: AHRI

AHRI Standard 1430-2022 (I-P) Demand Flexible Electric Storage Water Heaters
2111 Wilson Blvd, Suite 500
Arlington, VA 22201

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This standard applies to communication, infrastructure, and system functionality as these relate to the implementation of energy management strategies for demand flexible water heaters (DFWH) and will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: It is to incorporate AHRI 1430 and align with IECC residential.

Final Hearing Results

CE2D-77-23	AM

CE2D-78-23 Part I

Original Proposal

IECC CE: NEMA (New)

Proponents: Duane Jonlin, City of Seattle, Seattle Dept of Construction and Inspections (iecccommercial@iccsafe.org)

2024 International Energy Code[CE Project] R3

Add new text as follows:

NEMA 1300 North 17th Street, Suite 900, Rosslyn, VA 22209. OS 4-2016 Requirements for Air-Sealed Boxes for Electrical and Communication Applications

Reason: Standard Reference for air-sealed boxes for electrical and communication applications provisions in IECC-C and IECC-R

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Reference standard. No cost implication

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Provides the needed reference standard.

Final Hearing Results

CE2D-78-23 Part I AS

CE2D-78-23 Part II

Original Proposal

IECC RE: NEMA (New)

Proponents: Duane Jonlin, City of Seattle, Seattle Dept of Construction and Inspections (iecccommercial@iccsafe.org)

2024 International Energy Code [RE] [RE Project] R3

Add new text as follows:

NEMA 1300 North 17th Street, Suite 900, Rosslyn, VA 22209. OS 4-2016 Requirements for Air-Sealed Boxes for Electrical and Communication Applications

Reason: Standard Reference for air-sealed boxes for electrical and communication applications provisions in IECC-C and IECC-R

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Reference standard. No cost implication

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: provides needed reference standard to Chapter 6.

Final Hearing Results

CE2D-78-23 Part II	AS

CE2D-95-23 Part I

Original Proposal

IECC CE: CG103.2.5.1

Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Code[CE Project] R3

Revise as follows:

CG103.2.5.1 Low indoor design conditions. Space heating systems sized for spaces with indoor design conditions of not greater than 40°F (4.5°C) and intended for freeze protection, including temporary systems in unfinished spaces, shall be permitted to use electric resistance. The *building thermal envelope* ~~building envelope~~ of any such space shall be insulated in compliance with Section C402.1.

Reason: Comments CED1-92-22 and RED1-185-22 corrected terminology associated with the defined term "building thermal envelope" throughout the commercial and residential provisions. This comment addresses four instances in new language that was incorporated into the 1st Public Comment Draft to maintain consistent application of the defined term.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The comment inserts a defined term to establish clear understanding of the associated provisions, which is neither intended nor expected to affect cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Changes building envelope to building thermal envelope to be consistent within the document.

Final Hearing Results

CE2D-95-23 Part I AS

CE2D-95-23 Part II

Original Proposal

IECC RE: R403.9, R405.5.4.1, R405.5.4.2

Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R403.9 Mechanical systems located outside of the building thermal envelope. Mechanical systems providing heat outside of the *building thermal envelope* ~~thermal envelope~~ of a building shall comply with Sections R403.9.1 through R403.9.4.

R405.5.4.1 Compliance report for permit application. A compliance report generated for submission with the application for building permit shall include the following:

1. *Building* street address, or other *building* site identification.
2. The name of the individual performing the analysis and generating the compliance report.
3. The name and version of the compliance software tool.
4. Documentation of all inputs entered into the software used to produce the results for the *standard reference design* and the *proposed design*.
5. A certificate indicating that the *proposed design* complies with Section R405.3. The certificate shall document the *building* components' energy specifications that are included in the calculation including: component-level insulation R-values or U-factors; *duct system* and *building* *thermal envelope* ~~envelope~~ air leakage testing assumptions; and the type and rated efficiencies of proposed heating, cooling, mechanical *ventilation* and service water-heating equipment to be installed. Where *on-site renewable energy* systems will be installed, the certificate shall report the type and production size of the proposed system.
6. Where a site-specific report is not generated, the *proposed design* shall be based on the worst-case orientation and configuration of the rated *dwelling unit*.

R405.5.4.2 Compliance report for certificate of occupancy. A compliance report generated for submission prior to obtaining the certificate of occupancy shall include the following:

1. *Building* street address, or other *building* site identification.
2. Declaration of the *simulated building performance* path on the title page of the energy report and the title page of the *building* plans.
3. A statement, bearing the name of the individual performing the analysis and generating the report, indicating that the as-built *building* complies with the requirements of Section R405.2.
4. The name and version of the compliance software tool.
5. A site-specific *energy analysis* report that is in compliance with the requirements of Section R405.4, where all inputs for the *proposed design* have been replaced in the simulation with confirmed energy features of the as-built *dwelling unit*.
6. A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the as-built *building* complies with Section R405.2. The certificate shall report the energy features that were confirmed to be in the *building*, including component-level insulation R-values or U-factors; results from any required *duct* system and *building* *thermal envelope* ~~envelope~~ air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical *ventilation* and service water-heating equipment installed.
7. When *on-site renewable energy* systems have been installed, the certificate shall report the type and production size of the installed system.

Reason: Comments CED1-92-22 and RED1-185-22 corrected terminology associated with the defined term "building thermal envelope" throughout the commercial and residential provisions. This comment addresses four instances in new language that was incorporated into the 1st Public Comment Draft to maintain consistent application of the defined term.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The comment inserts a defined term to establish clear understanding of the associated provisions, which is neither intended nor expected to affect cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Provides consistency with previous updates made.

Final Hearing Results

CE2D-95-23 Part II	AS

CEAPP-01-24

Original Proposal

IECC CE: C406.1.1, C406.1.1.1, C406.1.1.2, C502.3.7.1, C403.4.6, CI101.1.1 (New), C403.4.6.2, CI102.1 (New), C405.2.8, C405.14, C405.14.1, TABLE C405.14.1, C405.14.2, C405.14.3, C405.14.4, C405.14.5, C405.14.5.1, C405.14.5.2, C405.14.5.3, C405.14.5.3.1, C405.14.5.3.2, CG101.2.6 (New), TABLE C405.13.2, C405.16, C405.16.1, C405.16.2, CJ101.1.2.1 (New), C405.16.2.2, C405.16.2.3, C405.16.2.4, APPENDIX CG, CG101.1, CG101.2, CG102, CG103, CG103.1, CG103.2, CG103.2.1, CG103.2.2, CG103.2.3, CG103.2.4, CG103.2.5, CG103.2.5.1, CG103.2.5.2, CG103.2.6, CG103.2.7, CG103.2.8, CG103.3, CG103.4, CG103.5, CG103.6, CG104, CG104.1, CG104.2, CG104.3, CG104.4, CG104.5, CG104.6, CG105, CD101.1, TABLE CD101.1
Proponents: By determination of the ICC Board of Directors on appeals to the IECC heard 3/18/24

2024 International Energy Code[CE Project] R3

Revise as follows:

C406.1.1 Additional energy efficiency credit requirements. *Buildings* shall comply with measures from C406.2 to achieve not less than the number of required efficiency credits from Table C406.1.1(1) based on *building* occupancy group and *climate zone,* ~~including any energy credit adjustments in accordance with Section C406.1.1.1~~
Where a project contains multiple occupancies, credits in Table C406.1.1(1) from each*building* occupancy shall be weighted by the gross *conditioned floor area* to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of SectionC406.

Exceptions:

1. Portions of buildings devoted to manufacturing or industrial use.
2. Where a *building* achieves more renewable and load management credits in Section C406.3 than are required in Section C406.1.2, surplus credits shall be permitted to reduce the required energy efficiency credits as follows:

$$EEC_{red} = EEC_{tbl} - \left\{the\ lesser\ of: \left(SRLM_{lim}, \quad SRLM_{adj} \times \left[RLM_{ach} - RLM_{req} \right] \right)\right\}$$

EEC_{red} = Reduced required energy efficiency credits
EEC_{tbl} = Required energy efficiency credits from Table C406.1.1(1)
$SRLM_{lim}$ = Surplus renewable and load management credit limit from Table C406.1.1(2)
$SRLM_{adj}$ = 1.0 for all-electric or all-renewable buildings (excluding emergency generation) 0.7 for buildings with fossil fuel equipment (excluding emergency generation)
RLM_{ach} = Achieved renewable and load management credits from Section C406.3
RLM_{req} = Required renewable and load management credits from Section C406.1.2

~~**C406.1.1.1**~~**CF103.1 Buildings without heat pumps.** The number of efficiency credits required by Section C406.1.1 shall be multiplied by 1.25 for the following:

1. Buildings using purchased energy that is not electricity for space heating or service water heating.
2. Buildings with electric storage water heaters that are not heat pumps.
3. Buildings with total heat pump space heating capacity less than the space heating load at heating design conditions calculated in accordance with Section C403.1.1.1.

Exceptions:

1. Portions of buildings devoted to manufacturing or industrial use.
2. Buildings complying with all the following:
   - 2.1. The building's peak heating load calculated in accordance with Section C403.1.1 is greater than the building's peak cooling load calculated in accordance with Section C403.1.1.
   - 2.2. The building's total heat pump space heating capacity is not less than 50 percent of the building's space heating load at heating design conditions calculated in accordance with Section C403.1.1.
   - 2.3. Any energy source other than electricity or on-site renewable energy is used for space heating only where a heat pump cannot provide the necessary heating energy to satisfy the thermostat setting.
   - 2.4. Electric resistance heat is used only in accordance with Section C403.4.1.1.
3. Low-energy buildings complying with Section C402.1.1.1.
4. Portions of buildings in Utility and Miscellaneous Group U, Storage Group S, Factory Group F or High-Hazard Group H.
5. Buildings located in Climate Zones 0A, 0B, 1A, 1B, 2A and 2B.

C406.1.1.2 Building Core/Shell and Build-Out Construction. Where separate permits are issued for core and shell buildings and build-outconstruction, compliance shall be in accordance with the following requirements. 1.Core and shell buildings or portions of buildings shall comply with one of the following: 1.1.Where the permit includes a central HVAC system or service water heating system with chillers, heat pumps, boilers, service water heating equipment, or loop pumping systems with heat rejection, the project shall achieve not less than 50 percent of the energy credits required by Sections C406.1.1 ~~and C406.1.1.1~~ in accordance with Section C406.2.

- 1.2.Alternatively, the project shall achieve not less than 33 percent of the energy credits required by Sections C406.1.~~1and C406.1.1~~..
- 2.For core and shell *buildings* or portions of *buildings* the energy credits achieved shall be subject to the following adjustments:
  1. 2.1.Lighting measure credits shall be determined only for areas with final lighting installed.
  2. 2.2.Where HVAC or *service water heating* systems are designed to serve the entire*building*, full HVAC or *service water heating* measure credits shall be achieved.
  3. 2.3.Where HVAC or *service water heating* systems are designed to serve individual areas, HVAC or*service water heating* measure credits achievedshall be reduced in proportion to the floor area with final HVAC systems or final *service water heating* systems installed.
- 3.Build-out construction shall be deemed to comply with Section C406.1 where either:
  1. 3.1.Where heating and cooling generation are provided by a previously installed central system, the energy credits achieved in accordance with Section C406.2 under the build-out project are not less than 33 percent of the credits required by Section C406.1.1~~ and C406.1.1.1~~.
  2. 3.2.Where heating and cooling generation are provided by an HVAC system installed in the build out, the energy credits achieved in accordance with Section C406.2 under the build-out project are not less than 50 percent of the credits required by Section C406.1.1~~ and C406.1.1.1~~.
  3. 3.3.Where the core and shell *building* was *approved* in accordance with C407 under 2021 IECC or later.

~~C502.3.7.1~~CF104.1 Additions not served by heat pumps. The number of efficiency credits required by Section C502.3.7 shall be multiplied by 1.25 for the following:

1. Additions using purchased energy that is not electricity for space heating or service water heating.
2. Additions served by electric storage water heaters that are not heat pumps.

3. Additions served by total heat pump space heating capacity less than the peak space heating load at heating design conditions calculated in accordance with Section C403.1.1.

   Exceptions: Additions complying with all of the following:

   1. The addition's peak heating load calculated in accordance with Section is greater than the addition's peak cooling load calculated in accordance with Section C403.1.1.
   2. The addition's total heat pump space heating capacity serving the addition is not less than 50 percent of the addition's space heating at heating design conditions calculated in accordance with Section C403.1.1.
   3. Any energy source other than electricity or on-site renewable energy is used for space heating serving the addition only where a heat pump cannot provide the necessary heating energy to satisfy the thermostat setting.
   4. Electric resistance heat serving the addition is used only in accordance with Section C403.4.1.1.

~~C403.4.6~~CI101.1 Demand responsive controls. Electric heating and cooling systems shall be provided with demand responsive controls capable of executing the following actions in response to a *demand response signal*:

1. Automatically increasing the *zone* operating cooling set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).
2. Automatically decreasing the *zone* operating heating set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).

Where a *demand response signal* is not available the heating and cooling system controls shall be capable of performing all other functions. Where thermostats are controlled by direct digital control including, but not limited to, an energy management system, the system shall be capable of *demand responsive control* and capable of adjusting all thermal set-points to comply. The demand responsive controls shall comply with either Section C403.4.6.1 or Section C403.4.6.2

Exceptions:

1. Group I occupancies
2. Group H occupancies
3. Controls serving *data center* systems
4. Occupancies or applications requiring precision in indoor temperature control as*approved* by the *code official*
5. Buildings that comply with Load Management measure G02 in Section C406.3.3

~~C403.4.6.1~~CI101.1.1 Air conditioners and heat pumps with two or more stages of control and cooling capacity of less than 65,000 Btu/h.. Thermostats for air conditioners and heat pumps with two or more stages of control and a cooling capacity less than 65,000 Btu/h (19 kW) shall be provided with a demand responsive control that complies with the communication and performance requirements of AHRI 1380.

~~C403.4.6.2~~CI101.1.2 All other heating and cooling systems. Thermostats for heating and cooling systems shall be provided with a *demand responsive control* that complies with one of the following:

1. Certified OpenADR 2.0a VEN, as specified under Clause 11, Conformance
2. Certified OpenADR 2.0b VEN, as specified under Clause 11, Conformance
3. Certified by the manufacturer as being capable of responding to a *demand response signal* from a certified OpenADR 2.0b VEN by automatically implementing the control functions requested by the VEN for the equipment it controls
4. IEC 62746-10-1

5. The communication protocol required by a controlling entity, such as a utility or service provider, to participate in an automated demand response program
6. The physical configuration and communication protocol of CTA 2045-A or CTA 2045-B.

Revise as follows:

~~C404.10~~CI102.1 Demand responsive water heating. Electric storage water heaters with a rated water storage volume of 40 gallons (151 L) to 120 gallons (454 L) and a nameplate input rating equal to or less than 12 kW shall be provided with demand responsive controls in accordance with ~~Table C404.10~~ Table CI102.1.

Exceptions:

1. Water heaters that provide a hot water delivery temperature of 180°F (82°C) or greater.
2. Water heaters that comply with Section IV, Part HLW or Section X of the ASME Boiler and Pressure Vessel Code.
3. Water heaters that use three-phase electric power.

~~C404.10~~CI102.1 DEMAND RESPONSIVE CONTROLS FOR WATER HEATING

~~C405.2.8~~CI103.1 Demand responsive lighting controls. Interior general lighting in group B, E, M, and S occupancies shall have demand responsive controls complying with C405.2.8.1 in not less than 75 percent of the interior floor area.

Exceptions:

1. Where the combined interior floor area of group B, E, M, and S occupancies is less than 10,000 square feet.
2. Buildings where a demand response signal is not available from a controlling entity other than the owner.
3. Parking garages.
4. Ambulatory care facilities.
5. Outpatient clinics.
6. Physician or dental offices.

Revise as follows:

~~C405.14~~CG101.2 Electric Vehicle Power Transfer Infrastructure. Parking facilities shall be provided with electric vehicle power transfer infrastructure in accordance with Sections ~~C405.14.1~~CG101.2.1 through ~~C405.14.6~~CG101.2.6.

~~C405.14.1~~CG101.2.1 Quantity. The number of required EV spaces, EV capable spaces and EV ready spaces shall be determined in accordance with this Section and Table ~~C405.14.1~~CG101.2.1 based on the total number of automobile parking spaces and shall be rounded up to the nearest whole number. For R-2 buildings, the Table CG101.2.1 requirements shall be based on the total number of dwelling units or the total number of automobile parking spaces, whichever is less.

1. Where more than one parking facility is provided on a *building* site, the number of required automobile parking spaces required to have EV power transfer infrastructure shall be calculated separately for each parking facility.
2. Where one shared parking facility serves multiple *building* occupancies, the required number of spaces shall be determined proportionally based on the floor area of each *building* occupancy.
3. Installed EVSE spaces that exceed the minimum requirements of this section may be used to meet minimum requirements for EV ready spaces and EV capable spaces.
4. Installed EV ready spaces that exceed the minimum requirements of this section may be used to meet minimum require-ments for EV capable spaces.

5. Where the number of EV ready spaces allocated for R-2 occupancies is equal to the number of dwelling units or to the number of automobile parking spaces allocated to R-2 occupancies, whichever is less, requirements for EVSE spaces for R-2 occupancies shall not apply.
6. Requirements for a Group S-2 parking garage shall be determined by the occupancies served by that parking garage. Where new automobile spaces do not serve specific occupancies, the values for Group S-2 parking garage in Table ~~C405.14.1~~ CG101.2.1 shall be used.

Exception: Parking facilities, serving occupancies other than R2 with fewer than 10 automobile parking spaces.

Revise as follows:

TABLE ~~C405.14.1~~CG101.2.1 REQUIRED EV POWER TRANSFER INFRASTRUCTURE

Occupancy	EVSE Spaces	EV Ready Spaces	EV Capable Spaces
Group A	10%	0%	10%
Group B	15%	0%	30%
Group E	15%	0%	30%
Group F	2%	0%	5%
Group H	1%	0%	0%
Group I	15%	0%	30%
Group M	15%	0%	30%
Group R-1	20%	5%	75%
Group R-2	20%	5%	75%
Group R-3 and R-4	2%	0%	5%
Group S exclusive of parking garages	1%	0%	0%
Group S-2 parking garages	15%	0%	30%

~~C405.14.2~~CG101.2.2 EV Capable Spaces. Each EV capable space used to meet the requirements of Section~~C405.14.1~~CG101.2.1 shall comply with the following:

1. A continuous raceway or cable assembly shall be installed between an enclosure or outlet located within 3 feet (914 mm) of the EV capable space and electrical distribution equipment.
2. Installed raceway or cable assembly shall be sized and rated to supply an minimum circuit capactiy in accordance with Section ~~C405.14.5~~ CG101.2.5.
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have dedicated overcurrent protection device space and electrical capacity to supply a calculated load in accordance with Section ~~C405.14.5~~ CG101.2.5 .
4. The enclosure or outlet and the electrical distribution equipment directory shall be marked: "For electric vehicle supply equipment (EVSE)."

~~C405.14.3~~CG101.2.3 EV Ready Spaces. Each branch circuit serving EV ready spaces used to meet the requirements of Section~~C405.14.1~~ CG101.2.1 shall comply with the following:

1. Terminate at an outlet or enclosure, located within 3 feet (914 mm) of each EV ready space it serves.
2. Have a minimum system and circuit capacity in accordance with~~C405.14.5~~ CG101.2.5.
3. The electrical distribution equipment directory shall designate the brach circuit as "For electric vehicle supply equipment (EVSE)" and the outlet or enclosure shall be marked "For electric vehicle supply equipment (EVSE)."

~~C405.14.4~~CG101.2.4 EVSE Spaces. An installed EVSE with multiple output connections shall be permitted to serve multiple EVSE spaces. Each EVSE installed to meet the requirements of Section ~~C405.14.1~~CG101.2.1, serving either a single EVSE space or multiple EVSE spaces, shall comply with the following:

1. Have a minimum system and circuit capacity in accordance with Section C405.14.5.
2. Have a nameplate rating not less than 6.2kW.
3. Be located within 3 feet (914 mm) of each EVSE space it serves.
4. Be installed in accordance with Section ~~C405.14.6~~ CG101.2.6.

Revise as follows:

~~C405.14.5~~CG101.2.5 System and circuit capacity. The system and circuit capacity shall comply with ~~C405.14.5.1~~Sections CG101.2.5.1 and ~~C405.14.5.2~~CG101.2.5.2.

~~C405.14.5.1~~CG101.2.5.1 System capacity. The electrical distribution equipment supplying the branch circuit(s) serving each EV capable space, EV ready space, and EVSE space shall comply with one of the following:

1. Have a calculated load of 7.2 kVA or the nameplate rating of the equipment, whichever is larger, for each EV capable space, EV ready space, and EVSE space.
2. Meets the requirements of Section ~~C405.14.5.3.1~~ CG101.2.5.3.1.

~~C405.14.5.2~~CG101.2.5.2 Circuit Capacity. The branch circuit serving each EV capable space, EV ready space, and EVSE space shall comply with one of the following:

1. Have a rated capacity not less than 50 amperes or the nameplate rating of the equipment, whichever is larger.
2. Meets the requirements of Section ~~C405.14.5.3.2~~ CG101.2.5.3.2.

Revise as follows:

~~C405.14.5.3~~CG101.2.5.3 System and circuit capacity management. Where system and circuit capacity management is selected in Section ~~C405.14.5.1(2)~~CG101.2.5.1 or Section ~~C405.14.5.2(2)~~CG101.2.5.2, the installation shall comply with Sections ~~C405.14.5.3.1~~ CG101.2.5.3.1 and ~~C405.14.5.3.2~~CG101.2.5.3.2.

~~C405.14.5.3.1~~CG101.2.5.3.1 System capacity management. The maximum equipment load on the electrical distribution equipment supplying the branch circuits(s) serving EV capable spaces, EV ready spaces, and EVSE spaces controlled by an energy management system shall be the maximum load permitted by the energy management system, but not less than 3.3 kVA per space.

~~C405.14.5.3.2~~CG101.2.5.3.2 Circuit Capacity Management. Each branch circuit serving multiple EVSE spaces, EV ready spaces or EV capable spaces controlled by an energy management system shall comply with one of the following: 1.Have a minimum capacity of 25 amperes per space. 2.Have a minimum capacity of 20 amperes per space for R-2 occupancies when all automobile parking spaces EV ready spaces or EVSE spaces.

~~C405.14.5.4~~CG101.2.6 EVSE installation. EVSE shall be installed in accordance with NFPA 70 and shall be listedand labeledin accordance with UL 2202 or UL 2594. EVSE shall be accessible in accordance with Section 1107 of the International Building Code.

TABLE C405.13.2 ENERGY USE CATEGORIES

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	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 but not limited to data centers, manufacturing equipment and commercial kitchens.
Electric vehicle charging	*Electric vehicle* charging loads that are powered through the *building*'s electrical service.
Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.
Electric hot water heating for uses other than space conditioning	Electricity used to generate hot water. **Exception:** Electric water heating with design capacity that is less than 10 percent of building service rating

Revise as follows:

~~C405.16~~CJ101.1 Electrical energy storage system. *Buildings* shall comply with Section ~~C405.16.1~~CJ101.1.1 or Section ~~C405.16.2~~ CJ101.1.2.

~~C405.16.1~~CJ101.1.1 Electrical energy storage energy capacity. Each *building* shall have one or more ESS with a total rated energy capacity and rated power capacity as follows:

1. ESS rated energy capacity (kWh)≥1.0 x Installed On-site Renewable Electric Energy System Rated Power (kWDC)
2. ESS rated power capacity (kW)≥0.25 x Installed On-site Renewable Electric Energy System Rated Power (kWDC).

Where installed, DC coupled battery systems shall meet the requirements for rated energy capacity alone.

~~C405.16.2~~CJ101.1.2 Electrical energy storage system ready. Each *building* shall have one or more reserved ESS-ready areas to accommodate future electrical storage in accordance with Sections ~~C405.16.2~~CJ101.1.2.1 through ~~C405.16.2.4~~CJ101.1.2.4.

~~C405.16.2.1~~CJ101.1.2.1 ESS-ready location. Each ESS-ready area shall be located in accordance with Section 1207 of the International Fire Code.

~~C405.16.2.2~~CJ101.1.2.2 ESS-ready minimum area requirements. Each ESS-ready area shall be sized in accordance with the spacing requirements of Section 1207 of the *International Fire Code* and the UL9540 or UL9540A designated rating of the planned system. Where rated to UL9540A, the area shall be sized in accordance with the manufacturer's instructions.

Revise as follows:

~~C405.16.2.3~~CJ101.1.2.3 Electrical distribution equipment. The onsite electrical distribution equipment shall have sufficient capacity, rating, and space to allow installation of overcurrent devices and circuit wiring in accordance with NFPA 70 for future electrical ESS installation complying with the capacity criteria of Section ~~C405.16.2~~CJ101.1.2.4.

~~C405.16.2.4~~CJ101.1.2.4 ESS-ready minimum system capacity. Compliance with ESS-ready requirements in Sections ~~C405.16.2.1~~ CJ101.1.2.1 through ~~C405.16.2.3~~CJ101.1.2.3 shall be based on a minimum total energy capacity and minimum rated power capacity as follows:

1. ESS rated energy capacity (kWh) ≥ gross conditioned floor area of the three largest floors (ft2) x 0.0008 kWh/ft2
2. ESS rated power capacity (kWh) ≥ gross conditioned floor area of the three largest floors (ft2) x 0.0002 kWh/ft2

~~APPENDIX~~RESOURCE ~~CG~~CRA
ALL-ELECTRIC COMMERCIAL BUILDING PROVISIONS

Revise as follows:

~~CG101.1~~CRA101.1 Intent. The intent of this Appendix is to amend the International Energy Conservation Code to reduce greenhouse gas emissions from buildings and improve the safety and health for commercial building occupants by requiring new all-electric buildings and efficient electrification of existing buildings.

~~CG101.2~~CRA101.2 Scope. The provisions in this appendix are applicable to commercial buildings. New construction shall comply with Section ~~CG103~~CRA103. Additions, alterations, repairs and changes of occupancy to existing buildings shall comply with Chapter 5 and Section ~~CG104~~CRA104.

~~CG102~~CRA102 DEFINITIONS. ALL-ELECTRIC BUILDING.A building using no purchased energy other than electricity when utility power is available. APPLIANCE.A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements. COMBUSTION EQUIPMENT.Any equipment or *appliance* used for space heating, *service water heating*, cooking, clothes drying, humidification, or lighting that uses *fuel gas* or fuel *oil*. PURCHASED ENERGY. Energy or power purchased for consumption and delivered to the *building site*.SUBSTANTIAL IMPROVEMENT.Any *repair*, reconstruction, rehabilitation, *alteration*, *addition* or other improvement of a *building* or structure, the cost of which equals or is more than 50 percent of the market value of the structure before the improvement. Where the structure has sustained substantial damage, as defined in the *International Building Code*, any repairs are considered substantial improvement regardless of the actual *repair* work performed. *Substantial improvement* does not include the following:1. Improvement of a *building* required to correct health, sanitary or safety code violations ordered by the*code official*, or2. *Alteration* of a *historic building* where the *alteration* will not affect the *building's* designation as a *historic building*.

Revise as follows:

~~CG103~~CRA103
NEW COMMERCIAL BUILDINGS

~~CG103.1~~CRA103.1 Application. New commercial buildings shall be all-electric buildings and comply with Sections~~C401.2.1~~CRA103.2.1 or ~~C401.2.2~~CRA103.2.8.

1. Purchased energy other than electricity shall be permitted where it has been demonstrated to the building official that the building is required by an applicable law or regulation to provide space heating with an emergency power system or a standby power system.
2. Purchased energy shall be permitted for an emergency power system or a standby power system.

~~CG103.2~~CRA103.2 Electric resistance heating equipment. The sole use of electric resistance equipment and appliances for space and water heating shall be prohibited other than for buildings or portions of buildings that comply with not less than one of Sections ~~CG103.2.1~~ CRA103.2.1 through ~~CG103.2.8~~CRA103.2.8.

~~CG103.2.1~~CRA103.2.1 Low space heating capacity. Electric resistance appliances or equipment shall be permitted in buildings or areas of buildings not served by a mechanical cooling system and with a total space heating capacity not greater than 4.0 BTU/h (1.2 watts) per square foot of conditioned space .

~~CG103.2.2~~CRA103.2.2 Small systems. Buildings in which electric resistance appliances or equipmentcomprise less than 5 percent of the total system heating capacity or serve less than 5 percent of the conditioned floor area.

Revise as follows:

CG103.2.3CRA103.2.3 Specific conditions. Portions of buildings or specific equipment and appliances that require electric resistance heating that cannot practicably be served by electric heat pumps as approved.

~~CG103.2.4~~CRA103.2.4 Kitchen make-up air. Make-up air for commercial kitchen exhaust systems required to be tempered by Section 508.1.1 of the International Mechanical Code is permitted to be heated by electric resistance

~~CG103.2.5~~CRA103.2.5 Freeze protection. The use of electric resistance heat for freeze protection shall comply with Sections~~CG103.2.5.1~~ CRA103.2.5.1 through ~~CG103.2.5.2~~CRA103.2.5.2.

~~CG103.2.5.1~~CRA103.2.5.1 Low indoor design conditions. Space heating systems sized for spaces with indoor design conditions of not greater than 40°F (4.5°C) and intended for freeze protection, including temporary systems in unfinished spaces, shall be permitted to use electric resistance. The building envelope of any such space shall be insulated in compliance with Section C402.1.

Revise as follows:

~~CG103.2.5.2~~CRA103.2.5.2 Freeze protection system. Freeze protection systems shall comply with Section C403.13.3.

~~CG103.2.6~~CRA103.2.6 Pre-heating of outdoor air. Hydronic systems without energy recovery ventilation and that do not use freeze protection fluids shall be permitted to utilize electric resistance to temper air to not more than 40°F (4.5°C). All systems with energy recovery ventilation shall be permitted to utilize electric resistance to preheat outdoor air to defrost or temper air entering the energy recovery device and shall comply with one of the following:

1. When the space is mechanically humidified or has a process application that will maintain the space above 30 percent relative humidity when the outdoor temperature is not greater than 25ºF (-4ºC) and the system recovers latent energy, the outdoor air shall not be preheated to greater than 25ºF (-4ºC);
2. For sensible-only heat recovery exchangers, outdoor air shall not be preheated to greater than 25ºF (-4ºC);
3. For all other systems, outdoor air shall not be preheated to greater than 5ºF (-15ºC).

~~CG103.2.7~~CRA103.2.7 Small buildings. Buildings with a conditioned floor area of not more than 250 square feet (23.2 m^2) and not served by a mechanical space cooling system shall be permitted to use electric resistance appliances or equipment for space heating.

~~CG103.2.8~~CRA103.2.8 Supplemental heat. Electric resistance heat shall be permitted as supplemental heat when installed with heat pumps sized in accordance with Section ~~CG103.3~~CRA103.3 and when operated only when a heat pump cannot provide the necessary heating energy to satisfy the thermostat setting.

~~CG103.3~~CRA103.3 Heat pump sizing for space heating. Heat pump space heating systems shall be sized to meet the building heating load at the greater of 0°F (-18°C) or the 99 Percent Annual Heating Dry-Bulb for the nearest weather station provided in the ASHRAE Handbook of Fundamentals. The heat pump space heating system shall not require the use of supplemental electric heat at or above this temperature other than for defrosting. Lower capacity heat pumps that operate in conjunction with thermal storage shall be permitted if the system meets the requirements of this section.

~~CG103.4~~CRA103.4 Heat pump sizing for water heating. Heat pump service heating systems shall be sized to meet not less than the building service water heating load at the greater of 15°F (-9.5°C) or the 99 Percent Annual Heating Dry-Bulb for the nearest weather station provided in the latest edition of the ASHRAE Fundamentals Handbook. Supplemental electric heat shall not be required at or above this temperature other than for temperature maintenance in recirculating systems and defrosting.

~~CG103.5~~CRA103.5 Heating outside a building. Systems for heating outside a building shall comply with C403.13.1.

~~CG103.6~~CRA103.6 Low capacity cooling equipment. Air conditioners with capacity less than 240,000 Btu/hr (70 kW) shall be electric heat pump equipment sized and configured to provide both space cooling and space heating.

~~CG104~~CRA104
EXISTING COMMERCIAL BUILDINGS

~~CG104.1~~CRA104.1 Combustion equipment in additions. Additions shall use no purchased energy other than electricity and new equipment installed to serve additions shall use no purchased energy other than electricity. Where existing systems using purchased energy other than electricity serve an addition, the existing building and addition together shall use no more purchased energy other than electricity than the existing building alone.

~~CG104.2~~CRA104.2 Substantial improvement. Buildings undergoing substantial improvements shall be all-electric buildings, comply with C402.5 and meet a site EUI by building type in accordance with ASHRAE Standard 100 Table 7-2a.

Exception: Compliance with Standard 100 shall not be required where Group R occupancies achieve an ERI score of 80 or below without on-site renewable energy included in accordance with RESNET/ICC 301, for each dwelling unit.

~~CG104.3~~CRA104.3 Cooling equipment. New and replacement air conditioners shall be electric heat pump equipment sized and configured to provide both space cooling and space heating. Any existing space heating systems other than existing heat pump equipment that serve the same zone as the new equipment shall be configured as supplementary heat in accordance with Section ~~CG104.6~~ CRA104.6.

~~CG104.4~~CRA104.4 Service water heating equipment. Where water heaters are added or replaced, they shall use no purchased energy other than electricity.

~~CG104.5~~CRA104.5 Furnace replacement. Newly installed warm air furnaces provided for space heating shall only be permitted as supplementary heat controlled in accordance with Section ~~CG104.6~~CRA104.6.

~~CG104.6~~CRA104.6 Heat pump supplementary heat. Heat pumps having combustion equipment or electric resistance equipment for supplementary space or service water heating shall have controls that limit supplemental heat operation to only those times when one of the following applies:

1. The heat pump is operating in defrost mode.
2. The vapor compression cycle malfunctions.
3. For space heating systems, the thermostat malfunctions.
4. For space heating systems, the vapor compression cycle cannot provide the necessary heating energy to satisfy the thermostat setting.
5. The outdoor air temperature is less than the design temperature determined in accordance with Section~~CG103.3~~ CRA103.3.
6. For service water heating, the heat pump water heater cannot maintain an output water temperature of not less than 120°F (49°C) .
7. For temperature maintenance in service water heating systems.

New supplementary space and *service water heating* systems for heat pump equipment shall not be permitted to have a heating output capacity greater than the heating output capacity of the heat pump equipment.

~~CG105~~CRA105
REFERENCE STANDARDS

~~CD101.1~~CRB101.1 Prescriptive compliance. Where compliance is demonstrated using the prescriptive compliance option in Section C401.2.1, the number of additional efficiency credits required by Section C406.1 shall be 1.4 times the number that are required by Section C406.1.1(1).

Exception: Where a *building* achieves more renewable and load management credits in Section C406.3 than are required in Section

C406.1.2, surplus credits shall be permitted to reduce required energy efficiency credits as follows:

$$EEC_{red} = EEC_{tbl} - \left\{ the\ lesser\ of\!: \left(SRLM_{lim}\,, \quad SRLM_{adj} \times \left[RLM_{ach} - RLM_{req} \right] \right) \right\}$$

EEC_{red} = Reduced required energy efficiency credits
EEC_{tbl} = Required energy efficiency credits from Table C406.1.1(1)
$SRLM_{lim}$ = Surplus renewable and load management credit limit from Table~~CD101.1~~CRB101.1
$SRLM_{adj}$ = 1.0 for all-electric or all-renewable buildings (excluding emergency generation)

0.7 for buildings with fossil fuel equipment (excluding emergency generation)
RLM_{ach} = Achieved renewable and load management credits from Section C406.3
RLM_{req} = Required renewable and load management credits from Section C406.1.2

TABLE ~~CD101.1~~CRB101.1 LIMIT TO ENERGY EFFICIENCY CREDIT CARRYOVER FROM RENEWABLE AND LOAD MANAGEMENT CREDITS

-	CLIMATE ZONE																		
BUILDING OCCUPANCY GROUP	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	19	25	27	29	33	20	15	37	36	5	37	34	5	8	36	5	5	5	5
I-2	17	13	10	5	5	5	5	5	5	5	5	5	7	16	20	15	21	20	43
R-1	9	5	9	5	22	7	13	23	25	5	22	19	5	18	16	5	5	5	6
B	5	5	5	5	6	6	5	9	13	10	26	20	9	25	34	5	9	9	32
A-2	31	28	25	26	23	16	5	8	16	5	8	7	5	5	9	5	5	5	5
M	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
E	17	15	23	16	20	14	5	22	27	10	32	16	10	21	12	5	5	15	10
S-1 and S-2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	43
All Other	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Reason: This is the final result of the IECC Commercial appeals process based upon the determination of the ICC Board of Directors.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.N/A

Cost Impact (Detailed): The change proposal is editorial in nature or a clarification and has no cost impact on the cost of construction

Justification:

N/A

Public Hearing Results (CAH1)

Committee Action (CAH1) **As Submitted**

Final Hearing Results

CEAPP-01-24 AS

CEC2D-1-23
Original Proposal

IECC CE: C403.4.6

Proponents: Richard Lord, Carrier Corporation, Carrier Corporation (richard.lord@carrier.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

C403.4.6 Demand responsive controls. Also add the requirements to C403.4.1.1 for thermostat dead band and setpoints. Electric heating and cooling systems shall be provided with demand responsive controls capable of executing the following actions in response to a *demand response signal*:

1. Automatically increasing the *zone* operating cooling set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).
2. Automatically decreasing the *zone* operating heating set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).

Where a *demand response signal* is not available the heating and cooling system controls shall be capable of performing all other functions. Where thermostats are controlled by direct digital control including, but not limited to, an energy management system, the system shall be capable of *demand responsive control* and capable of adjusting all thermal set-points to comply. The demand responsive controls shall comply with either Section C403.4.6.1 or Section C403.4.6.2

Exceptions:

1. Group I occupancies
2. Group H occupancies
3. Controls serving *data center* systems
4. Occupancies or applications requiring precision in indoor temperature control as*approved* by the *code official*
5. Buildings that comply with Load Management measure G02 in Section C406.3.3
6. <u>Buildings with energy storage with the capacity for not less than a 25 percent load reduction at peak load for a period of not less than 3 hours.</u>

Reason: The requirements to thru demand limiting will result in a setup of cooling to a higher temperature to turn on heat and the setback for heating operation could turn on cooling for building thermostats that have a single setpoint which we have found is commonly used in Hotels and some commercial buildings. The proposed text is pulled from a new ASHRAE 90.1 addendum

Also with electrification buildings may have cooling and heating thermal storage which could be used for demand limiting without resulting in comfort problems. We have proposed adding an exception for buildings with thermal storage.

Bibliography: This change has been proposed for ASHRAE 90.1 and has been thru public review.

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

The Capability Exists in Most Thermostats and Control Systems. Most modern controllers already have dual set points since the dead band capability has been a requirement of Standard 90.1 since 1989. And many already have displays that meet the new requirements. Direct digital control systems generally have configurable displays that can be readily modified to meet the proposed requirements. So the primary first cost impact will be to modify the displays of non-DDC (firmware) thermostats, but these are low-cost thermostats to begin with and also the thermostats that this addendum is targeting. The energy savings will more than cover the small first cost in just a few years of demand control.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Encourages the use of thermal energy storage by providing an additional technology option for reducing demand.

Final Hearing Results

CEC2D-1-23	AM

CEC2D-3-23

Original Proposal

IECC CE: SECTION C202
Proponents: Glenn Heinmiller, Lam Partners, International Association of Lighting Designers (glenn@lampartners.com)

2024 International Energy Code[CE Project] R3

Revise as follows:

SECTION C202 GENERAL DEFINITIONS. **<u>CONGREGATE LIVING FACILITIES</u>**. <u>A building or part thereof that contains *sleeping units* where residents share bathroom or kitchen facilities, or both.</u>

Reason: *Congregate living facilities* is a defined term from the IBC that is now used in the IECC.
C405.2.10.2 uses the term *congregate living facilities* and it is italicized, but it cannot be found in C202.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
adds a defintion

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: for clarity on what are congregate living facilities.

Final Hearing Results

CEC2D-3-23	AS

CEC2D-4-23 Part I

Original Proposal

IECC CE: SECTION C110, SECTION C110 (New)
Proponents:

2024 International Energy Code[CE Project] R3

Revise as follows:

SECTION ~~C110~~C109 MEANS OF APPEALS

SECTION ~~C109~~C110 STOP WORK ORDER

Reason: Editorial change to align ordering of Chapter 1 sections with other I-Codes

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Editorial change

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Consistent with other I-Codes.

Final Hearing Results

CEC2D-4-23 Part I	AS

CEC2D-4-23 Part II

Original Proposal

IECC RE: SECTION R110, SECTION R110 (New)

Proponents: Duane Jonlin, City of Seattle, Seattle Dept of Construction and Inspections (iecccommercial@iccsafe.org)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

SECTION ~~R110~~R109 MEANS OF APPEALS

SECTION ~~R109~~R110 STOP WORK ORDER

Reason: Editorial change to align ordering of Chapter 1 sections with other I-Codes

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial change

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: aligns Chapter 1 with other I-Codes for consistency.

Final Hearing Results

CEC2D-4-23 Part II	AS

CEC2D-6-23

Original Proposal

IECC CE: C403.4.1.2 (New), C403.4.1.3 (New), C403.4.1.4 (New)

Proponents: Blake Shelide, IECC CE HVACR & Water Heating Subcommittee, IECC CE HVACR & Water Heating Subcommittee (iecccehvacr@iccsafe.org)

2024 International Energy Code[CE Project] R3

Revise as follows:

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

1. Have separate set points for heating and cooling, each individually adjustable,
2. Be capable of and initially configured to provide a temperature range or dead band between the two set points of not less than 5°F (3°C) within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum, and
3. Have a minimum dead band of not less than 1°F (0.5°C) when set points are adjusted.

Exceptions:

1. Thermostats ~~that require~~ requiring *manual* changeover between heating and cooling modes.
2. Occupancies or applications where applicable codes or accreditation standards requiring precision in indoor temperature control ~~as approved by the code official~~ shall be permitted to be initially configured to not less than 1ºF (0.5ºC) deadband.

Add new text as follows:

C403.4.1.3 Set point adjustment and display. Where thermostatic control set points are capable of being adjusted by occupants or HVAC system operators, the adjustment shall be independent for the heating set point and the cooling set point; when one set point is changed, the other shall not change except as needed to maintain the minimum dead band required by Section C403.4.1.2. For thermostatic controls that display set points, both the heating and cooling set points shall be displayed simultaneously, or the set point of the currently active mode (heating or cooling) shall be displayed along with an indication of that mode.

Revise as follows:

C403.4.1.~~3~~4 Set point overlap restriction. Where heating and cooling to a zone are controlled by ~~has a~~ separate ~~heating and a separate cooling~~zone thermostatic controls located within the zone, mechanical or software means shall be provided ~~a limit switch, mechanical stop or direct digital control system with software programming shall be configured~~ to prevent the heating setpoint from exceeding the cooling setpoint, minus the deadband required by ~~and to maintain a deadband in accordance with~~Section C403.3.4.1.

Reason: The requirements to thru demand limiting will result in a setup of cooling to a higher temperature to turn on heat. The setback for heating operation could turn on cooling for building thermostats that have a single setpoint, which we have found is commonly used in Hotels and some commercial buildings. The proposed text is pulled from a new ASHRAE 90.1 addendum

Also with electrification, buildings may have cooling and heating thermal storage, which could be used for demand limiting without resulting in comfort problems. We have proposed adding an exception for buildings with thermal storage.

Bibliography: This change is the same as addendum c to ASHRAE 90.1-2022.

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

The code change proposal will increase the cost of construction.

The capability exists in most thermostats and control systems. Most modern controllers already have dual set points since the dead band capability has been a requirement of Standard 90.1 since 1989. And many already have displays that meet the new requirements. Direct digital control systems generally have configurable displays that can be readily modified to meet the proposed requirements. So the primary first cost impact will be to modify the displays of non-DDC (firmware) thermostats, but these are low-cost thermostats to begin with and also the thermostats that this addendum is targeting. The energy savings will more than cover the small first cost in just a few years of demand control.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Changes proposed will align with ASHRAE 90.1-2025.

Final Hearing Results

CEC2D-6-23	AS

CECD1-1-22

Original Proposal

IECC: C405.1.1, C405.2.5

Proponents: Michael Jouaneh, IECC CE Electrical Power, Lighting, and Renewables Subcommittee, IECC CE Electrical Power, Lighting, and Renewables Subcommittee

2024 International Energy Conservation Code [RE Project]

Revise as follows:

C405.1.1 Lighting for dwelling units. No less than 90 percent of the permanently installed lighting serving sleeping units and dwelling units, including lighting integrated into range hoods and exhaust fans,shall be provided by lamps with an efficacy of not less than 65 lm/W or luminaires with an efficacy of not less than 45 lm/W.

Exceptions:

1. Lighting integral to ~~a kitchen~~ other appliances ~~appliance or exhaust hood~~.
2. Antimicrobial lighting used for the sole purpose of disinfecting.

C405.2.5 Specific application controls. Specific application controls shall be provided for the following:

1. The following lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a time-switch control complying with Section C405.2.2.1. In addition, a manual control shall be provided to control such lighting separately from the general lighting in the space:

   ~~1.1.~~ Luminaires for which additional lighting power is claimed in accordance with Section C405.3.2.2.1.

   ~~1.2.~~ Display and accent lighting, including lighting in display cases.

   1.3 Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting.

   1.4 Lighting equipment that is for sale or demonstration in lighting education.

2. *Sleeping units* shall have control devices or systems that are configured to automatically switch off all installed luminaires and switched receptacles within 20 minutes after all occupants have left the unit.

   Exceptions:

   1. Lighting and switched receptacles controlled by card key controls in buildings containing fewer than 50 sleeping units.
   2. Spaces where patient care is directly provided.

3. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a time switch control complying with Section C405.2.2.1 that is independent of the controls for other lighting within the room or space.
4. Task lighting for medical and dental purposes that is in addition to *general lighting* shall be provided with a *manual control*.
5. Lighting integrated into range hoods and exhaust fans shall be controlled independently of fans.

Reason: A quick search of home improvement stores like Home Dept and Lowes makes clear that range hoods and exhaust fans are commonly provided with high efficacy LED lighting. There is no reason not to make this an enforceable requirement of the code similar to other lighting sources.

There is also energy to be saved in controlling ventilation fans separately from lighting in bathrooms. The uses are not coincident. In a bathroom with a window one may choose to use the fan and not the light during the day when bathing. In the evening, one may choose to use the light and not the fan when grooming.

Ceiling fans are subject to NAECA regulation, so efficacy of the lighting kits cannot be regulated under base code. However, these can be included in the lighting efficacy requirements of L06.

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

This code change will result in a modest increase in the cost of construction. The LED lamps will likely cost $5-$10 more per range hood. And in some instances an additional switch will be required to control the fan separately from the light. But this increase in construction costs will be more than offset by the long-term energy savings.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Clarification which appliances are required; Range hoods and exhaust fans offer high efficacy options, and they should be included.

Final Hearing Results

CECD1-1-22	AS

CECD1-2-22

Original Proposal

IECC: C503.5, C503.5.1, C503.5.2 (New)

Proponents: Michael Jouaneh, IECC CE Electrical Power, Lighting, and Renewables Subcommittee, IECC CE Electrical Power, Lighting, and Renewables Subcommittee (ieccceelectrical@iccsafe.org)

2024 International Energy Conservation Code [RE Project]

Delete and substitute as follows:

~~**C503.5 Lighting systems.** New lighting systems that are part of the *alteration* shall comply with Sections C405~~ .

> ~~**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.~~

C503.5 Lighting systems. Lighting systems that are part of the alteration shall comply with Sections C503.5.1 and C503.5.2.

~~**C503.5.1 Lighting acceptance testing.** Where an *alteration* requires compliance with Section C405 or any of its subsections, lighting systems that serve the *alteration* shall comply with Section C408.3.~~

C503.5.1 Interior lighting and controls. Alterations to interior spaces, lighting, or controls shall comply with the following:

1. Where the area of interior spaces is altered, those spaces shall comply with the lighting power requirements of Section C405.3 and those spaces shall comply with the lighting control requirements of Sections C405.2 and C408.3.
2. Where the lighting within interior spaces is altered, those spaces shall comply with the lighting power requirements of C405.3 and those spaces shall comply with the lighting control requirements of C405.2 and C408.3.
3. Where the lighting controls within interior spaces are altered, those spaces shall comply with the lighting control requirements of Sections C405.2 and C408.3.

> **Exception:** Compliance with Section C405.2.9 is not required for alterations.

Add new text as follows:

C503.5.2 Exterior lighting and controls. Alterations to exterior lighting and controls shall comply with the following:

1. Where the connected exterior lighting power is increased by more than 400 Watts, all exterior lighting, including lighting which is not proposed to be altered, shall comply with lighting power requirements of Section C405.5.
2. Where the combined power of added and replacement luminaires is more than 400 Watts, all lighting which is added or altered shall be controlled in accordance with Sections C405.2 and C408.3.

   > **Exception:** Individual luminaires less than 50 Watts which pass functional tests verifying that lights are automatically shut off where daylight is present.

3. Where exterior lighting controls are added or altered, those portions of the lighting control system which are added or altered shall comply with Sections C405.2 and C408.3.

Reason: This proposal provides a set of comprehensive provisions for the alteration of lighting systems which addresses several long-standing problems with the existing code language:

1. It is not clear whether existing light fixtures can be altered without a requirement that existinglighting controls also be altered to comply with the current code, and vice-versa. This proposal clearly specifies when alterations to one trigger mandatory compliance upgrades for the other.

2. It is not clear how compliance should be determined for exterior lighting alterations. For interior spaces compliance can always be determined on a room by room basis, but compliance for exterior lighting can only be determined for the entire site.

3. The existing exception does 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.

4. Exceptions based on altered and new luminaire wattage are easier to calculate and enforce than calculating both existing wattage and altered wattage and calculating a fraction (especially for large outdoor lighting systems).

5. The newly added demand responsive lighting control requirements in Section C405.2.9 are intended for lighting systems installed on a building wide basis and not as an alteration.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal improves the clarity and enforceability of the lighting alterations requirements.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal improves the clarity and enforceability of the lighting alterations requirements.

Final Hearing Results

CECD1-2-22	AM

CECD1-4-22

Original Proposal

IECC: C405.2.3.1, C406.2.5.2, C408.3.1.4, C408.3.1.5 (New)
Proponents: Michael Jouaneh, IECC CE Electrical Power, Lighting, and Renewables Subcommittee, IECC CE Electrical Power, Lighting, and Renewables Subcommittee (ieccceelectrical@iccsafe.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

C405.2.3.1 Dimming control function. Spaces required to havedimming control shall be provided with manual controls that allow lights to be dimmed from full output to 10 percent of full power or lower with continuous dimming, as well asturning lights off. Manual control shall be provided within each room to dim lights.

Exception: Manual dimming control is not requiredin spaces where *high-end trim* lighting controls are provided which comply with following: ~~lighting controls have a high-end trim setting and have undergone functional testing in accordance with Section C408.3.1.4~~.

1. The calibration adjustment equipment is located for *ready access* only by authorized personnel. Occupant sensors will be required in more space types for base code compliance.
2. Lighting controls with ready access for users cannot increase the lighting power above the maximum level established by the *high-end trim* controls.

C406.2.5.2 L02 ~~Enhanced digital lighting controls~~*High-end trim* lighting controls. Measure credits shall be achieved where qualifying spaces are no less than 50 percent of the~~gross~~project interior floor area exclusive of *dwelling and sleeping units* ~~within the project shall comply with the requirements of this section.~~Qualifying spaces are those where general lighting is controlled by*high-end trim* lighting controls complying with the following:

1. The calibration adjustment equipment is located for *ready access* only by authorized personnel.
2. Lighting controls with *ready access* for users cannot increase the lighting power above the maximum level established by the*high-end trim* controls.
3. Construction documents shall state that maximum light output or power of*general lighting* in spaces contributing to the qualifying floor area shall be not greater than 85 percent of full power or light output.
4. *High-end trim* lighting controls shall be tested in accordance with Section C408.3.1.5.

~~1. Lighting controls function. Interior general lighting shall be located, scheduled and operated in accordance with Section C405.2 and shall be configured with the following enhanced control functions:~~

~~1.1. Luminaires shall be configured for continuous dimming~~.

~~1.2. Each luminaire shall be individually addressed~~.

~~**Exceptions:**~~

~~1. Multiple luminaires mounted on no more than 12 linear feet (3.66 m) of a single lighting track and addressed as a single luminaire.~~

~~2. Multiple linear luminaires that are ganged together to create the appearance of a single longer fixture and addressed as a single luminaire, where the total length of the combined luminaires is not more than 12 feet (3.66 m).~~

~~1.3. No more than eight luminaires within a daylight zone are permitted to be controlled by a*single daylight responsive control*.~~

2. ~~Luminaires shall be controlled by a digital control system configured with the following capabilities~~:

   2.1. ~~Sheduling and illumination levels of individual luminaires and groups of luminaires are capable of being reconfigured through the system.~~

   2.2. ~~Load shedding.~~

   2.3. ~~Occupancy sensors and daylight responsive controls are capable of being reconfigured through the system~~.

3. ~~Construction documents shall include submittal of a Sequence of Operations, including a specification outlining each of the functions required by this section.~~

4. ~~High-end trim. Luminaires shall be initially configured with the following~~:

   4.1. ~~High-end trim, setting the maximum light output of individual luminaires or groups of luminaires to support visual needs of a space or area, shall be implemented and construction documents shall state that maximum light output or power of controlled lighting shall be initially reduced by atleast 15 percent from full output. The average maximum light output or power of the controlled lighting shall be documented without high-end trim and with high-end trim to verify reduction of light output or power by at least 15 percent when tuned.~~

   4.2. ~~Where lumen maintenance control is used, controls shall be configured to limit the initial maximum lumen output or maximum lighting power to 85 percent or less of full light output or full power draw and lumen maintenance controls shall be limited to increasing lighting power by 1 percent per year.~~

   4.3. ~~High-end trim and lumen maintenance controls shall be accessible only to authorized personnel~~.

~~Where general lighting in more than 50 percent of the gross lighted floor area receives high-end trim, the~~The base credits from Tables C406.1.2(1) through C406.1.2(9) shall be prorated as follows:*~~[Tuned lighted fl oor area,%]~~*HET × *[Base energy credits for C406.2.5.2] / 50%* HET = Floor area of qualifying spaces where *general lighting* is provided with *high-end trim* lighting controls complying with this section, expressed as a percentage of total interior floor area excluding *dwelling and sleeping* units.

C408.3.1.4 *High-end trim* controls. Where lighting controls are configured for *high-end* *trim* ~~trims~~, verify the following:

1. ~~That high~~*High-end trim* maximum level has been set.
2. ~~That the~~ The calibration adjustment equipment is located for *ready access* only by authorized personnel.
3. ~~That lighting~~ Lighting controls with *ready access* for users cannot increase the lighting power above the maximum level established by the *high-end trim* controls.

Add new text as follows:

C408.3.1.5 *High end trim* lighting control verification for Additional Efficiency Credit L02. . For the qualifying spaces associated with the project receiving additional efficiency credits in Section C406.2.5.2, the following shall be documented while daylight responsive controls are not reducing lighting power:

1. The maximum setting for power or light output for each control group of *general lighting* luminaires.
2. The *high-end trim* setting for power or light output for each control group of *general lighting* luminaires.
3. For projects with seven or fewer claimed qualifying spaces, the reduction in light level or reduction in power due to *high-end trim* shall be tested in all spaces and shown to reduce the general lighting power or light level to not greater than 85 percent of full power or light output. For projects with more than seven claimed qualifying spaces, the reduction in light level or reduction in power due to *high-end trim* shall be tested in not less than 10 percent of spaces, and no less than seven spaces, and shown to reduce general lighting power or light level to not greater than 85 percent of full power or light output. Where more than 30 percent of the tested spaces fail, the remaining qualifying spaces shall be tested.
4. Summarize the reduction in *general lighting* power resulting from the *high-end trim* setting for each qualifying space and the floor area of each qualifying space.

5. <u>Summarize the fraction of total floor area for spaces where *high-end trim* reduces *general lighting* power to not greater than 85 percent of full power or light output.</u>

Reason: Additional efficiency credit L02 in Public Comment Draft #1 combines two different lighting control strategies: high-end trim, and digitally addressable luminaires.
High-end trim can be accomplished at a reasonable cost and is already recognized in C405.2.3.1 as an alternate for dimming controls. It also has clear and demonstrated energy savings.
Digitally addressable luminaires are extremely expensive, and do not have any demonstrated energy savings.
This proposal dramatically simplifies L02 by eliminating the requirement for digitally addressable luminaires and focusing the credit entirely on high-end trim.
This proposal also clarifies base code requirements for high-end trim lighting controls and adds new functional testing and documentation requirements for projects pursuing energy credit L02.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change proposal will neither increase nor decrease the cost of construction for projects which do not pursue L02. For projects which do pursue L02, the cost of construction will be dramatically reduced.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal reduces the cost of the measure while not reducing energy savings.

Final Hearing Results

CECD1-4-22	AS

CECD1-5-22

Original Proposal

IECC: C405.2.9, C405.2.9.1 (New), C406.3.2, C408.3.1.6 (New)

Proponents: Michael Jouaneh, IECC CE Electrical Power, Lighting, and Renewables Subcommittee, IECC CE Electrical Power, Lighting, and Renewables Subcommittee (ieccceelectrical@iccsafe.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

C405.2.9 Demand responsive lighting controls. ~~*Buildings* shall have controls that are capable of automatically reducing general lighting power not less than 15 percent in response to a demand response signal.~~Interior *general lighting* in group B, E, M, and S occupancies shall have *demand responsive controls* complying with C405.2.9.1 in not less than 75 percent of the interior floor area.

Exceptions:

1. ~~Buildings with less than 4,000 watts of combined installed general lighting power in spaces that have more than 0.5 W/ft² (5.38 W/m²) of general lighting power~~. Where the combined interior floor area of group B, E, M, and S occupancies is less than 10,000 square feet.
2. ~~*Buildings* where demand response programs are not available~~. *Buildings* where a *demand response signal* is not available from a controlling entity other than the owner.
3. ~~I-2 and I-3 occupancies~~. Parking garages.

Add new text as follows:

C405.2.9.1 Demand responsive lighting controls function. Demand responsive lighting controls shall be capable of the following:

1. Automatically reducing the output of demand responsive controlled lighting to 80 percent or less of full power or light output upon receipt of a *demand response signal*.
2. Where high end trim has been set, automatically reducing the output of controlled lighting to 80 percent or less of the high-end trim set point upon receipt of a *demand response signal*.
3. Dimming controlled lights gradually and continuously over a period of not longer than 15 minutes to get to their demand response setpoint.
4. Returning lights to their normal operational settings at the end of the demand response event.

Exception: Warehouse and retail storage building areas shall be permitted to switch off 25 percent or more ogf *eneral lighting* power rather than dimming.

Revise as follows:

C406.3.2 G01 Lighting Load Management. ~~Luminaires shall have dimming capability and automatic load management controls that shall gradually reduce *general lighting* power during peak periods. The load management controls shall reduce lighting power in 75 percent of the building area by at least 20 percent with *continuous dimming* over a period no longer than 15 minutes. Where less than 75 percent, but at least 50 percent of the project *general lighting* is controlled, the credits from Tables C406.3 shall be prorated as follows:~~A project not required to comply with C405.2.9 can achieve energy credits for installing demand responsive lighting controls for interior *general lighting* that comply with C405.2.9.1. The demand responsive lighting controls shall automatically reduce the light output or power of controlled lighting to no more than 80 percent of full output, or 80 percent of the high-end trim set point, whichever is less. Energy credits can be earned where demand responsive lighting controls are installed for the following:

1. Not less than 10 percent of the interior floor area in Group R or I occupancies; or

2. Not less than 50 percent of the interior floor area in all other occupancies.

G01 credits shall be prorated using Equation 4-29 with no more than 75 percent of the interior floor area being counted.

(Equation 4-29)

[~~building~~ interior floor area with lighting load management, %] x [table credits for C406.3.2] / 75%

~~**Exception:** Warehouse or retail storage building areas shall be permitted to achieve this credit by switching off at least 25 percent of lighting power in 75 percent of the building area without dimming, or as adjusted by Equation 4-29.~~

Add new text as follows:

C408.3.1.6 Demand responsive lighting controls G01. For spaces associated with the project receiving Renewable and Load Management Credits in Section C406.3.2, the following procedures shall be performed:

1. Confirm the maximum set point upon receipt of the *demand response signal* has been established for each space.
2. For projects with seven or fewer rooms with controls, each room shall be tested.
3. For projects with more than seven rooms with controls, testing shall be done for each unique space type. Where multiple rooms of each space type exist, not less than 10 percent and in no case fewer than one room, of each space type shall be tested unless the *code official* requires a higher percentage to be tested. Where 30 percent or more of the tested controls fail in a space type, all remaining identical space types shall be tested.
4. For demand responsive controls to be tested, verify the following:
   4.1 Where *high-end trim* controls are used, the high-end trim shall be set before testing.
   4.2 Turn off all non-general lighting in the room.
   4.3 Set general lighting to its maximum illumination level. Where *high-end trim* is set, this will be the maximum illumination level at the high-end trim setpoint.
   4.4 An illumination measurement shall be taken in an area of the room not controlled by daylight responsive controlled lighting. If there is not an area without *daylight responsive controls* the *daylight responsive controls* shall be overridden from reducing the lighting level during the test.
   4.5 Measure and document the room maximum illumination level.
5. Simulate a *demand response signal* and measure the illumination level at the same location as for the measurement in C408.3.1.5.(4.5). Verify the illumination level has been reduced to no greater than 80 percent of the maximum illumination level documented in C408.3.1.5.(4.5).
6. Simulate the end of a demand event by turning off the *demand response signal*, confirm controls automatically return to their normal operational settings at the end of the demand response event.

Reason: This proposal makes a number of important improvements to the code requirements for demand responsive lighting controls:
1. It limits the scope in base code to those occupancies (B, E, M, and S) where this can reasonably be achieved without excessive complexity and/or negative impact on building operations.
2. Changes the 4,000W exception to 10,000 square feet to significantly simplify compliance determination.
3. Specifies the capabilities of the required controls, so that it is clear to designers and building code officials what control systems would comply.
4. Modifies C406.3.2 to refer to the technical requirements in C405.2.9.1 so that the code can have one clear and consistent standard for

how these controls operate.
5. Revises language to be clear that compliance with both base code and energy credits is determined occupancy by occupancy for mixed-use buildings.
6. Adds functional testing requirements for demand responsive lighting controls.

To coordinate with C405.2.9 requirements, where a demand response signal is available and the building is not exempt, the credits are reduced by half.

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

This code change proposal will decrease the cost of construction by limiting the requirement for demand responsive lighting controls in C405.2.9 to occupancy groups B, E, M, and S.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal makes a number of important improvements to the code requirements for demand responsive lighting controls.

Final Hearing Results

CECD1-5-22	AS

CECD1-6-22

Original Proposal

IECC: TABLE C406.2(1), TABLE 406.2(2), TABLE 406.2(3), TABLE 406.2(5), TABLE 406.2(9), C406.2.5.4, TABLE C406.2.5.4

Proponents: Michael Jouaneh, IECC CE Electrical Power, Lighting, and Renewables Subcommittee, IECC CE Electrical Power, Lighting, and Renewables Subcommittee (ieccceelectrical@iccsafe.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE C406.2(1) BASE ENERGY CREDITS FOR GROUP R-2, R-4, AND I-1 OCCUPANCIES[a]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	8	13	7	11	6	8	9	6	1	24	8	9	30	15	5	32	28	31	36
E03	Envelope leak reduction	C406.2.1.3	15	10	12	8	6	16	13	5	1	7	7	9	65	16	1	73	43	52	26
E04	Add Roof Insulation	C406.2.1.4	1	1	1	1	1	1	4	3	1	5	3	4	6	5	1	7	7	6	8
E05	Add Wall Insulation	C406.2.1.5	10	10	6	8	5	6	8	4	1	8	3	4	11	7	1	14	12	13	13
E06	Improve Fenestration	C406.2.1.6	7	7	4	6	9	11	13	3	1	22	5	10	27	18	7	41	33	22	21
H01	HVAC Performance	C406.2.2.1	20	19	16	17	14	13	11	11	5	13	10	8	15	12	7	18	14	17	19
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	3	1	1	6	2	3	10	5	2	14	10	13	16
H03	Cooling efficiency	C406.2.2.3	7	6	4	4	3	3	1	1	1	1	1	1	1	1	x	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	9	10	8	22	20	25	16	17	32	21	24	17	23	27	16	21	24	18	18
H05	DOAS/fan control	C406.2.2.5	32	31	27	28	23	23	28	21	12	42	24	24	56	36	19	73	54	70	79
W01	SHW preheat recovery	C406.2.3.1 a	61	63	74	74	85	88	101	100	121	103	109	122	102	111	130	93	106	99	96
W02	Heat pump water heater	C406.2.3.1 b	50	52	62	61	72	74	86	85	104	88	94	106	88	96	112	81	92	87	84
W03	Efficient gas water heater	C406.2.3.1 c	38	39	46	46	53	55	63	62	76	64	68	76	64	69	81	58	66	62	60
W04	SHW pipe insulation	C406.2.3.2	7	7	8	7	8	8	8	9	10	8	9	9	7	8	9	6	7	6	6
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	3	3	3	3	3	3	3	3	4	3	3	4	3	3	4	3	3	3	2
W07	SHW heat trace system	C406.2.3.3 c	12	12	13	13	14	15	15	15	18	14	15	16	13	14	16	11	13	11	10
W08	SHW submeters	C406.2.3.4	11	11	13	13	15	16	18	18	22	19	20	22	19	20	24	17	20	18	18
W09	SHW distribution sizing	C406.2.3.5	45	46	55	54	63	65	74	73	89	75	80	89	74	81	95	68	77	72	70
W10	Shower heat recovery	C406.2.3.6	15	16	19	19	22	23	26	26	32	27	29	32	27	29	34	25	28	27	26
P01	Energy monitoring	C406.2.4	3	3	2	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2	3
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L03	Increase occp. sensor	C406.2.5.3	3	3	4	4	4	4	3	4	3	2	3	2	1	1	2	1	1	1	1

L04	Increase daylight area	C406.2.5.4	~~5~~x	~~5~~x	~~5~~x	~~5~~x	~~5~~x	~~5~~x	~~4~~x	~~4~~x	~~4~~x	~~4~~x	~~4~~x	~~3~~x	~~3~~x	~~4~~x	~~3~~x	~~2~~x	~~3~~x	~~3~~x	~~2~~x
L05	Residential light control	C406.2.5.5	8	8	9	9	9	9	8	8	10	6	8	7	4	6	8	3	5	4	3
L06	Light power reduction	C406.2.5.7	2	2	2	2	2	2	2	2	2	1	2	1	1	1	1	1	1	1	1
Q01	Efficient elevator	C406.2.6.1	4	4	4	4	5	5	5	5	5	4	5	5	4	4	5	4	4	4	3
Q02	Commercial kitchen equip.	C406.2.6.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.6.3	15	15	17	16	17	18	17	18	20	16	17	18	15	16	18	13	15	13	12
Q04	Fault detection	C406.2.6.4	3	3	2	3	2	2	2	2	1	2	2	1	1	2	1	3	2	3	3

a. "x" indicates credit is not available for that measure.

TABLE 406.2(2) BASE ENERGY CREDITS FOR GROUP I-2 OCCUPANCIES[a]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	6	11	6	11	7	9	6	6	2	3	3	3	4	3	7	5	5	17	3
E03	Envelope leak reduction	C406.2.1.3	5	3	4	3	5	8	8	3	2	6	2	2	7	3	1	9	7	19	5
E04	Add Roof Insulation	C406.2.1.4	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	1	2	3
E05	Add Wall Insulation	C406.2.1.5	1	3	1	3	2	2	9	4	1	4	1	1	3	1	1	3	3	3	3
E06	Improve Fenestration	C406.2.1.6	1	1	1	1	1	1	1	1	1	4	3	5	5	1	1	5	5	2	2
H01	HVAC Performance	C406.2.2.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H02	Heating efficiency	C406.2.2.2	x	x	x	x	2	3	4	3	7	6	4	6	8	6	10	11	12	15	19
H03	Cooling efficiency	C406.2.2.3	6	6	4	4	3	3	2	2	1	1	1	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	41	41	40	40	42	36	42	37	39	49	40	46	56	46	61	65	68	82	93
W01	SHW preheat recovery	C406.2.3.1 a	4	4	4	4	5	5	5	5	6	6	6	6	6	6	6	6	5	5	5
W02	Heat pump water heater	C406.2.3.1 b	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3
W03	Efficient gas water heater	C406.2.3.1 c	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W04	SHW pipe insulation	C406.2.3.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
P01	Energy monitoring	C406.2.4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	5	5	5	5	5	6	5	6	6	5	6	6	5	5	5	4	4	3	2

L03	Increase occp. sensor	C406.2.5.3	5	5	5	5	5	5	5	5	6	5	5	6	5	5	5	4	4	3	2
L04	Increase daylight area	C406.2.5.4	~~7~~x	~~7~~x	~~7~~x	~~7~~x	~~7~~x	~~7~~x	~~7~~x	~~7~~x	~~8~~x	~~6~~x	~~6~~x	~~6~~x	~~6~~x	~~6~~x	~~5~~x	~~5~~x	~~5~~x	~~5~~x	~~4~~x
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	7	7	7	7	7	7	7	7	9	7	7	8	6	7	7	5	5	4	3
Q01	Efficient elevator	C406.2.6.1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Q02	Commercial kitchen equip.	C406.2.6.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.6.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.6.4	3	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3	4	4

a. "x" indicates credit is not available for that measure.

TABLE 406.2(3) BASE ENERGY CREDITS FOR GROUP R-1 OCCUPANICES[a]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	4	7	4	7	3	4	7	2	1	7	2	3	10	6	4	12	9	19	11
E03	Envelope leakage reduction	C406.2.1.3	5	3	4	2	2	2	5	1	1	8	1	2	13	4	1	18	9	18	7
E04	Add Roof Insulation	C406.2.1.4	2	2	2	2	2	2	3	2	1	3	1	2	3	2	2	3	3	2	3
E05	Add Wall Insulation	C406.2.1.5	13	14	8	11	4	4	7	4	1	5	2	4	6	4	3	9	7	10	8
E06	Improve Fenestration	C406.2.1.6	5	5	4	5	7	7	8	2	1	8	2	4	10	5	1	21	17	10	9
H01	HVAC Performance	C406.2.2.1	21	20	17	18	16	13	12	12	11	11	11	8	11	11	8	13	11	14	16
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	1	1	6	2	1	1	3	2	2	6	4	8	11
H03	Cooling efficiency	C406.2.2.3	7	6	4	4	3	2	1	2	1	1	2	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	32	30	26	28	25	23	24	22	28	26	22	20	30	26	19	41	34	48	62
W01	SHW preheat recovery	C406.2.3.1 a	18	19	22	22	25	27	31	21	32	34	34	38	37	36	40	36	37	36	35
W02	Heat pump water heater	C406.2.3.1 b	14	15	18	17	20	22	25	25	27	29	29	32	31	31	34	30	32	31	30
W03	Efficient gas water heater	C406.2.3.1 c	11	12	14	14	16	17	19	19	20	21	21	24	23	23	25	22	23	23	22
W04	SHW pipe insulation	C406.2.3.2	3	3	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	1	1
W07	SHW heat trace system	C406.2.3.3 c	5	6	6	6	6	7	7	7	7	7	7	8	7	7	8	7	7	6	6
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	13	14	16	16	18	20	22	22	23	25	25	28	27	26	29	26	27	26	25
W10	Shower heat recovery	C406.2.3.6	4	5	5	5	6	7	8	8	8	9	9	10	10	9	10	9	10	10	9
P01	Energy monitoring	C406.2.4	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

L03	Increase occp. sensor	C406.2.5.3	3	3	3	3	3	3	3	3	3	4	2	3	2	2	3	2	2	1	1
L04	Increase daylight area	C406.2.5.4	~~4~~x	~~5~~x	~~5~~x	~~4~~x	~~5~~x	~~5~~x	~~4~~x	~~4~~x	~~4~~x	~~5~~x	~~4~~x	~~4~~x	~~3~~x	~~4~~x	~~3~~x	~~3~~x	~~3~~x	~~3~~x	~~2~~x
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	1	1	2	2	2	2	2	2	2	2	1	2	1	1	2	1	1	1	1
Q01	Efficient elevator	C406.2.6.1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	2	2	2	2
Q02	Commercial kitchen equip.	C406.2.6.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.6.3	9	9	10	10	10	11	11	11	11	11	11	12	11	11	12	10	11	10	9
Q04	Fault detection	C406.2.6.4	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2

a. "x" indicates credit is not available for that measure.

TABLE 406.2(5) BASE ENERGY CREDITS FOR GROUP A-2 OCCUPANCIES[a]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	1	1	1	1	2	2	9	2	1	19	4	5	26	7	3	33	23	29	13
E03	Envelope leak reduction	C406.2.1.3	2	1	1	1	2	3	11	2	1	24	4	6	33	9	3	42	29	36	16
E04	Add Roof Insulation	C406.2.1.4	1	1	0	1	1	1	2	1	1	1	1	1	2	2	1	2	2	1	2
E05	Add Wall Insulation	C406.2.1.5	1	1	0	1	1	2	3	3	1	2	1	1	2	2	2	2	2	2	2
E06	Improve Fenestration	C406.2.1.6	1	1	1	1	1	1	2	2	1	1	2	2	3	2	1	4	4	1	1
H01	HVAC Performance	C406.2.2.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H02	Heating efficiency	C406.2.2.2	x	x	x	x	1	1	6	3	3	10	6	8	15	11	10	19	15	23	28
H03	Cooling efficiency	C406.2.2.3	6	5	3	4	3	2	1	1	1	1	1	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	29	27	20	25	24	21	36	27	15	51	35	38	67	53	45	84	70	97	115
W01	SHW preheat recovery	C406.2.3.1 a	24	26	31	29	33	35	37	38	45	38	41	44	37	40	44	34	38	33	30
W02	Heat pump water heater	C406.2.3.1 b	15	16	19	18	21	23	25	25	29	26	28	30	26	28	31	25	27	24	22
W03	Efficient gas water heater	C406.2.3.1 c	15	16	19	18	21	22	23	24	28	24	25	27	23	25	27	21	24	21	18
W04	SHW pipe insulation	C406.2.3.2	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3	2	2	2	2
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	3	3	3	3
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P01	Energy monitoring	C406.2.4	2	2	2	2	2	1	2	1	1	2	1	1	2	2	1	2	2	2	3
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

L02	Lighting dimming & tuning	C406.2.5.2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1	1	1	0
L03	Increase occp. sensor	C406.2.5.3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0
L04	Increase daylight area	C406.2.5.4	~~3~~x	~~3~~x	~~3~~x	~~3~~x	~~3~~x	~~3~~x	~~2~~x	~~2~~x	~~2~~x	~~2~~x	~~2~~x	~~2~~x	~~1~~x	~~2~~x	~~1~~x	~~1~~x	~~1~~x	~~1~~x	~~1~~x
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	1	2	1	1
Q01	Efficient elevator	C406.2.6.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Q02	Commercial kitchen equip.	C406.2.6.2	24	26	28	27	28	29	27	29	32	26	28	29	24	26	28	21	23	19	17
Q03	Residential kitchen equip.	C406.2.6.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.6.4	3	2	2	2	2	2	2	2	1	2	2	1	2	2	2	3	2	3	4

a. "x" indicates measure is not available for that measure.

TABLE 406.2(9) BASE ENERGY CREDITS FOR OTHER OCCUPANCIES[a,b]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	5	9	5	8	5	6	10	5	2	20	6	6	25	10	4	28	22	26	16
E03	Envelope leak reduction	C406.2.1.3	6	4	5	4	3	7	12	3	2	28	5	6	36	9	3	41	27	33	15
E04	Add Roof Insulation	C406.2.1.4	4	4	3	4	4	4	8	6	2	7	6	7	9	8	9	9	10	9	12
E05	Add Wall Insulation	C406.2.1.5	16	19	11	17	5	6	10	7	2	9	6	8	9	7	7	9	9	10	8
E06	Improve Fenestration	C406.2.1.6	4	4	3	4	5	6	6	4	1	9	4	7	11	7	6	16	14	8	8
H01	HVAC Performance	C406.2.2.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	6	2	3	11	6	8	15	11	9	18	15	19	23
H03	Cooling efficiency	C406.2.2.3	7	7	5	5	4	3	1	2	1	x	x	x	x	x	x	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	7	36	31	34	30	28	43	32	23	61	42	49	75	61	49	90	77	93	90
W01	SHW preheat recovery	C406.2.3.1 a	18	19	22	21	25	26	28	29	34	29	31	34	29	31	35	26	29	27	26
W02	Heat pump water heater	C406.2.3.1 b	12	12	15	14	17	17	20	20	24	21	22	25	21	23	26	20	22	21	20
W03	Efficient gas water heater	C406.2.3.1 c	11	11	13	13	15	16	17	17	21	18	19	21	18	19	22	16	18	17	16
W04	SHW pipe insulation	C406.2.3.2	3	3	4	4	4	4	4	4	5	4	4	5	4	4	5	3	4	3	3
W05	Point of use water heaters	C406.2.3.3 a	8	10	11	10	11	12	12	12	14	13	13	14	13	13	14	11	12	12	11
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	2	1	1	2	1	1	2	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	5	5	5	5	6	6	6	6	7	6	6	7	5	6	7	5	5	5	5
W08	SHW submeters	C406.2.3.4	11	11	13	13	15	16	18	18	22	19	20	22	19	20	24	17	20	18	18
W09	SHW flow reduction	C406.2.3.5	29	30	36	35	41	43	48	48	56	50	53	59	51	54	62	47	52	49	48
W10	Shower heat recovery	C406.2.3.6	6	6	7	7	8	9	10	10	11	10	11	12	10	11	12	10	11	10	10
P01	Energy monitoring	C406.2.4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4

L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	5	5	5	5	6	6	5	6	7	5	5	5	4	4	5	3	4	3	2
L03	Increase occp. sensor	C406.2.5.3	5	6	6	6	7	7	6	7	8	5	6	6	4	5	6	3	4	3	2
L04	Increase daylight area	C406.2.5.4	~~7~~x	~~8~~x	~~9~~x	~~8~~x	~~9~~x	~~9~~x	~~8~~x	~~8~~x	10x	~~6~~x	~~7~~x	~~7~~x	~~5~~x	~~6~~x	~~6~~x	4x	~~5~~x	~~5~~x	4x
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	7	7	8	7	8	8	7	8	9	5	7	6	4	5	6	4	4	3	2
Q01	Efficient elevator	C406.2.6.1	4	4	5	4	5	5	5	5	6	4	5	5	4	4	5	3	4	3	3
Q02	Commercial kitchen equip.	C406.2.6.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.6.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.6.4	3	3	3	3	3	2	3	2	2	3	3	2	3	3	2	4	3	4	4

a. "x" indicates measure is not available for that measure.

b. Other occupancy groups include all Groups except for Groups A-2, B, E, I, M, and R.

C406.2.5.4 L04 Increase daylight area. The total daylight area of the building ~~project~~ (DLA_{BLDG}) ~~with continuous daylight dimming meeting the requirements of C405.2.4~~ determined by Equation 4-23 shall be at least 5 percent greater than the typical~~daylit~~ daylight area (DLA_{TYP}) from Table C406.2.5.4.

$$DLA_{BLDG} = DLZ / LFA \qquad \textbf{(Equation 4-23)}$$

where:

DLZ = The total building floor area located within sidelit and toplit *daylight zones* complying with C405.2.4.2 or C405.2.4.3 and provided with daylight responsive controls complying with C405.2.4.1, ft^2 or m^2.

LFA = The total building floor area used to determine the lighting power allowance in C405.3.2, ^{2}~~ft~~ or m^2.

Credits for measure L04 shall be determined by ~~based on~~ Equation 4-24or Equation 4-25, whichever is less::

$$EC_{DL} = EC_{DL5} \times 20 \times (DLA_{BLDG} - DLA_{TYP}) \qquad \textbf{(Equation 4-24)}$$

EC_{DL}= The lesser of actual area of *daylight zones* in the *building* with continuous daylight dimming, ft^2 or m^2 and (GLFA x DLA_{max}) see TableC406.2.5.4. *Daylight zones* shall meet the criteria in Sections C405.2.4.2 and C405.2.4.3 for primary sidelit *daylight zones*, secondary sidelit *daylight zones*,and toplit *daylight zones*.

~~GLFA = Project gross lighted fl oor area, f^{2}t or m^2~~

DLA_{TYP}= Typical % of *building* area with daylight control (as a fraction) from Table C406.2.5.4:

EC_{DL5}= C406.2.5.4 L04 base energy credits from Section C406.2

$$EC_{DL} = EC_{DL5} \times 20 \times (DLA_{MAX} - DLA_{TYP}) \qquad \textbf{(Equation 4-25)}$$

where:EC_{DL} = The number of credits achieved by this measure.

EC_{DL5} = C406.2.5.4 L04 base energy credits from Section C406.2 Tables C406.2(4), C406.2(6), C406.2(7), and C406.2(8).

DLA_{TYP} = Typical % percent of building floor area with daylight control (as a fraction) from Table C406.2.5.4.

DLA_{MAX} = Maximum percent of building floor area with daylight control that can be counted for compliance with this measure, from Table C406.2.5.4.

TABLE C406.2.5.4 ADDED DAYLIGHTING PARAMETERS

Building use type	DLATYP	DLAMAX
Group B; Office ≤ 5000 ft^2 (460 m^2)	10%	20%
Group B; Office > 5000 ft^2 (460 m^2)	21%	31%
Group M; Retail with ≤ 1000 f^{2}t (900 m^2) roof area	0%	20%
Group M; Retail with > 1000 ft^2 (900 m^2) roof area	60%	80%
Group E; Education	42%	52%
Groups S-1 and S-2; Warehouse	50%	70%
Group I-2, R, and other; Medical, hotel, multifamily, dormitory, and other	NA	NA

Reason: There are several problems with this credit which are corrected by this proposal:

1. This credit can only be achieved for occupancies where there are values provided for DLATYP and DLAMAX in Table C406.2.5.4 - otherwise the credit cannot be calculated. The relevant tables in C406.2 are amended to indicate that L04 cannot be achieved for those occupancies where DLATYP and DLAMAX are not provided.
2. C406.2.5.4 says that the credit is achieved when “the daylight area of the building is at least 5% greater than a percentage”. Equation 4-23 is added to convert DLABLDG to a percentage so that this comparison can be made.
3. GLFA (gross lighted floor area) is not a readily understood term. It is not used anywhere else in the code, and the word “gross” is unclear. This is revised to LFA (lighted floor area) and given a clear meaning.
4. ECDL is very confusing as the description includes conditional logic. This is broken into two separate equations for clarity.
5. Table C406.2.5.4 is amended to indicate clearly that buildings in Group S-1 and S-2 which are not warehouse cannot obtain the credit.
6. Table C406.2.5.4 is amended to strike the occupancy groups which are currently indicated as “NA”. This does not need to be in C406.2.5.4 when the tables in C406.2 are amended to show that L04 is not available for these occupancies.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No changes in scope or applicability are proposed – revisions are editorial.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Per reason statement of proposal

Final Hearing Results

CECD1-6-22 AS

CECD1-7-22

Original Proposal

IECC: C406.2.5.6

Proponents: Michael Jouaneh, IECC CE Electrical Power, Lighting, and Renewables Subcommittee, IECC CE Electrical Power, Lighting, and Renewables Subcommittee (ieccceelectrical@iccsafe.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

C406.2.5.6 L06 Reduced lighting power. Interior lighting within ~~the whole~~ all building areas shall comply with ~~all the requirements of~~ this section. ~~The net connected interior lighting power (LPn) shall be 95 percent or less than the net interior lighting power allowance (LPAn) determined in accordance with Section C405.3.2.2. In R-1 and R-2 occupancies the credit is calculated for all common areas other than dwelling units and sleeping units. No less than 95 percent of the permanently installed light fixtures in dwelling units and sleeping units, excluding kitchen appliance lighting, shall be provided by high efficacy lamps with aminimum efficacy of 90 lumens per watt or high efficacy luminaires that have a minimum efficacy of 55 lumens per watt. Energy credits shall not be greater than four times the L06 base credit from Section C406.2 and shall be determined using Equation 4-25:~~

1. The connected interior lighting power (LP) determined in accordance with C405.3.1 shall be 95 percent or less than the interior lighting power allowance (LPA) determined in accordance with Section C405.3.2 using the same method used to comply with C405.3. Energy credits shall not be greater than four times the L06 base credit from Section C406.2 and shall be determined using Equation 4-25.
2. All permanently installed lighting serving *dwelling units and sleeping units*, including ceiling fan light kits and lighting integrated into range hoods and exhaust fans shall be provided by lamps with an efficacy of not less than 90 lumens per watt or by luminaires that have an efficacy of not less than 65 lumens per watt.

    Exceptions:

    1. LIghting integral to other appliances.
    2. Antimicrobial lighting used for the sole purpose of disinfecting.

(Equation 4-25)

$$EC_{LPA} = EC_5 \times 20 \times (LPA_n - LP_n)/LPA_n$$

EC_{LPA}= additional energy credit for lighting power reduction
$LP_{\cancel{n}}$= ~~net~~ connected interior lighting power calculated in accordance with Section C405.3.1, watts~~, excluding any additional lighting power allowed in Section C405.3.2.2.1~~
$LPA_{\cancel{n}}$= interior lighting power allowance calculated in accordance with the requirements of Section C405.3.2~~.2~~, watts,~~ less any additional interior lighting power allowed in Section C405.3.2.2.1~~
EC5 = L06 base credit from Section C406.2

Reason: This section required some editorial fixes to align with IECC 2024 PC#1. Additionally, some minor changes in stringency are proposed. The proponent of CEPI-193 (DoE) was involved in development of these proposed changes.

- The reference to the section that defines how lighting power is calculated was corrected (C405.3.2)

- The explanation that dwelling units and sleeping are excluded from the calculation is no longer needed due to the addition of C405.3.1 exception #1 in PC Draft #1

- The requirement that no less than 95% of lighting comply, was removed. This is appropriate for an additional efficiency option and simplifies the requirement significantly.

- The language regarding kitchen appliance/exhaust fans was revised to match a draft PLR SC proposal that makes this change.
- Wording was revised to match C405.1.1 in PC draft#1
- Luminaire efficacy threshold was increased to 65 LPW. This is appropriate for an additional efficiency option.
- The exclusion of additional lighting power from the calculation of credits was removed. This will align with the way that COMCheck calculates the percentage reduction in power below code allowed and simplifies the calculation. This change may slightly increase stringency for some projects but does not reduce stringency for any project.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither decrease nor increase the cost of construction

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Mostly editorial changes to better align with base code, and increase in stringency in terms of luminaire efficacy.

Final Hearing Results

CECD1-7-22 AS

CECD1-8-22

Original Proposal

IECC: C407.5, C407.5.1, C407.5.1.1 (New), C407.5.2, C407.5.3, ASHRAE Chapter 06, C407.5.1.2 (New), C407.5.2 (New)
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C407.5 Calculation software tools. Calculation procedures used to comply with~~this section~~ Section C407 shall ~~be~~ apply an approved version of a performance analysis software tools capable of calculating the annual energy consumption of all building elements that differ between the *standard reference design* and the *proposed design*. The same approved version of the performance analysis tool shall be used to calculate the proposed design and standard reference design.~~and shall include the following capabilities.~~

1. ~~Building operation for a full calendar year (8,760 hours)~~.
2. ~~Climate data for a full calendar year (8,760 hours) and shall reflect*approved* coincident hourly data for temperature, solar radiation, humidity and wind speed for the building location.~~
3. ~~Ten or more thermal zones~~.
4. ~~Thermal mass effects.~~
5. ~~Hourly variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads.~~
6. ~~Part-load performance curves for mechanical equipment~~.
7. ~~Capacity and efficiency correction curves for mechanical heating and cooling equipment~~.
8. ~~Printed *code official* inspection checklist listing each of the *proposed design* component characteristics from Table C407.4.1(1) determined by the analysis to provide compliance, along with their respective performance ratings, including but not limited to *R*-value, *U*-factor, SHGC, HSPF, AFUE, SEER and EF~~.

C407.5.1 ~~Specific~~ Software tool approval. Any version of a performance ~~Performance~~ analysis~~ tools complying with the applicable subsections~~tool meeting the requirements of Section ~~C407~~ C407.5.1.1 and C407.5.1.2 ~~tested according to ASHRAE Standard 140~~ shall be permitted to be *approved.* Tools are permitted to be*approved* based on meeting a specified threshold for a jurisdiction. The*code official* shall be permitted to approve tools for a specified application or limited scope.

Add new text as follows:

C407.5.1.1 Software tool capabilities. Approved software tools shall include the following capabilities:

1. Building operation for a full calendar year (8,760 hours).
2. Climate data for a full calendar year (8,760 hours) and shall reflect approved coincident hourly data for temperature, solar radiation, humidity, and wind speed for the building location.
3. Ten or more thermal zones.
4. Thermal mass effects.
5. Hourly variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads.
6. Part-load performance curves for mechanical equipment.
7. Capacity and efficiency correction curves for mechanical heating and cooling equipment.

8. Printed code official inspection checklist listing each of the proposed design component characteristics from Table C407.4.1(1) determined by the analysis to provide compliance, along with their respective performance ratings, including but not limited to R-value, U-factor, SHGC, HSPF, AFUE, SEER and EF.

Revise as follows:

C407.5.~~2~~3 Input values. Where calculations require input values not specified by Sections C402, C403, C404 and C405, those input values shall be taken from an *approved* source.

C407.5.~~3~~4 Exceptional calculation methods. Where the simulation program does not model a design, material or device of the *proposed design*, an exceptional calculation method shall be used where approved by the *code official*. Where there are multiple designs, materials or devices that the simulation program does not model, each shall be calculated separately and exceptional savings determined for each. The total exceptional savings shall not constitute more than half of the difference between the baseline simulated building performance and the proposed simulated building performance. Applications for approval of an exceptional method shall include all of the following:

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

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

140~~—2014~~2020: Standard Method of Test for ~~the Evaluation of~~ Evaluating Building ~~Energy Analysis Computer Programs~~Performance Simulation Software (with Addenda A and B)

Add new text as follows:

C407.5.1.2 Testing required by software vendors. Prior to approval, software tools shall be tested by the software vendor in accordance with ASHRAE Standard 140, except Sections 7 and 8. During testing, hidden inputs that are not normally accessible to the user shall be permitted to avoid introducing source code changes strictly used for testing. Software vendors shall publish, on a publicly available website, the following ASHRAE Standard 140 test results, input files, and modeler reports for each tested version of a software tool:

1. Test results demonstrating the software tool was tested in accordance with ASHRAE Standard 140 and that meet or exceed the values for “The Minimum Number of Range Cases within the Test Group to Pass” for all test groups in ASHRAE Standard 140, Table A3-14.
2. Test results of the performance analysis tool and input files used for generating the ASHRAE Standard 140 test cases along with the results of the other performance analysis tools included in ASHRAE Standard 140, Annexes B8 and B16.
3. The modeler report in ASHRAE Standard 140, Annex A2, Attachment A2.7. Report Blocks A and G shall be completed for results exceeding the maximum or falling below the minimum of the reference values shown in ASHRAE Standard 140 Table A3-1 through Table A3-13, and Report Blocks A and E shall be completed for any omitted results.

C407.5.2 Algorithms not tested. Algorithms not tested in accordance with C407.5.1.2, including algorithms that are alternatives to those that were tested, and numerical settings not tested, such as timesteps and tolerances, shall be permitted to be used when modeling the proposed design and *standard reference design*.

Reason: Addendum b for ASHRAE Standard 140-2020 adds software acceptance criteria to Standard 140, allowing codes citing Standard 140, such as IECC, to require the results from software to provide results within the ranges included in the addendum. This provides the IECC with a measure of the acceptability of a building performance simulation software program based on the tests included in Standard 140. Before Addendum b, Standard 140 had test cases with example results to evaluate building performance software. But, it did not include any information on when a software's results would be considered acceptable for the test cases. This meant that organizations that cited Standard 140 would only require that software ran the tests and not that their results had to be within a specific range of results. Historically, this caused confusion for jurisdictions adopting IECC when determining if software passed or failed 140 when simply running the tests was all that was required.

All major building energy modeling software developers were invited to participate in the process to determine the acceptance ranges that appear in 140-2020, Addendum b and many software developers participated. The acceptance ranges were set so that most commonly used software programs are within the ranges, and additional software is expected to be within the ranges as software developers address outlying results. Overall, this approach will encourage building performance simulation software to be more accurate and consistent. No comments were provided during the public review of Addendum b, which reflects the consensus reached within the software and modeling community.

This proposal adds the necessary referencing language to utilize Addendum b for ASHRAE Standard 140, including the acceptance ranges to be met, the reporting requirements, and the details necessary for testing to section C407 Simulated Building Performance.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither increase nor decrease the cost of construction. It impacts only an alternative path to compliance C407. The modeler needs to select to use software that complies, which is no different than previously. The additional burden of testing software using Standard 140 rests with the building performance software vendor, where for many software vendors much of this cost has already been borne when they submitted results during development of the acceptance criteria.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal incorporates ASHRAE Standard 140-2020 modeling software acceptance criteria into Section C407.5.

Final Hearing Results

CECD1-8-22 AS

CECD1-9-22

Original Proposal

IECC: 6 AAMA, AAMA Chapter 06, CSA Chapter 06, 6 WDMA, WDMA Chapter 06
Proponents:

2024 International Energy Conservation Code [CE Project]

Delete and substitute as follows:

Revise as follows:

AAMA

American Architectural Manufacturers Association
1827 Walden Office Square Suite 550
Schaumburg, IL 60173-4268

AAMA/WDMA/CSA 101/I.S.2/A440~~—17~~22:	North American Fenestration Standard/Specification for ~~Windows~~windows, ~~Doors~~doors, and ~~Skylights~~skylights

CSA

CSA Group
8501 East Pleasant Valley Road
Cleveland, OH 44131-5516

AAMA/WDMA/CSA 101/I.S.2/A440~~—17~~22:	North American Fenestration Standard/Specification for ~~Windows~~windows, ~~Doors~~doors, and ~~Unit Skylights~~skylights

WDMA

Window and Door Manufacturers Association
2025 M Street NW, Suite 800
Washington, DC 20036-3309

AAMA/WDMA/CSA 101/I.S.2/A440~~—17~~22:	North American Fenestration Standard/Specification for ~~Windows~~windows, ~~Doors~~doors, and ~~Skylights~~skylights

Reason: This proposal provides corrections to the listing of the *North American Fenestration Standard/Specification for windows, doors, and skylights* which is a referenced standard in Chapter 4 the IECC. There have been recent changes to the names and/or locations of the promulgating organizations. In addition, the title was slightly incorrect and the standard has also been updated.

The American Architectural Manufacturers Association (AAMA) has changed its name to the Fenestration & Glazing Industry Alliance (FGIA) and also changed its office address.

The Window & Door Manufacturers Association relocated its office.

Also, the title of *AAMA/WDMA/CSA 101/I.S.2/A440: North American Fenestration Standard/Specification for windows, doors, and skylights* has been inconsistently referenced in the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

no change to cost of construction

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Based on proponent's reason statement.

Final Hearing Results

CECD1-9-22 AS

CECD1-11-22

Original Proposal

IECC: SECTION 202, C402.4, CB103.1, CD101.3
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

LOW SLOPE~~LOW-SLOPED ROOF~~. A ~~roof having a~~ slope less than 2 units vertical in 12 units horizontal(17-percent slope) as applied to roofs.

C402.4 Roof solar reflectance and thermal emittance.~~Low-sloped~~ *Low slope* roofs directly above cooled conditioned spaces in*Climate Zones* 0 through 3 shall comply with one or more of the options in Table C402.4.

Exceptions: The following roofs and portions of roofs are exempt from the requirements of Table C402.4:

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 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.

CB103.1 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~~*low slope* roofs. Solar-ready zones shall comply with Sections CB103.2 through CB103.8.

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 CB103.3 cannot be met because of extensive rooftop equipment, skylights, vegetative roof areas or other obstructions.

CD101.3 On-site renewable electricity systems. In addition to any renewable energy generation equipment provided to comply with Section C406.3, buildings shall install equipment for on-site renewable energy generation with a direct current (DC) nameplate capacity rating of not less than that computed using Equation CD-2.

CD-1

$$\underline{AA = CA + SNA/3}$$

AA = Adjusted area, in ft^2 (m^2)
CA = Conditioned area, in ft^2 (m^2)
SNA = Semi-heated and nonconditioned area, in ft^2 (m^2)

CD-2

$$\underline{REQ = AA \times CF}$$

REQ = Required on-site capacity, in DC watts
AA = Adjusted area from Equation CD-1, in ft^2 (m^2)
CF = Capacity factor from Table CD101.3, in watts/ft^2 (m^2)

Exceptions:

1. Any required renewable energy generation capacity in excess of 10 W/f^{2}t (108 W/m^2) of net available roof area is permitted to be provided using an off-site renewable energy system in accordance with Section CD101.4. For the purposes of this section, net available roof area is the gross roof area minus the roof area occupied by any combination of skylights, mechanical equipment, vegetated areas, required access pathways, vehicle parking, and occupied roof terrace area.
2. The following buildings are permitted to provide off-site renewable energy generation in accordance with Section CD101.4 in lieu of all or part of the on-site renewable energy generation capacity required by Section CD101.3.
   2.1 Any *building* where more than 50 percent of roof area would be shaded from direct-beam sunlight by existing natural objects or by structures that are not part of the building for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.

   2.2 Any *building* with gross conditioned floor area less than 1,000 square feet (93 m^2).

   2.3 Any *building* whose primary roof slope is 2 units vertical in 12 units horizontal (17-percent slope) orgreater ~~than 2 in 12~~.
3. Alternate forms of renewable energy generation capacity are permitted where the annual energy generation is not less than that produced by the required solar capacity, and where annual energy generation is calculated using an *approved* methodology.
4. All or part of the required renewable energy generation capacity is permitted to be replaced by other efficiency measures provided such measures will reduce the annual energy consumption of the *building* by an amount no less than that which would otherwise be produced annually by the required renewable energy capacity, as calculated using the total building performance compliance path in Section C407 and an approved calculation methodology for solar production.

Reason: This comment:

· Changes the IECC commercial provisions defined term from "low-sloped roof" to "low slope."

· Adjusts the definition to align with the term and coordinate with the existing IBC definition of "steep slope" [i.e., "A roof slope 2 units vertical in 12 units horizontal (17-percent slope) or greater."].

· Makes changes to use the defined term in C402.4.

· Makes changes to use the defined term in CB103.1.

· Changes the wording of CD101.3 to align the exception with the definition.

In combination, these modifications are intended to clarify provisions within the IECC and align complementary terminology between the IECC and IBC.

RED1-182-22 is a companion comment which changes the new terms "low-sloped roof" and "steep-sloped roof" in the residential 1st Public

Comment Draft to “low slope” and “steep slope,” respectively, and coordinates their use with the residential roof radiative property provisions. RED1-182-22 has been approved by the Residential Consensus Committee.

The term serves within the body of the commercial 1st Public Comment Draft solely as a trigger in C402.4 for roof radiative properties. As is shown via the proposed change to CB103.1, it may be appropriate as a trigger for solar-ready zones. However, if the intention in CB103.1 is to refer to a slope trigger different than 2 in 12, the defined term should not be used and the proposed change to CB103.1 should be removed from this comment.

The proposed modification to CD101.3 coordinates an exception to the onsite renewable electricity system provisions in the appendix by clarifying that a roof with a slope of exactly 2 in 12 falls within the exception, creating consistency between the defined term and this trigger.

Regarding potential concerns about defining the term “low slope” solely with respect to roofs, note that the words “slope” and “sloped” appear in the Commercial 1st Public Comment Draft in the following locations in addition to the ones included for revision in this comment:

· **Chapter 2, definition of fenestration**

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

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

· **Table C301.1**

o North Slope, Alaska

o Slope, North Dakota

· **Figure C405.2.4.2(3)**

o Daylight Zone Under a Sloped Rooftop Monitor

No confusion is created with the proposed term “low slope” with respect to these other uses of “slope.” Uses in the residential 1st Public Comment Draft are identical except there is no equivalent to Figure C405.2.4.3(3) and there is a use in the definition of “grade plane,” which is not defined in the commercial 1st Public Comment Draft.

Limiting the definition to roofs also serves to guide decisions about where to italicize “low slope.” In fact, this is not an issue in the 2021 IBC or 2021 IRC, which include no uses of the phrase “low slope” outside the roofing chapters (i.e., 15 and 9, respectively). There are no uses of “low slope” in the IEBC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
this proposal neither increases or decreases the cost of construction. It is merely a terminology clarification.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The definition of slopes, with regard to roofing, is clarified.

Final Hearing Results	
CECD1-11-22	AM

CECD1-12-22

Original Proposal

IECC: TABLE C403.3.2(12), TABLE C403.3.2(13), 6 AHRI, AHRI Chapter 06
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C403.3.2(12) ELECTRICALLY OPERATED DX-DOAS UNITS, SINGLE-PACKAGE AND REMOTE CONDENSER, WITHOUT ENERGY RECOVERY—MINIMUM EFFICIENCY REQUIREMENTS[~~b~~]

EQUIPMENT TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Air cooled (dehumidification mode)	—	4.03.8 ISMRE2	AHRI 920
Air-source heat pumps (dehumidification mode)	—	4.03.8 ISMRE2	AHRI 920
Water cooled (dehumidification mode)	Cooling tower condenser water	4.94.7 ISMRE2	AHRI 920
	Chilled water	6.0 ISMRE	
Air-source heat pump (heating mode)	—	2.72.05 ISCOP2	AHRI 920
Water-source heat pump (dehumidification mode)	Ground source, closed and open loop[b]	4.84.6 ISMRE2	AHRI 920
	Ground-water source	5.0 ISMRE	
	Water source	4.03.8 ISMRE2	
Water-source heat pump (heating mode)	Ground source, closed and open loop[b]	2.02.13 ISCOP2	AHRI 920
	Ground-water source	3.2 ISCOP	
	Water source	3.52.13 ISCOP2	

a. Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

b. ~~This table is a replica of ASHRAE 90.1 Table 6.8.1-13 Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, without Energy Recovery--Minimum Efficiency Requirements.~~ For minimum efficiency compliance purposes, open loop systems shall be rated using closed-loop test conditions.

TABLE C403.3.2(13) ELECTRICALLY OPERATED DX-DOAS UNITS, SINGLE-PACKAGE AND REMOTE CONDENSER, WITH ENERGY RECOVERY—MINIMUM EFFICIENCY REQUIREMENTS[~~b~~]

EQUIPMENT TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Air cooled (dehumidification mode)	—	5.25.0 ISMRE2	AHRI 920
Air-source heat pumps (dehumidification mode)	—	5.25.0 ISMRE2	AHRI 920
Water cooled (dehumidification mode)	Cooling tower condenser water	5.35.1 ISMRE2	AHRI 920
	Chilled water	6.6 ISMRE	
Air-source heat pump (heating mode)	—	3.33.2 ISCOP2	AHRI 920
Water-source heat pump (dehumidification mode)	Ground source, closed and open loop[b]	5.25.0 ISMRE2	AHRI 920

	Ground-water source	5.8 ISMRE	
	Water source	4.84.6 ISMRE2	
Water-source heat pump (heating mode)	Ground source, closed and open loop[b]	3.83.5 ISCOP2	AHRI 920
	Ground-water source	4.0 ISCOP	
	Water source	4.8 4.04 ISCOP2	

a. Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

b. ~~This table is a replica of ASHRAE 90.1 Table 6.8.1-14 Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, with Energy Recovery—Minimum Efficiency Requirements.~~ For minimum efficiency compliance purposes, open loop systems shall be rated using closed-loop test conditions.

AHRI

Air-Conditioning, Heating, & Refrigeration Institute
2111 Wilson Blvd, Suite 500
Arlington, VA 22201

~~920—2015:~~ANSI/AHRI 920-2020 Performance Rating of DX-Dedicated Outdoor Air System Units with Addendum 1:

Reason: To ensure marketplace consistency with DOE's adoption of ISMRE2 and ISCOP2 levels based on AHRI 920-2020, this committee drafted proposal includes the following changes:

1. Updates existing IECC 2021 ISMRE and ISCOP standards to ISMRE2 and ISCOP2 standards consistent with the Department of Energy final rule, published in the Federal Register on November 1, 2022. (87 FR 65651)

a. Note: The effective date of this rule was January 3, 2023. Compliance with the standards established for DX-DOASes in this final rule is required on and after May 1, 2024, so no date was proposed herein as standards will already be federally effective upon publication of UECC 2025.

2. For the four equipment classes covered by 90.1, but not considered by DOE, this proposal harmonizes with Addendum cv of ASHRAE Standard 90.1-2019, changing ISMRE and ISCOP standards to ISMRE2 and ISCOP2 standards based on an industry analysis. Four of these equipment classes were be combined into two.

3. Adds AHRI Standard 920-2020 to Normative References in Section 6

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change is not expected to change the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: To ensure marketplace consistency with DOE's adoption of ISMRE2 and ISCOP2 levels based on AHRI 920-2020, this committee drafted proposal includes the following changes:

1. Updates existing IECC 2021 ISMRE and ISCOP standards to ISMRE2 and ISCOP2 standards consistent with the Department of Energy final rule, published in the Federal Register on November 1, 2022. (87 FR 65651)

a. Note: The effective date of this rule was January 3, 2023. Compliance with the standards established for DX-DOASes in this final rule is required on and after May 1, 2024, so no date was proposed herein as standards will already be federally effective upon publication of UECC 2025.

2. For the four equipment classes covered by 90.1, but not considered by DOE, this proposal harmonizes with Addendum cv of ASHRAE

Standard 90.1-2019, changing ISMRE and ISCOP standards to ISMRE2 and ISCOP2 standards based on an industry analysis. Four of these equipment classes were be combined into two.

3. Adds AHRI Standard 920-2020 to Normative References in Section 6

Final Hearing Results	
CECD1-12-22	AS

CECD1-13-22

Original Proposal

IECC: C403.11.6
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.11.6 Heat recovery for space conditioning in healthcare facilities. Where heating water is used for space heating, a ~~condenser~~ heat pump chiller meeting the requirements of Table C403.3.2(15) for heat recovery ~~system~~ and uses the cooling *system* return water as the heat source shall be installed where ~~provided that all of~~ the following are true:

1. The building is a Group I-2, Condition 2 occupancy.
2. The total design chilled water capacity for the Group I-2,Condition 2 occupancy, either air cooled or water cooled, required at cooling design conditions exceeds 3,600,000 Btu/h (1100 kw) of cooling.
3. Simultaneous heating, including *reheat*, and cooling occurs above 60°F (16°C) outdoor air temperature.

The ~~required~~ heat recovery system shall have a cooling capacity ~~that is~~ of not less than 7 percent of the total design chilled water capacity of the Group I-2, Condition 2 occupancy at peak design conditions.

Exceptions:

1. Buildings that provide 60 percent or more of their reheat energy from on-site renewable energy or other site-recovered energy. *On-site renewable energy* used to meet Sections C405.15.1 or C406.3.1 shall not be used to meet this exception.
2. Buildings in Climate Zones 5C, 6B, 7, and 8.

Reason: Section C403.11.6, “Heat Recovery for Space Conditioning in Healthcare Facilities,” requires heat recovery in most acute inpatient hospitals. The existing language refers to “condenser heat recovery.” The heat source was intended to be the chilled water return, and the economic justification was built on that. The diagram shows a parallel and in-series system. Both are acceptable ways to meet the requirement.

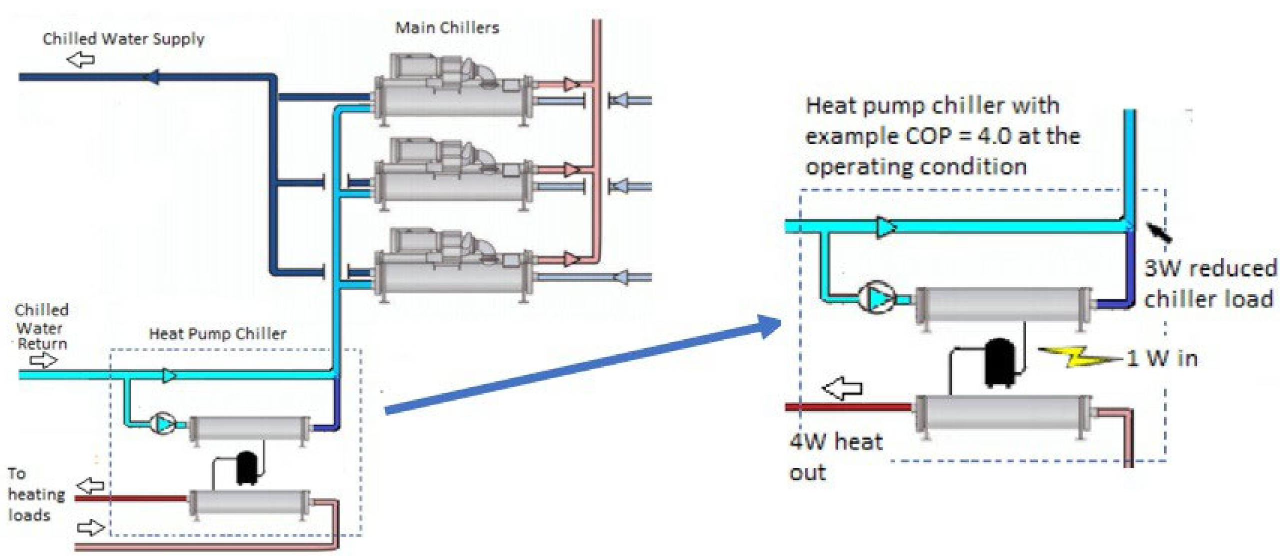


Figure 1. Heat pump chiller piped in series

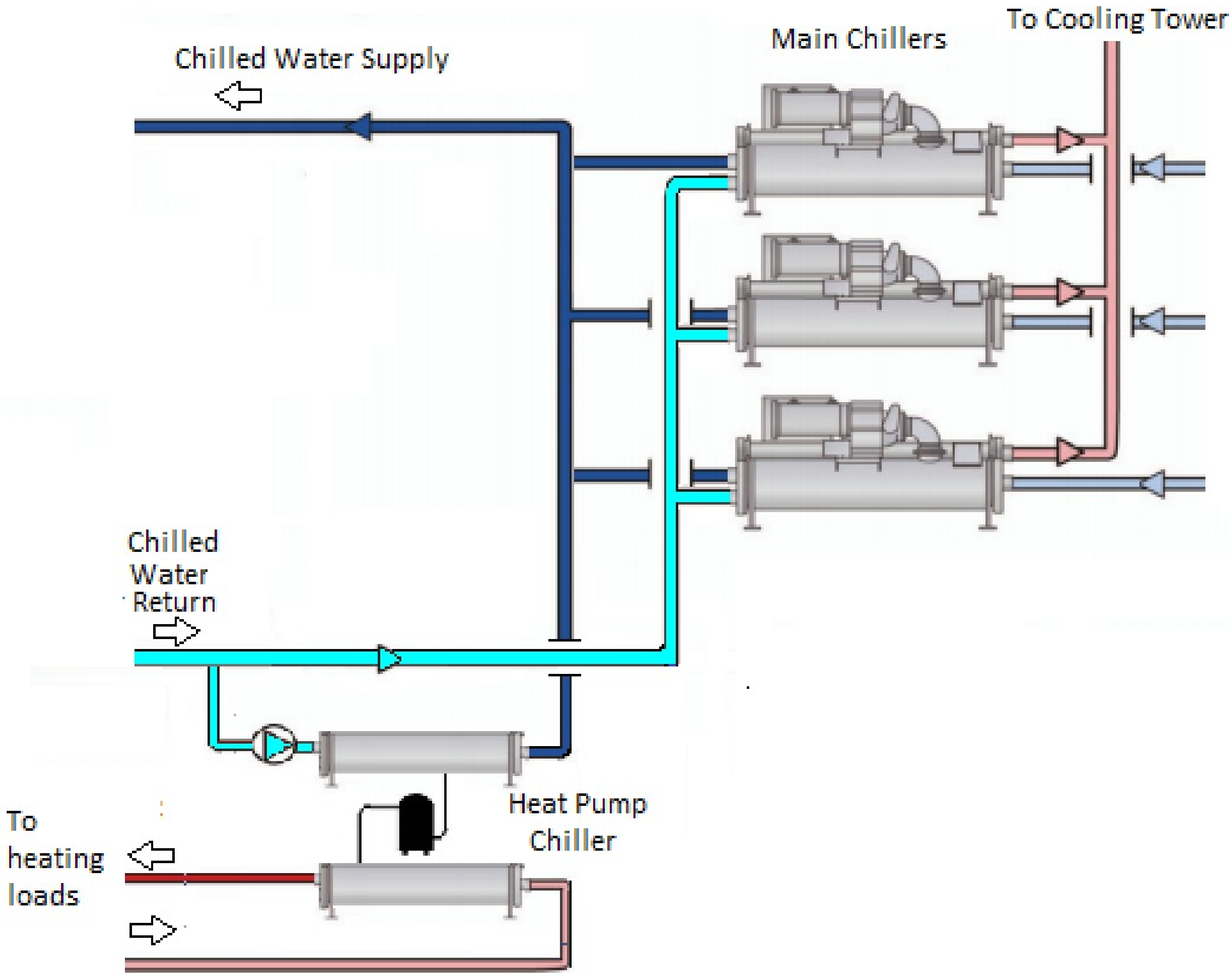


Figure 2. Heat pump chiller piped in parallel

The term “condenser heat recovery” has led some users to believe that the heat source can be water leaving the main chiller condenser. While this method does recover heat, it does not reduce the load on the chillers. Using the chilled return water as the heat source saves much more energy.

Reviewers should know that the misunderstanding extends to the ASHRAE 90.1-2019 User’s Manual. The intent of the language is not correctly described. This discrepancy will be addressed.

ASHRAE SSPC 90.1 passed addendum cu, which is nearly identical to this proposal. It was included in the 2022 version of the standard. The addendum can be found at this link:

https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/90_1_2019_cu_202

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Economic justification:

This addendum clarifies existing requirements. The economic justification was completed when Section 6.5.6.3 was created for the 2019 version of ASHRAE 90.1, and the same rationale was used for IECC 2021. The justification was based on recovering heat from the chilled water return.

Cost of construction:

This proposal neither increases nor decreases the cost of construction. The exception for site recovered energy was removed because there is no first cost increase to use the chilled water return system as the heat source rather than the chiller condenser water. The exception for on-site renewable energy was removed because there are now separate requirements for on-site renewable energy elsewhere in the standard.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Standing on the reason statement with the proposal but with clearer language.

Final Hearing Results

CECD1-13-22	AS

CECD1-14-22

Original Proposal

IECC: SECTION 202 (New), C404.2.1, C404.8.3
Proponents:

2024 International Energy Conservation Code [CE Project]

Add new definition as follows:

HIGH-CAPACITY GAS-FIRED WATER HEATER. Gas-fired instantaneous water heaters with a rated input greater than 200,000 Btu/h (58.6 kW) and not less than 4,000 Btu/h per gallon (310 W per litre) of stored water, and gas-fired storage water heaters with a rated input both greater than 105,000 Btu/h (30.8 kW) and less than 4,000 Btu/h per gallon (310 W per litre) of stored water.

Revise as follows:

C404.2.1 High input service water-heating systems. Gas-fired ~~service water-heating equipment~~ *water heaters* installed in new buildings where the total input capacity provided by *high-capacity gas-fired water heaters* ~~high-capacity service water heating equipment~~ is 1,000,000 Btu/h (293 kW) or greater shall ~~be in compliance~~ comply with either or both of the following requirements.

1. Where a singular piece of *high-capacity gas-fired water heater* ~~high-capacity gas-fired service water-heating equipment~~ is installed, ~~such equipment~~ the *water heater* shall have a thermal efficiency, Et, of not less than 92 percent.
2. Where multiple pieces of *high-capacity gas-fired water heaters* ~~high-capacity gas-fired service water-heating equipment~~ are connected to the same service water-heating system, the combined input-capacity-weighted-average thermal efficiency, Et, shall not be less than 90 percent and a minimum of 30 percent of the input to the *high-capacity gas-fired water heaters* ~~gas-fired equipment~~ in the service water-heating system shall have a thermal efficiency of not less than 92 percent.

~~High-capacity gas-fired service water-heating equipment is comprised of gas-fired instantaneous water heaters with a rated input both greater than 200,000 Btu/h (58.6 kW) and not less than 4,000 Btu/h per gallon (310 W per litre) of stored water, and gas-fired storage water heaters with a rated input both greater than 105,000 Btu/h (30.8 kW) and less than 4,000 Btu/h per gallon (310 W per litre) of stored water.~~

Exceptions:

1. The input rating of *water heaters* installed in individual dwelling units shall not be required to be included in the total input rating of service water-heating equipment for a building.
2. The input rating of *water heaters* with an input rating of not greater than 105,000 Btu/h (30.8 kW) shall not be required to be included in the total input rating of service water-heating equipment for a building.
3. Where not less than 25 percent of the annual service water heating requirement is provided by *on-site renewable energy* or site-recovered energy, the minimum thermal efficiency requireements of this section shall not apply. *On-site renewable energy* used to meet Sections C405.15.1 or C406.3.1 shall not be used to meet this exception.

C404.8.3 Covers. Outdoor heated pools and outdoor permanent spas shall be provided with a vapor-retardant cover or other *approved* vapor-retardant means.

Exception: Where more than 75 percent of the energy for heating, computed over an operating season of not fewer than 3 calendar months, is from a heat pump or an on-site renewable energy system, covers or other vapor-retardant means shall not be required. On-site renewable energy used to meet Sections C405.15.1 or C406.3.1 shall not be used to meet this exception.

Reason: The exceptions to efficiency requirements in Sections C404.2.1 and C404.8.3 were created long before the IECC included provisions for employing on-site renewable energy. The exceptions were created because the underlying requirements were not cost-effective if a portion of the energy was free. In addition, there was the added benefit of encouraging the use of renewable energy.

The addition of on-site renewable energy requirements in Section C405.15.1 and optional credits in Section C406.3.1 creates a risk that the renewable energy used to meet those sections could be applied to the exceptions. Therefore, this proposal requires that on-site renewable energy used to meet the exception is not the same energy used to meet other requirements.

The changes in the body of C404.2.1 High-input service water-heating systems are editorial and do not change the requirement.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Changes are editorial and do not change the requirement.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: this proposal requires that on-site renewable energy used to meet the exception is not the same energy used to meet other requirements.
The changes in the body of C404.2.1 High-input service water-heating systems are editorial and do not change the requirement.

Final Hearing Results

CECD1-14-22 AS

CECD1-15-22

Original Proposal

IECC: CD101.1, CD101.2
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

CD101.1 Prescriptive compliance. Where compliance is demonstrated using the prescriptive compliance option in Section C401.2.1, the number of additional efficiency credits required by Section C406.1 shall be ~~50 percent higher than~~1.4 times the number that required by ~~Table~~ Section C406.1.1.

CD101.2 Total building performance compliance . Where compliance is demonstrated using the total building performance option of Section C401.2.1, the percentage of annual energy cost (PAEC), applied to the standard reference design referenced in Equation ~~4-23~~4-32, shall be multiplied by ~~0.98~~0.97.

Reason: The Glide Path appendix was originally approved with "placeholder" values, pending evaluation of the overall code progress. Attached please find the proposed revisions to those values, based on input from PNNL and Mike Waite.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
this modifications do not increase or decrease the cost of construction

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal updates “placeholder values” for the prescriptive pathway additional energy credit requirement and the performance path PAEC multiplier based on input from PNNL and others. It also incorporates two editorial changes.

Final Hearing Results

CECD1-15-22	AM

CECD1-16-22

Original Proposal

IECC: C406.2.5.5
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C406.2.5.5 L05 Residential light control. In *buildings* with Group R-2 occupancy spaces, interior lighting systems shall comply with the following:

1. In common ~~Common area~~ area, the following space types ~~Restrooms, laundry rooms, storage rooms, and utility rooms~~shall have ~~automatic full OFF occupancy~~ occupant sensor controls that comply with the requirements of C405.2.1.1 :Laundry/washing areas, dining areas, food preparation areas, seating areas, exercise areas, playing areas, and massage spaces. . ~~Each additional control device shall control no more than 5,000 sq.ft (464 m^2).~~
2. In dwelling units, not less than one receptacle in each living room and each sleeping room shall be controlled by a switch in that room.
3. ~~2.~~ 3. Each dwelling unit shall have aswitch ~~main control~~ by the main entrance that turns off all the ~~lights~~ lighting and all switched receptacles in the dwelling unit. The switch shall be clearly labeled. ~~Two switched receptacles shall be provided in living and sleeping rooms or areas and clearly identified. All switched receptacles shall be located within 12 inches (30 cm) of an unswitched receptacle. The main control shall be permitted to have two controls, one for permanently wired lighting and one for switched receptacles. The main controls should be clearly identified as "lights master off" and "switched outlets master off."~~

Reason: This is primarily, but not entirely, an editorial cleanup. The following issues are addressed by this proposal:
1. Some of the listed common area space types are already required to have occupant sensor controls in base code (restrooms, storage rooms).
2. Space types are revised to conform to the list of spaces in C405.3.2(2) for consistency with other sections of the code, and to improve enforceability.
3. Occupant sensor is a defined term in the code, but occupancy sensor is not.
4. No common areas in residential building would have individual rooms greater than 5,000 sf.
5. The proposal was not clear on the quantity of switched receptacles required – two per apartment unit, or two per living and sleeping room. We revised to one per living and sleeping room.
6. Usually in residential construction switched receptacles are counted as meeting NEC receptacle requirements. We were not clear on why these are required to be in addition to NEC receptacle requirements (which is the effect of requiring a non-dim receptacle within 12 inches).
7. Having two controls at the main entry makes it more likely that the receptacle switch control will just be left "on".

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Will not change the cost of construction

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Adds space types for occupant sensor control and removes spaces that already would have been required to install occupant sensors. Also, provide clarifications and makes the language more enforceable.

Final Hearing Results

CECD1-16-22 AS

CECD1-17-22

Original Proposal

IECC: C403.8.1, TABLE C403.8.1(1) (New), TABLE C403.8.1(2) (New), TABLE C403.8.1(1), TABLE C403.8.1(2), TABLE C403.8.1(3), TABLE C403.8.1(4), C403.8.1.1, C403.8.1.2, C403.8.2

Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.8.1 ~~Fan power~~Allowable fan horsepower. ~~For each fan system serving an occupied space or other enclosed space that includes one or more fans or fan arrays with fan electrical input power greater than 1 kW, fan system electrical input power determined per Section C403.8.1.2 at the fan system design airflow shall not be greater than the limit is calculated in accordance with Section C403.8.1.1. This section does not apply to fans service heat rejection equipment.~~Where the summed fan system motor nameplate horsepower of an HVAC fan system is greater than 5 hp (3.7 kW) at fan system design conditions, itshall not be greater than the allowable total fan system motor nameplate hp (Option 1) or fan system bhp (Option 2) specified in Table C403.8.1(1). Such summed HVAC fan system motor nameplate horsepower shall include supply fans, exhaust fans, return or relief fans, and fan-powered terminal units associated with systems providing heating or cooling capability. Single-zone variable air volume systems shall comply with the constant volume fan power limitation.

Exceptions:

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

Add new text as follows:

TABLE C403.8.1(1) FAN POWER LIMITATION

-	LIMIT	CONSTANT VOLUME	VARIABLE VOLUME
Option 1: Fan system motor nameplate hp	Allowable nameplate motor hp	hp<=CFMs x 0.0011	hp<=CFMs x 0.0015
Option 2: Fan system bhp	Allowable fan system bhp	bhp<=CFMs x 0.00094 + *A*	bhp<=CFMs x 0.0013 + *A*

For SI: 1 bhp = 735.5 W, 1 hp = 745.5 W, 1 cfm = 0.4719 L/s.

where:

CFM_S =The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.

hp = The maximum combined motor nameplate horsepower.

bhp = The maximum combined fan brake horsepower.

A = Sum of [PD × CFM_D / 4131].

where:

PD = Each applicable pressure drop adjustment from Table C403.8.1(2) in. w.c.

CFM_D = The design airflow through each applicable device from Table C403.8.1(2) in cubic feet per minute.

-

TABLE C403.8.1(2) FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT

DEVICE	ADJUSTMENT
CREDITS	-
Return air or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms	0.5 inch w.c. (2.15 inches w.c. for laboratory and vivarium systems)
Return and exhaust airflow control devices	0.5 inch w.c.
Exhaust filters, scrubbers or other exhaust treatment	The pressure drop of device calculated at fan system design condition
Particulate filtration credit: MERV 9 thru 12	0.5 inch w.c.
Particulate filtration credit: MERV 13 thru 15	0.9 inch w.c.
Particulate filtration credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2 times the clean filter pressure drop at fan system design condition.
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition.
Biosafety cabinet	Pressure drop of device at fan system design condition.
Energy recovery device, other than coil runaround loop	For each airstream, (2.2 x energy recovery effectiveness - 0.5) inch w.c.
Coil runaround loop	0.6 inch w.c. for each airstream.
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design conditions.
Sound attenuation section (fans serving spaces with design background noise goals below NC35)	0.15 inch w.c.
Exhaust system serving fume hoods	0.35 inch w.c.
Laboratory and vivarium exhaust systems in high-rise buildings	0.25 inch w.c./100 feet of vertical duct exceeding 75 feet.
Deductions	-
Systems without central cooling device	-0.6 inch w.c.
Systems without central heating device	-0.3 inch w.c.
Systems with central electric resistance heat	-0.2 inch w.c.

For SI: 1 inch w.c. = 249 Pa, 1 inch = 25.4 mm, 1 foot = 304.8 mm.
w.c. = Water Column, NC = Noise Criterion

-

Delete without substitution:

~~TABLE C403.8.1(1) SUPPLY FAN POWER ALLOWANCES (W/CFM)~~

~~Multi-Zone VAV Fan System Airflow (cfm)~~[a]	~~All Other Fan Systems Airflow (cfm)~~					
~~Air system Component~~	~~<5,000~~	~~5,000 to <10,000~~	~~≥10,000~~	~~<5,000~~	~~5,000 to <10,000~~	~~≥10,000~~
~~W/cfm~~						
~~Supply System Base Allowance for each fan system~~	~~0.413~~	~~0.472~~	~~0.480~~	~~0.243~~	~~0.267~~	~~0.248~~
~~Particle filtration (select all that apply)~~						
~~Filter not higher than MERV 12~~	~~0.094~~	~~0.079~~	~~0.073~~	~~0.097~~	~~0.084~~	~~0.075~~
~~MERV 13 to MERV 16 filter~~	~~0.210~~	~~0.177~~	~~0.165~~	~~0.217~~	~~0.185~~	~~0.168~~
~~HEPA filter~~	~~0.347~~	~~0.292~~	~~0.277~~	~~0.357~~	~~0.304~~	~~0.278~~
~~Heating (select all that apply)~~						
~~Hydronic heating coil (central)~~	~~0.047~~	~~0.050~~	~~0.055~~	~~0.049~~	~~0.053~~	~~0.057~~
~~Electric heat~~	~~0.047~~	~~0.050~~	~~0.055~~	~~0.049~~	~~0.042~~	~~0.038~~
~~Gas or oil furnace <90% Et or <90% AFUE~~	~~0.071~~	~~0.060~~	~~0.073~~	~~0.061~~	~~0.063~~	~~0.075~~
~~Gas or oil furnace ≥ 90% Et or ≥90% AFUE~~	~~0.117~~	~~0.099~~	~~0.092~~	~~0.122~~	~~0.104~~	~~0.094~~
~~Cooling and dehumidification (select all that apply)~~						
~~Hydronic/DX cooling coil, or heat pump coil (wet) [Healthcare facilities can select twice]~~	~~0.141~~	~~0.118~~	~~0.110~~	~~0.146~~	~~0.125~~	~~0.112~~
~~Fluid economizer coil~~	~~0.141~~	~~0.118~~	~~0.110~~	~~0.146~~	~~0.125~~	~~0.112~~

Desiccant system-solid or liquid	0.164	0.138	0.128	0.170	0.145	0.131
Hot gas reheat coil	0.047	0.040	0.037	0.049	0.042	0.038
Series energy recovery	0.141	0.118	0.110	0.146	0.125	0.112
Evaporative humidifier/cooler in series with a cooling coil. Value shown is allowed W/cfm per 1.0 in. wg. Determine pressure loss (in. wg.) at the lesser of 400 fpm or maximum velocity allowed by the manufacturer. [Calculation required[b]]	0.233	0.196	0.184	0.241	0.205	0.186
Energy recovery						
Enthalpy Recovery Ratio ≥0.50 and <0.55	0.141	0.118	0.110	0.146	0.125	0.112
Enthalpy Recovery Ratio ≥0.55 and <0.60	0.166	0.140	0.130	0.172	0.147	0.133
Enthalpy Recovery Ratio ≥0.60 and <0.65	0.191	0.161	0.151	0.198	0.169	0.153
Enthalpy Recovery Ratio ≥0.65 and <0.70	0.217	0.182	0.171	0.224	0.191	0.173
Enthalpy Recovery Ratio ≥0.70 and <0.75	0.242	0.204	0.191	0.250	0.213	0.193
Enthalpy Recovery Ratio ≥0.75 and <0.80	0.267	0.225	0.212	0.276	0.235	0.213
Enthalpy Recovery Ratio ≥0.80	0.292	0.246	0.232	0.301	0.257	0.234
Run-around liquid or refrigerant coils	0.141	0.118	0.110	0.146	0.125	0.112
Gas-phase filtration						
Gas-phase filtration	0.233	0.196	0.184	0.241	0.205	0.186
Other						
Economizer return damper	0.049	0.042	0.038	0.049	0.043	0.039
100% Outdoor air system[c]	0.000	0.000	0.000	0.073	0.104	0.112
Low-turndown single-zone VAV fan systems[d]	0.000	0.000	0.000	0.073	0.104	0.094
Air blender	0.047	0.040	0.037	0.049	0.042	0.038
Sound attenuation section [fans serving spaces with design background noise goals below NC35]	0.035	0.030	0.027	0.036	0.032	0.029
Deducation for systems that feed a terminal unit or fan coil with a fan with electrical input power <1kWe	-0.500	-0.500	-0.500	-0.100	-0.100	-0.100

~~a. See section C408.3.1.1 for requirements for a Multi-Zone VAV system.~~

~~b. Power allowances require further calculation. Multiply the actual pressure drop of the device or component by the fan power allowance in Table C403.8.1(2).~~

~~c. The 100 percent outdoor air system must serve 3 or more HVAC zones.~~

~~d. A low-turndown single-zone VAV fan system must be capable of and configured to reduce airflow to 50 percent of design airflow and use no more than 30 percent of the design wattage at that airflow. No more than 10 percent of the design load served by the equipment shall have fixed loads.~~

~~e. The deduction of 0.500 W/cfm is a default value for multizone VAV fan systems. If the terminal unit or fan coil manufacturer can demonstrate that the share of the unit's fan power required to move the fan system's air is less than 0.500 W/cfm, that value may be used. The W/cfm shall be calculated by dividing the power required to operate the terminal unit's fan at fan system design conditions by the airflow of the terminal unit at those conditions.~~

~~TABLE C403.8.1(2) EXHAUST, RETURN, RELIEF, TRANSFER FAN SYSTEM POWER ALLOWANCES (W/CFM)~~

~~Mult-Zone VAV Fan System airflow[a] (cfm)~~			~~All Other Fan Systems Airflow (cfm)~~			
~~Air System Component~~	~~<5,000~~	~~5,000 TO <10,000~~	~~≥10,000~~	~~<5,000~~	~~5,000 to <10,000~~	~~≥10,000~~
~~W/cfm~~						
~~Exhaust, Return, Relief, and Transfer System Base Allowance for each *fan system*~~	~~0.231~~	~~0.256~~	~~0.248~~	~~0.194~~	~~0.192~~	~~0.200~~
~~Particle filtration~~						
~~Filter (any MERV value)[b]~~	~~0.049~~	~~0.042~~	~~0.038~~	~~0.049~~	~~0.043~~	~~0.039~~
~~Energy recovery~~						
~~Enthalpy Recovery Ratio ≥ 0.50 and <0.55~~	~~0.146~~	~~0.125~~	~~0.112~~	~~0.146~~	~~0.128~~	~~0.114~~
~~Enthalpy Recovery Ratio ≥0.55 and <0.60~~	~~0.173~~	~~0.148~~	~~0.133~~	~~0.173~~	~~0.150~~	~~0.135~~
~~Enthalpy Recovery Ratio≥0.60 and <0.65~~	~~0.199~~	~~0.170~~	~~0.153~~	~~0.199~~	~~0.173~~	~~0.155~~
~~Enthalpy Recovery Ratio ≥0.65 and <0.70~~	~~0.225~~	~~0.192~~	~~0.173~~	~~0.226~~	~~0.196~~	~~0.176~~
~~Enthalpy Recovery Ratio ≥0.70 and <0.75~~	~~0.250~~	~~0.214~~	~~0.193~~	~~0.252~~	~~0.218~~	~~0.196~~
~~Enthalpy Recovery Ratio ≥0.75 and <0.80~~	~~0.276~~	~~0.236~~	~~0.213~~	~~0.277~~	~~0.240~~	~~0.216~~
~~Enthalpy Recovery Ratio ≥0.8~~	~~0.302~~	~~0.258~~	~~0.234~~	~~0.303~~	~~0.263~~	~~0.236~~
~~Run-around liquid or refrigerant coils~~	~~0.146~~	~~0.125~~	~~0.112~~	~~0.146~~	~~0.128~~	~~0.114~~
~~Special exhaust and return system requirements (select all that apply)~~						
~~Return or exhaust systems required to be fully ducted by code or accreditation standards~~	~~0.122~~	~~0.105~~	~~0.094~~	~~0.122~~	~~0.107~~	~~0.096~~
~~Return and/or exhaust airflow control devices required by code or accreditation standards to maintain pressure relationships between spaces~~	~~0.122~~	~~0.105~~	~~0.094~~	~~0.122~~	~~0.107~~	~~0.096~~
~~Laboratory and vivarium exhaust systems in high-rise buildings for vertical duct exceeding 75 feet. Value shown is allowed W/cfm per 0.25 inch wg for each 100 feet exceeding 75 feet. [Calculation required[c]]~~	~~0.061~~	~~0.053~~	~~0.047~~	~~0.061~~	~~0.054~~	~~0.048~~
~~Exhaust system serving fume hoods~~	~~0.085~~	~~0.074~~	~~0.066~~	~~0.085~~	~~0.075~~	~~0.067~~
~~Biosafety cabinet. Value shown is allowed W/cfm per 1.0 inch wg air pressure drop [Calculation required[c]]~~ -	~~0.241~~	~~0.206~~	~~0.186~~	~~0.242~~	~~0.210~~	~~0.188~~
~~Exhaust filters, scrubbers, or other exhaust treatment required by code or standard. Value shown is allowed W/cfm per 1.0 inch wg air pressure drop. [Calculation required[c]]~~	~~0.241~~	~~0.206~~	~~0.186~~	~~0.242~~	~~0.210~~	~~0.188~~
~~Other~~						
~~Sound attenuation section (fans serving spaces with design background noise goals below NC35)~~	~~0.036~~	~~0.032~~	~~0.029~~	~~0.036~~	~~0.032~~	~~0.029~~

a. ~~See Section C408.3.1.1 for requirements for a Multi-Zone VAV System.~~

b. ~~Particle filter pressure loss can only be counted once per fan system.~~

c. ~~Power allowances require further calculation. Multiply the actual pressure drop of the device or component by the fan power allowance in Table C403.8.1(2).~~

~~TABLE C403.8.1(3) FAN POWER LIMIT ALTITUDE CORRECTION FACTOR~~

Altitude (ft)	Correction factor
<3,000	1.000
≥3,000 and <4,000	0.896
≥4,000 and <5,000	0.864
≥5,000 and <6,000	0.832
≥6,000	0.801

~~TABLE C403.8.1(4) DEFAULT VALUES FOR FAN ELECTRICAL INPUT POWER BASED ON MOTOR NAMEPLATE HP[a,b]~~

Motor Nameplate Horsepower	Variable-Speed Drive (kW)	Without Variable-Speed Drive (kW)
<1	0.96	0.89
≥1 and <1.5	1.38	1.29
≥1.5 and <2	1.84	1.72
≥2 and <3	2.73	2.57
≥3 and <5	4.38	4.17
≥5 and <7.5	6.43	6.15
≥7.5 and <10	8.46	8.13
≥10 and <15	12.47	12.03
≥15 and <20	16.55	16.04
≥20 and <25	20.58	19.92
≥25 and <30	24.59	23.77
≥30 and <40	32.74	31.70
≥40 and <50	40.71	39.46
≥50 and <60	48.50	47.10
≥60 and <75	60.45	58.87
≥75 and <100	80.40	78.17

a. ~~This table cannot be used for Motor Nameplate Horsepower values greater than 100.~~

b. ~~This table is to be used only with motors with a service factor ≤1.15. If the service factor is not provided, this table may not be used.~~

~~**C403.8.1.1 Determining Fan Power Limit.** The maximum allowed fan system electrical input power, shall be determined in accordance with the following steps 1 through 5:~~

1. ~~The fan system's classification shall be determined. A fan system is considered to be multizone VAV where it meets the following requirements; fan systems that do not meet the following requirements shall be classified as other fans:~~

   1.1 ~~The fan system shall serve three or more HVAC zones and airflow to each shall be individually controlled based on heating, cooling and/or ventilation requirements.~~

   1.2 ~~The sum of the minimum airflows for each HVAC zone shall be not greater than 40 percent of the fan system design conditions.~~

      ~~**Exception:** Hospital, vivarium, and laboratory systems that use flow control devices on exhaust or return to maintain space pressure relationships necessary for occupant health and safety or environmental control shall use the multizone VAV fan power allowances.~~

2. ~~Determine the fan system airflow and choose the applicable table(s) for fan power allowance.~~

   2.1 ~~For single-cabinet fan systems, use the fan system airflow and the power allowances in both Table C403.8.1(1) and Table C403.8.1(2).~~

   2.2 ~~For supply-only fan systems, use the fan system airflow and power allowances in Table C403.8.1(1).~~

   2.3 ~~For relief fan systems, use the design relief airflow and the power allowances in Table C403.8.1(2).~~

   2.4 ~~For exhaust, return and transfer fan systems, use the fan system airflow and the power allowances in Table C403.8.1(2).~~

   2.5 ~~For complex fan systems and DOAS with energy recovery fan systems, separately calculate the fan power allowance for the supply and return/exhaust systems and sum them. For the supply airflow at the fan system design conditions, and the power allowances in Table C403.8.1(1). For the return/exhaust airflow, use return or exhaust airflow at the fan system design conditions, and the power allowances in Table C403.8.1(2).~~

3. ~~For each fan system determine the components included in the fan system and sum the fan power allowances of those components. All fan systems shall include the System Base Allowance. If, for a given component, only a portion of the fan system airflow passes through the component, calculate the fan power allowance for the com-ponent per equation 4-7:~~

~~**(Equation 4-7)**~~

$$\cancel{FPA_{adj} = (Q_{comp} / Q_{sys}) * FPA_{comp}}$$

~~FPA_{adj} = The corrected fan power allowance for the component in w/cfm~~
~~Q_{comp} = The airflow through component in cfm~~
~~Qsys = The fan system airflow in cfm~~
~~FPA_{comp} = The fan power allowance of the component from Table C403.8.1(1) or Table C403.8.1(2)~~

4. ~~Multiply the fan system airflow by the sum of the fan power allowances for the fan system, then divide by 1000 to convert to KW.~~

~~**(Equation 4-8)**~~

$$\cancel{FPL = (Q_{sys} * FPA_{sum})/1000}$$

~~FPL = The fan power limit in KW~~
~~Q_{sys} = The fan system airflow in cflm (L/s)~~
~~FPA_{sum} = The sum of the fan power allowance for the system in W/cfm~~
~~1000 = The conversion from W to kW~~

5. ~~For building sites at elevations greater than 3,000 feet (900 m), multiply the fan power limit by the correction factor from Table C408.3.1(3).~~

$$FPL_{alt} = FPL * C_{alt}$$

~~(Equation 4-9~~)

~~FPL_{alt} = The adjusted fan power limit in KW.~~
~~FPL = The fan power limit in KW calculated in step 4~~.
~~C_{alt} = The altitude correction factor from Table C408.3.1(~~3)

~~C403.8.1.2 Determining Fan System Electrical Input Power.~~ ~~The fan system electrical input power is the sum of the fan electrical input power of each fan or fan array in-cluded in the fan system other than fans with fan electrical input power ≤ 1 kW. If variable speed drives are used their efficiency losses shall be included. Fan system input power shall be calculated with mid-life filter pressure drop, which is the mean of the clean filter pressure drop and design final filter pressure drop. The fan electrical input power for each fan or fan array shall be determined using one of the following methods. There is no requirement to use the same method for all fans in a fan system:~~

1. ~~Use the default fan electrical input power in Table C408.3.1(4) for one or more of the fans. This method cannot be used for complex fan systems.~~
2. ~~Use the fan electrical input power at fan system design conditions provided by the manufacturer of the fan, fan array, or equipment that includes the fan or fan array, calculated per a test procedure included in 10 CFR Part 430, 10 CFR Part 431, ANSI/AMCA Standard 210, ASHRAE 51 AHRI Standard 430, AHRI Standard 440, or ISO 5801.~~
3. ~~Use the fan electrical input power provided by the manufacturer, calculated at fan system design conditions per one of the methods listed in section 5.3 of ANSI/AMCA 208.~~
4. ~~Use the fan nameplate electrical input power.~~

Revise as follows:

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

1. For fans less than 6 bhp (4476 W), 1.5 times the fan brake horsepower.
2. For fans 6 bhp (4476 W) and larger, 1.3 times the fan brake horsepower.

Exceptions:

1. Fans equipped with electronic speed control devices to vary the fan airflow as a function of load.
2. Fans with a fan nameplate electrical input power of less than 0.89 kW.
3. Systems complying with Section C403.8.1 fan system motor nameplate hp (Option 1).
4. Fans with motor nameplate horsepower less than 1 hp (746 W).

Reason: This harmonizes the code with ASHRAE 90.1-2022

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

The code change proposal will decrease the cost of construction.
Changes to Section C403.8.1 as included in the Public Draft 1 would increase the cost of construction. Reverting to the language in the 2021 IECC would reduce the cost, by comparison.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The same language was approved by ASHRAE SSPC 90.1, but not in time for the 2022 version. To keep the codes in alignment, IECC 2024 should keep the language that is in IECC 2021.

Final Hearing Results

CECD1-17-22	AM

CECD1-18-22

Original Proposal

IECC: SECTION 202 (New), C406.1.1.1 (New), C406.1.1.1, C502.3.7.1 (New)
Proponents:

2024 International Energy Conservation Code [CE Project]

Add new definition as follows:

PURCHASED ENERGY. energy or power purchased for consumption and delivered to the building site.

Add new text as follows:

C406.1.1.1 Buildings without heat pumps. *Buildings* using *purchased energy* that is not electricity for space heating or *service water heating, buildings* with electric storage water heaters that are not heat pumps and buildings with total heat pump space heating capacity less than the space heating load at heating design conditions calculated in accordance with Section C403.1.1 shall comply with measures from C406.2 to achieve not less than 1.25 multiplied by the number of required efficiency credits from Table C406.1.1 based on building occupancy group and climate zone. Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be multiplied by 1.25 and weighted by the gross conditioned floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.

Exceptions:

1. Portions of *buildings* devoted to manufacturing or industrial use.
2. *Buildings* complying with all of the following:
   - 2.1 The *building's* peak heating load calculated in accordance with Section C403.1.1 is greater than the *building's* peak cooling load calculated in accordance with Section C403.1.1.
   - 2.2 The *building's* total heat pump space heating capacity is not less than 50% of the *building's* space heating load at heating design conditions calculated in accordance with Section C403.1.1.
   - 2.3 Any energy source other than electricity or *on-site renewable energy* is used for space heating only when a heat pump cannot provide the necessary heating energy to satisfy the thermostat setting.
   - 2.4 Electric resistance heat is used only in accordance with Section C403.4.1.1.
3. Low-energy *buildings* complying with Section C402.1.1.1.
4. Portions of *buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, or High-Hazard Group H.

Revise as follows:

~~C406.1.1.1~~C406.1.1.2 Building Core/Shell and Initial Build-Out Construction. Where separate permits are issued for core and shell buildings and build-outconstruction, compliance shall be in accordance with the following requirements.

1. Core and shell buildings or portions of buildings shall comply with one of the following:
   - 1.1. Where the permit includes a central HVAC system or service water heating system with chillers, heat pumps, boilers, service water heating equipment, or loop pumping systems with heat rejection, the project shall achieve not less than 50 percent of the energy credits required ~~in Table C406.1.1~~ by Sections C406.1.1 and C406.1.1.1 in accordance with Section C406.2.
   - 1.2. Alternatively, the project shall achieve not less than 33 percent of the energy credits required in~~Table C406.1.1~~ by Sections C406.1.1 and C406.1.1.1..

2. For core and shell *buildings* or portions of *buildings* the energy credits achieved shall be subject to the following adjustments:
   2.1. Lighting measure credits shall be determined only for areas with final lighting installed.
   2.2. Where HVAC or service water heating systems are designed to serve the entire building, full HVAC or service water heating measure credits shall be achieved.
   2.3. Where HVAC or service water heating systems are designed to serve individual areas, HVAC or service water heating measure credits achievedshall be reduced in proportion to the floor area with final HVAC systems or final service water heating systems installed.

3. Build-out construction shall be deemed to comply with Section C406.1 where either:
   3.1. Where heating and cooling generation are provided by a previously installed central system, the energy credits achieved in accordance with Section C406.2 under the build-out project are not less than 33 percent of the credits required ~~in Table C406.1.1~~ by Sections C406.1.1 and C406.1.1.1.
   3.2. Where heating and cooling generation are provided by an HVAC system installed in the build out, the energy credits achieved in accordance with Section C406.2 under the build-out project are not less than 50 percent of the credits required ~~in Table C406.1.1~~ by Sections C406.1.1 and C406.1.1.1.
   3.3. Where the core and shell building was approved in accordance with C407 under 2021 IECC or later.

Add new text as follows:

C502.3.7.1 Additions not served by heat pumps. *Additions* using *purchased energy* that is not electricity for space heating or *service water heating, additions* served by electric storage water heaters that are not heat pumps and *additions* served by total heat pump space heating capacity less than the peak space heating load at heating design conditions calculated in accordance with Section C403.1.1 shall comply with measures from Sections C406.2 and C406.3 to achieve not less than 67.5 percent of the number of required efficiency credits from Table C406.1.1 based on building occupancy group and *climate zone*. Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the gross conditioned floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of this section. *Alterations* to the existing building that are not part of an *addition*, but permitted with an *addition*, may be used to achieve the required credits.

Exceptions:

1. *Buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, or High-Hazard Group H.
2. *Additions* less than 1,000 ft^2 (92 m^2) and less than 50 percent of existing floor area.
3. *Additions* that do not include the addition or replacement of equipment covered by Tables C403.3.2(1) through C403.3.2(16) or Section C404.2.

4. *Additions* that do not contain conditioned space.

5. Where the *addition* alone or the existing building and *addition* together comply with Section C407.

6. *Additions* complying with all of the following:

   6.1 The *addition's* peak heating load calculated in accordance with Section C403.1.1 is greater than the *addition's* peak cooling load calculated in accordance with Section C403.1.1.

   6.2 The *addition's* total heat pump space heating capacity serving the *addition* is not less than 50% of the *addition's* space heating load at heating design conditions calculated in accordance with Section C403.1.1.

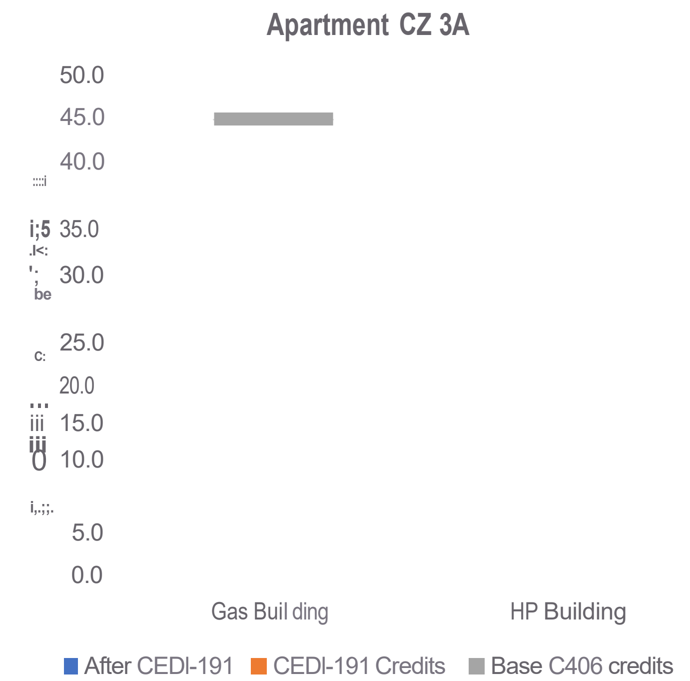
   6.3 Any energy source other than electricity or *on-site renewable energy* is used for space heating serving the *addition* only when a heat pump cannot provide the necessary heating energy to satisfy the thermostat setting.

   6.4 Electric resistance heat serving the *addition* is used only in accordance with Section C403.4.1.1.

7. Low-energy *buildings* complying with Section C402.1.1.1.

-

Reason: The additional energy efficiency credit flexibility is of great value, and the increased requirement for energy savings in this proposal are important. However, the public review draft does not recognize the differences among buildings primarily relying on efficient electric technologies and buildings that continue to rely on fossil fuels for their space heating, water heating and cooking end uses in either their site energy usage or in the imperative to decarbonize buildings. Electric alternatives to fossil fuel systems require less site energy usage, generally considerably less with heat pump coefficients of performance for space and water heating (see Figure 1). In general, efficient electric technologies are also already the lowest emission option across end uses. However, in some locations, the use of fossil fuels for peak heating requirements at very low outside air temperatures may represent a comparable site energy option and the lowest emission option when compared to electric resistance supplemental heat in the near- or medium-term. Therefore, it is prudent to allow for flexibility in the model code with an exception for buildings with heat pump heating capacity of more than half of the building's peak heating demand, so long as other heating sources are not the primary heating source. The proposed changes set 50% higher energy efficiency requirements for buildings that use fossil fuels for anything other than peak space heating needs or that primarily rely on electric resistance for space or water heating. This same 50% higher level is included in proposed Section C502.3 text for Additions, which require 50% of those for new buildings.


Apartment CZ 3A
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45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
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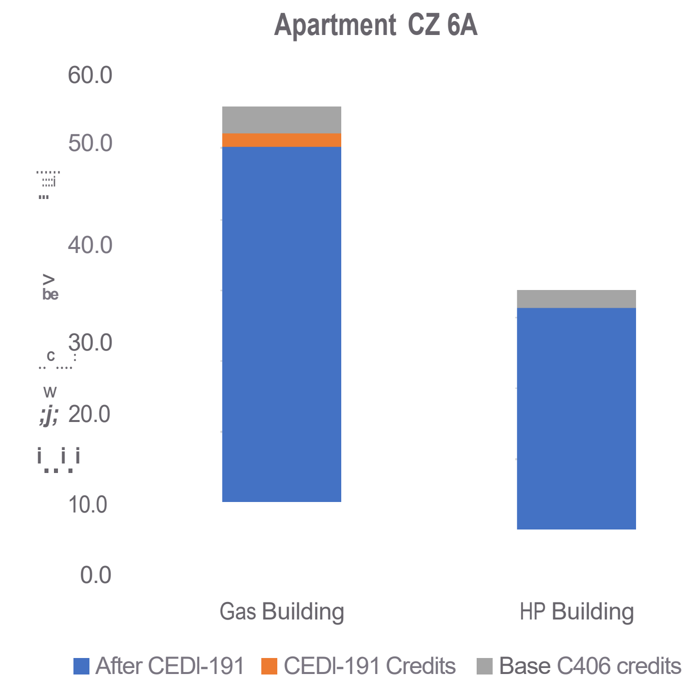
Gas Building
HP Building
After CEDI-191
CEDI-191 Credits
Base C406 credits


Apartment CZ 6A
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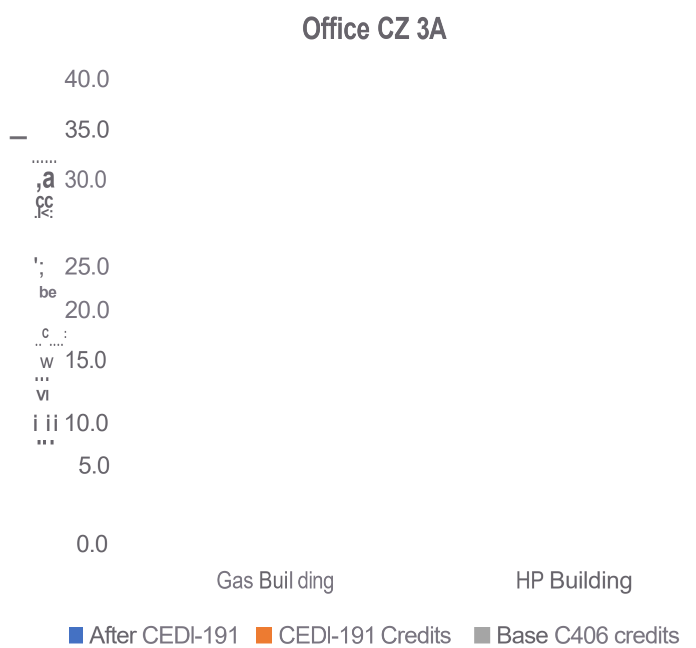
10.0
0.0
Gas Building
HP Building
After CEDI-191
CEDI-191 Credits
Base C406 credits


Office CZ 3A
40.0
35.0
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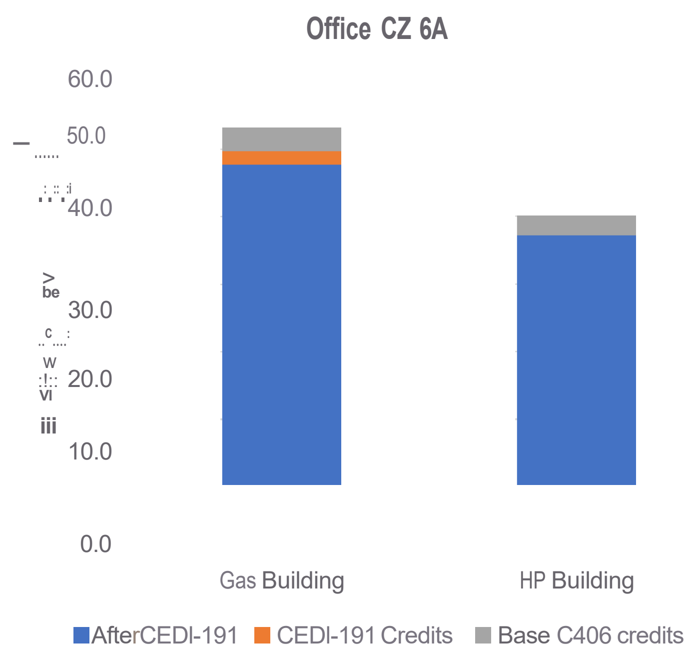
Gas Building
HP Building
After CEDI-191
CEDI-191 Credits
Base C406 credits


Office CZ 6A
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CEDI-191 Credits
Base C406 credits

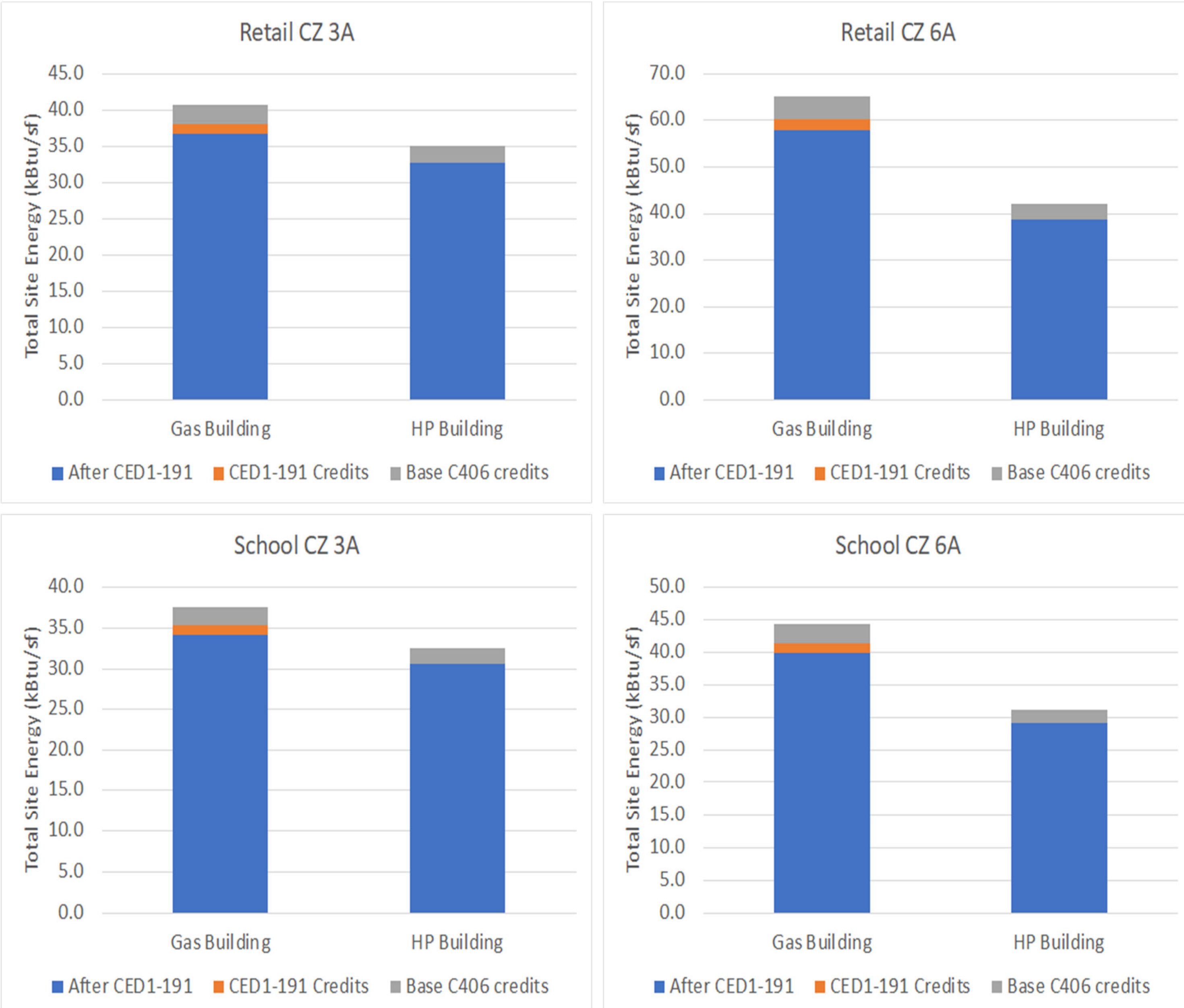


Fig. 1: Comparing site EUI of fossil fuel and electric heat pump buildings using DOE prototype models

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The number of credits that the original proponent of these changes (PNNL) set for Section C406 were determined based on a cost-effectiveness test using an unreasonably high 9.3% nominal discount rate. The Commercial Consensus Committee approved cost-effectiveness criteria of both a 5.3% nominal discount rate and a 9.3% nominal discount rate. The 5.3% discount rate is much more appropriate for this analysis. For PNNL's original submission, they used an 8% nominal discount rate and proposed a set of credit requirements more than 14% higher (area-weighted average by building type and climate zone) than those in the public review draft. A straight line extrapolation would yield 43% higher credit requirements; because the discount rate effect is non-linear, it is reasonable to expect the level of cost-effective credits required to comfortably exceed 50% above those in the public review draft. Although detailed data is not available from PNNL, further analysis using the outputs of PNNL's cost-effectiveness analysis and the DOE prototype models indicates that an additional 25% higher energy efficiency credits would have to cost an average of 12.2 times the upfront cost of the base credits to violate the cost-effectiveness criteria with a 9.3% nominal discount rate (16.6 times the base credits' upfront cost with a 5.3% nominal discount rate, as shown in Fig. 2). A similar analysis was presented to the Commercial Consensus Committee for an additional 50% credit requirement; here it's even stronger at 25% and excluding Storage spaces. The public review draft's Appendix CF includes an "Advanced Energy Credits Package" double that of the Section C406 requirements, which PNNL determined to be the maximum credits a jurisdiction could reasonably require. Taken together, this indicates that 50% higher energy efficiency credits would be rather easily cost justified regardless of the heating and hot water systems.

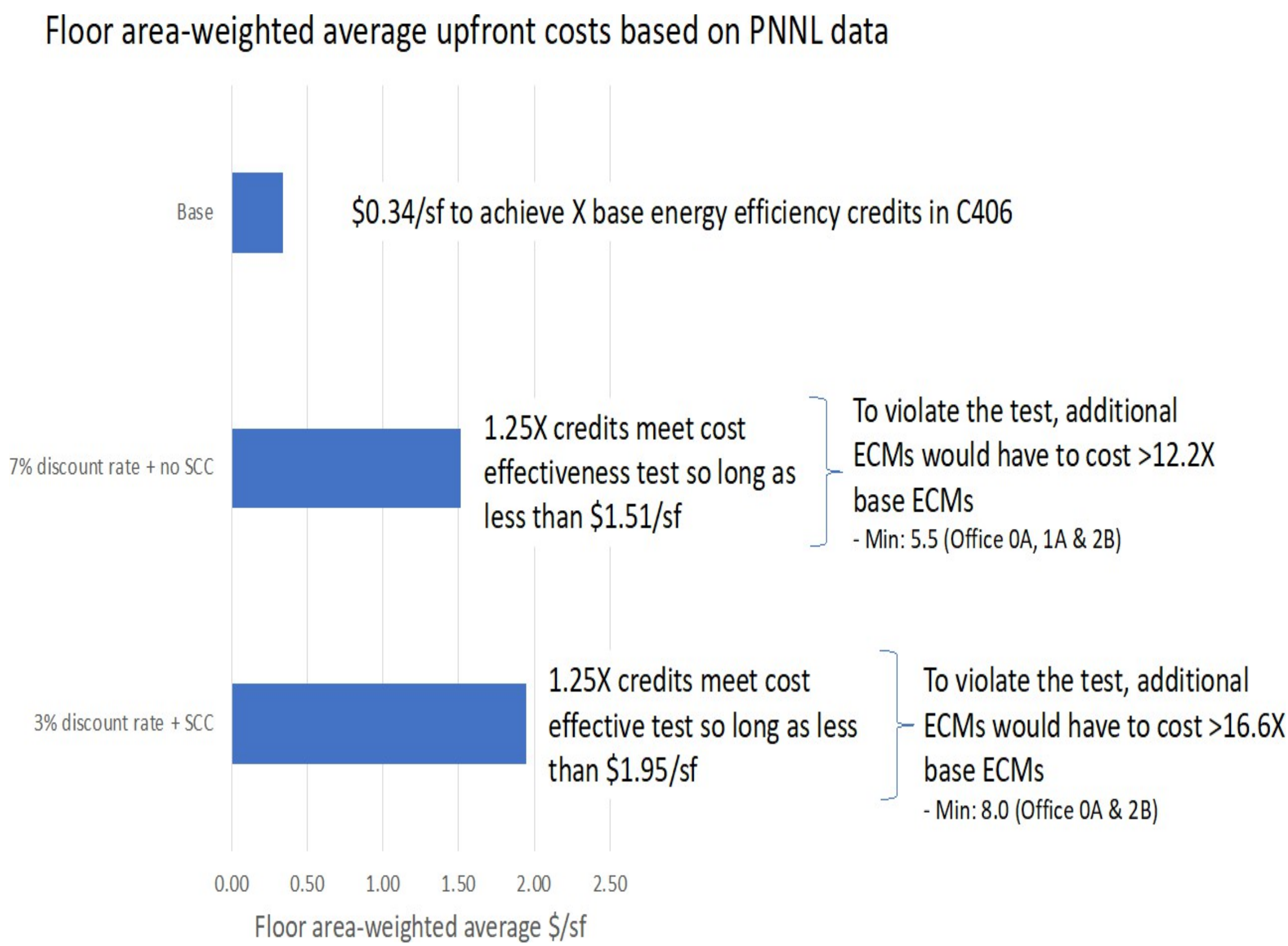


Fig. 2: Cost-effectiveness analysis using PNNL data

In addition to the base cost-effectiveness analysis support, the Commercial Consensus Committee provided the option of including a social cost of carbon in cost-effectiveness calculations. PNNL also did not do calculations showing what that high-efficiency cost-effective credit package level would be with a SCC. Further, there is mounting evidence supporting a SCC more than 3X higher than that recommended by the Committee, which warrants further consideration.

This background is somewhat inconsequential as there were indeed cost-effective credit levels with the high discount rate used by PNNL. Under this proposal, anyone can submit a design that meets those low credit levels for a building with electric heat pumps as the primary space heating and water heating equipment. If they choose to use fossil fuel or electric resistance equipment, they would have to meet a higher number of energy efficiency credits. The entire code has separate energy efficiency requirements depending on the fuel and equipment type chosen, so this proposal is consistent with the current code.

The IECC will often allow less efficiency depending on design decisions without consideration of cost-effectiveness (e.g. where a designer chooses to have a window instead of an opaque wall or in relaxing lighting power density requirements to allow for non-essential services such as advertising lighting). The Committee is certainly not precluded from considering higher efficiency requirements following particular design decisions. The Committee is also not precluded from considering the societal benefits of reducing greenhouse gas emissions, such as they did explicitly in the justification for on-site renewable energy requirements in this public review draft.

In summary: (1) this proposal is cost-effective and (2) the Committee does not have to base its decisions on cost-effectiveness alone.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposed change align the requirements in C409 with changes in C402.

Final Hearing Results

CECD1-18-22	AM

CECD1-19-22

Original Proposal

IECC: TABLE C404.2

Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C404.2 MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	DRAW PATTERN	PERFORMANCE REQUIRED[a]	TEST PROCEDURE[b]
Electric Table-top water heaters[c]	≤12 kW	≥ 20 gal ≤ 120 gal[d]	Very small Low Medium High	UEF ≥ 0.6323 - (0.0058 × Vr) UEF ≥ 0.9188 - (0.0031 × Vr) UEF ≥ 0.9577 - (0.0023 × Vr) UEF ≥ 0.9884 - (0.0016 × Vr)	DOE 10 CFR Part 430 App. E
Electric Storage water heaters[e,f]: resistance and heat pump	≤12 kW	≥ 20 gal ≤ 55 gal[f]	Very small Low Medium High	UEF ≥ 0.8808 - (0.0008 × Vr) UEF ≥ 0.9254 - (0.0003 × Vr) UEF ≥ 0.9307 - (0.0002 × Vr) UEF ≥ 0.9349 - (0.0001 × Vr)	DOE 10 CFR Part 430 App. E
	≤12 kW	> 55 gal ≤120 gal[f]	Very small Low Medium High	UEF ≥ 1.9236 - (0.0011 × Vr) UEF ≥ 2.0440 - (0.0011 × Vr) UEF ≥ 2.1171 - (0.0011 × Vr) UEF ≥ 2.2418 - (0.0011 × Vr)	DOE 10 CFR Part 430 App. E
Electric Storage water heaters[e,f,l]	> 12 kW	-	-	(0.3 + 27/Vm), %h	DOE 10 CFR 431.106 App B
Grid-enabled water heaters[g]	-	>75 gal d	Very small Low Medium High	UEF ≥ 1.0136 - (0.0028 × Vr) UEF ≥ 0.9984 - (0.0014 × Vr) UEF ≥ 0.9853 - (0.0010 × Vr) UEF ≥ 0.9720 - (0.0007 × Vr)	10 CFR 430 Appendix E
Electric Instantaneous water heaters[h]	≤12 kW	< 2 gal[d]	Very small Low Medium High	UEF ≥ 0.91 UEF ≥ 0.91 UEF ≥ 0.91 UEF ≥ 0.92	DOE 10 CFR Part 430
	>12 kW & ≤ 58.6 kW[i]	≤ 2 gal & ≤180ºF	All	UEF ≥ 0.80	DOE 10 CFR Part 430
Gas Storage water heaters[e,l]	≤ 75,000 Btu/h	≥20 gal & ≤ 55 gal[d]	Very small Low Medium High	UEF ≥ 0.3456 - (0.0020 × Vr) UEF ≥ 0.5982 - (0.0019 × Vr) UEF ≥ 0.6483 - (0.0017 × Vr) UEF ≥ 0.6920 - (0.0013 × Vr)	DOE 10 CFR Part 430 App. E
	≤ 75,000 Btu/h	> 55 gal & ≤ 100 gal[d]	Very small Low Medium High	UEF ≥ 0.6470 - (0.0006 × Vr) UEF ≥ 0.7689 - (0.0005 × Vr) UEF ≥ 0.7897 - (0.0004 × Vr) UEF ≥ 0.8072 - (0.0003 × Vr)	DOE 10 CFR Part 430 App. E
	> 75,000 Btu/h and ≤ 105,000 Btu/h [j,k]	≤ 120 gal & ≤180ºF	Very small Low Medium High	UEF ≥ 0.2674-0.0009 x Vr UEF ≥ 0.5362-0.0012 x Vr UEF ≥ 0.6002-0.0011 x Vr UEF ≥ 0.6597-0.0009 x Vr	DOE 10 CFR Part 430 App. E
	> 105,000 Btu/h[k]	-	-	80% Et SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Gas Instantaneous water heaters[i]	> 50,000 Btu/h and < 200,000 Btu/h[k]	< 2 gal[d]	Very small Low Medium High	UEF ≥ 0.80 UEF ≥ 0.81 UEF ≥ 0.81 UEF ≥ 0.81	DOE 10 CFR Part 430 App. E

	≥ 200,000 Btu/h[k]	< 10 gal	-	80% Et	DOE 10 CFR 431.106
	≥ 200,000 Btu/h[k]	≥10 gal	-	80% Et $SL \le (Q/800 + 110\sqrt{V})$, Btu/h	
Oil Storage water heaters[e,l]	≤ 105,000 Btu/h	≤ 50 gal[d]	Very small Low Medium High	$UEF = 0.2509 - (0.0012 \times V_r)$ $UEF = 0.5330 - (0.0016 \times V_r)$ $UEF = 0.6078 - (0.0016 \times V_r)$ $UEF = 0.6815 - (0.0014 \times V_r)$	DOE 10 CFR Part 430
	> 105,000 Btu/h and ≤ 140,000 Btu/h[l]	≤ 120 gal & ≤180ºF	Very small Low Medium High	$UEF \ge 0.2932 - 0.0015 \times V_r$ $UEF \ge 0.5596 - 0.0018 \times V_r$ $UEF \ge 0.6194 - 0.0016 \times V_r$ $UEF \ge 0.6740 - 0.0013 \times V_r$	DOE 10 CFR Part 430 App. E
	>140,000 Btu/h	All	-	80% Et $SL \le (Q/800 + 110\sqrt{V})$, Btu/h	DOE 10 CFR 431.106
Oil Instantaneous water heaters[h,l]	≤ 210,000 Btu/h	< 2 gal	-	80% Et $EF \ge 0.59 - 0.0005 \times V$	DOE 10 CFR Part 430 App. E
	> 210,000 Btu/h	< 10 gal	-	80% Et	DOE 10 CFR 431.106
	> 210,000 Btu/h	≥ 10 gal	-	78% Et $SL \le (Q/800 + 110\sqrt{V})$, Btu/h	DOE 10 CFR 431.106
Hot water supply boilers, gas and oil[h]	≥300,000 Btu/h and < 12,500,000 Btu/h	< 10 gal	-	80% Et	DOE 10 CFR 431.106
Hot water supply boilers, gas[i,l]	≥300,000 Btu/h and < 12,500,000 Btu/h	≥ 10 gal	-	80% Et $SL \le (Q/800 + 110\sqrt{V})$, Btu/h	DOE 10 CFR 431.106
Hot water supply boilers, oil[h,l]	≥300,000 Btu/h and < 12,500,000 Btu/h	≥ 10 gal	-	78% Et $SL \le (Q/800 + 110\sqrt{V})$, Btu/h	DOE 10 CFR 431.106
Pool heaters, gas[d]	All	_[f]	-	82% Et	DOE 10 CFR Part 430 App. P
Heat pump pool heaters	All	50°F db 44.2°F wb outdoor air 80.0°F entering water	-	4.0 COP	DOE 10 CFR Part 430 App. P
Unfired storage tanks	All	-	-	Minimum insulation requirement R-12.5 (h-ft2-°F)/Btu	(none)

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m^2, °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. Thermal efficiency (Et) is a minimum requirement, while standby loss is a maximum requirement. In the standby loss equation, V is the rated volume in gallons and Q is the nameplate input rate in Btu/h. Vm is the measured volume in the tank in gallons. Standby loss for electric water heaters is in terms of %/h and denoted by the term “S,” and standby loss for gas and oil water heaters is in terms of Btu/h and denoted by the term “SL” Draw pattern (DP) refers to the water draw profile in the Uniform Energy Factor (UEF) test. UEF and Energy Factor (EF) are minimum requirements. In the UEF standard equations, Vr refers to the rated volume in gallons.

b. Chapter 6 contains a complete specification, including the year version, of the referenced test procedure.

c. A tabletop water heater is a storage water heater that is enclosed in a rectangular cabinet with a flat top surface not more than three feet (0.91 m) in height and has a ratio of input capacity (Btu/h) to tank volume (gal) < 4000.

d. Water heaters or gas pool heaters in this category are regulated as consumer products by the USDOE as defined in 10 CFR 430.

e. Storage water heaters have a ratio of input capacity (Btu/h) to tank volume (gal)<4000.

f. Efficiency requirements for electric storage water heaters ≤ 12 kW apply to both electric resistance and heat pump water heaters. There are no minimum efficiency requirements for electric heat pump water heaters greater than 12kW or for gas heat pump water heaters.

g. 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 (284 L).
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 a 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."

h. Instantaneous water heaters and hot water supply boilers have an input capacity (Btu/h) divided by storage volume (gal) ≥ 4000 Btu/h-gal.

i. Electric instantaneous water heaters with input capacity >12 kW and ≤58.6 kW that have either (1) a storage volume >2 gal(7.6L); or (2) is designed to provide outlet hot water at temperatures greater than 180°F(82ºC); or (3) uses three-phase power has no efficiency standard.

j. Gas storage water heaters with input capacity >75,000 Btu/h (21.98 kW) and ≤105,000 Btu/h (30.77 kW) must comply with the requirements for the >105,000 Btu/h (30.77 kW) if the water heater either (1) has a storage volume >120 gal (454L); (2) is designed to provide outlet hot water at temperatures greater than 180°F (82ºC); or (3) uses three-phase power.

k. Refer to Section C404.2.1 for additional requirements for gas storage and instantaneous water heaters and gas hot-water supply boilers.l Oil storage water heaters with input capacity>105,000 Btu/h (30.77 kW) and ≤140,000 Btu/h (41.03 kW) must comply with the requirements for the >140,000 Btu/h (41.03 kW) if the water heater either (1) has a storage volume > 120 gal(454L); (2) is designed to provide outlet hot water at temperatures greater than 180ºF (82ºC); or (3) uses three-phase power.

l. <u>Water heaters and hot water supply boilers having more than 140 gallons of storage capacity need not meet the standby loss requirement if: (1) The tank surface area is thermally insulated to R-12.5 or more; (2) a standing pilot light is not used; and (3) for gas or oil-fired storage water heaers, they have a fire damper or fan-assisted combustion.</u>

Reason: This proposal updates Table C404.2 to reflect energy conservation standards per Department of Energy (DOE) 10 CFR 431.110 which were missing from Table C404.2.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal updates Table C404.2 to reflect energy conservation standards per Department of Energy (DOE) 10 CFR 431.110 which were missing from Table C404.2.

Final Hearing Results

CECD1-19-22 AS

CECD1-20-22

Original Proposal

IECC: C405.3.1
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.3.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-12.

$$TCLP = [LVL + BLL + LED + TRK + \text{Other}] \quad \textbf{(Equation 4-12)}$$

where:

TCLP = Total connected lighting power (watts).*LVL* = For luminaires with lamps connected directly to building power, such as line voltage lamps, the rated wattage of the lamp.*BLL* = For luminaires incorporating a ballast or transformer, the rated input wattage of the ballast or transformer when operating that lamp.*LED* = For light-emitting diode luminaires with either integral or remote drivers, the rated wattage of the luminaire.*TRK* = For lighting track, cable conductor, rail conductor, and plug-in busway systems that allow the addition and relocation of luminaires without rewiring, the wattage shall be one of the following:

1. The specified wattage of the luminaires, but not less than 8 W per linear foot (25 W/lin m).
2. The wattage limit of the permanent current-limiting devices protecting the system.
3. The wattage limit of the transformer supplying the system.

Other = The wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data supplied by the manufacturer or other *approved* sources.
The connected power associated with the following lighting equipment and applications is not included in calculating total connected lighting power.

1. Emergency lighting that is automatically off during normal operations.
2. Lighting in spaces specifically designed for use by occupants with special lighting needs, including those with visual impairment and other medical and age-related issues.
3. Casino gaming areas.
4. Mirror lighting in makeup or dressing areas used for video broadcasting, video or film recording, or live theatrical and music performance.
5. Task lighting for medical and dental purposes that is in addition to general lighting.
6. Display lighting for exhibits in galleries, museums and monuments that is in addition to general lighting.
7. Lighting in any location that is specifically used for video broadcasting, video or film recording, or live theatrical and music performance.
8. Lighting for photographic processes.
9. Lighting integral to equipment or instrumentation and installed by the manufacturer.
10. Task lighting for plant growth or maintenance.
11. Advertising signage or directional signage.
12. Lighting for food warming.
13. Lighting equipment that is for sale.

14. Lighting demonstration equipment in lighting education facilities.
15. Lighting approved because of safety considerations.
16. Lighting in retail display windows, provided that the display area is enclosed by ceiling-height partitions.
17. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
18. Exit signs.
19. Antimicrobial lighting used for the sole purpose of disinfecting a space.
20. Lighting in sleeping units and dwelling units.
21. <u>For exit access stairways, exit stairways and their landings, where the applicable building code or life safety code requires a minimum illuminance of 10 footcandles on the walking surface, the power in excess of the allowed power calculated according to C405.3.2.2, is not included.</u>

Reason: IBC 2021 requires that: "along exit access stairways, exit stairways and their required landings, the illumination level shall not to be less than 10 fc (108 lux) at the walking surface when the stairway is in use."

This is an exceptionally high light level for an exit stair, and 10 times greater than required by the IBC 2018. The current lighting power allowance for stairways is insufficient. In the limited case of the stairway itself, it would be impossible to meet the requirements of both the IBC and the IECC. This exception eliminates that conflict by permitting any **power in excess of the allowed power**associated with the lighting of the stair to be excluded from the lighting power density calculations.

This is similar to C405.5.1 exception #15 for exterior lighting, which was approved and is in PCD1.

Another solution was considered and studied but is not ready for inclusion in the code and is much more complex. It was concluded that the exclusion approach is the best at this time, and arguably could lead to better energy efficiency.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Will not increase the cost of construction

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This addresses changes to Section 1008.2.1 of the IBC which requires higher illuminances exit access stairways, exit stairways and at their required landings.

Final Hearing Results

CECD1-20-22	AS

CECD1-21-22

Original Proposal

IECC: C405.1, C405.2, C405.2.5, C405.3, C405.3.2.1, C405.3.2.2, C405.1.1
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.1 General. Electrical power and lighting systems and generation shall comply with this section. ~~*Sleeping units* and dwelling units in hotels, motels, congregate living, and vacaction timeshare propoerties shall comply with Section C405.2.5 and with Section C405.1.1~~ . *General lighting* shall consist of all lighting included when calculating the total connected interior lighting power in accordance with Section C405.3.1 and which does not require specific application controls in accordance with Section C405.2.5.

Exception: *Dwelling units* and *sleeping units* that comply with Section C405.2.10 Section C405.3.3 and Section C405.6.

C405.2 Lighting controls. Lighting systems powered through the energy service for the building shall be provided with controls that comply with Sections C405.2.1 through ~~C405.2.9~~ C405.2.10.

Exceptions: Lighting controls are not required for the following:

1. Spaces where an automatic shutoff could endanger occupant safety or security.
2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency lighting that is automatically off during normal operations.
4. Emergency lighting required by the *International Building Code* in exit access components which are not provided with fire alarm systems.
5. Up to 0.02 watts per square foot (0.06 W/m^2) of lighting in exit access components which are provided with fire alarm systems.

C405.2.5 Specific application controls. Specific application controls shall be provided for the following:

1. The following lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a time-switch control complying with Section C405.2.2.1. In addition, a manual control shall be provided to control such lighting separately from the general lighting in the space:
   1.1. Luminaires for which additional lighting power is claimed in accordance with Section C405.3.2.2.1.
   1.2. Display and accent lighting, including lighting in display cases.
   1.3. Lighting in display cases.
   1.3 Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting.
   1.4 Lighting equipment that is for sale or demonstration in lighting education.
2. *Sleeping units* shall have control devices or systems that are configured to automatically switch off all installed luminaires and switched receptacles within 20 minutes after all occupants have left the unit.

   Exceptions:

   1. Lighting and switched receptacles controlled by card key controls in buildings containing fewer than 50 sleeping units.
   2. Spaces where patient care is directly provided.

3. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a time switch control complying with Section C405.2.2.1 that is independent of the controls for other lighting within the room or space.
4. Task lighting for medical and dental purposes that is in addition to *general lighting* shall be provided with a *manual control*.

Revise as follows:

C405.3 Interior lighting power requirements. A building complies with this section where its total connected interior lighting power calculated under Section C405.3.1 is not greater than the interior lighting power allowance calculated under Section C405.3.2. *Sleeping units* and *dwelling units* shall comply with C405.3.3.

C405.3.2.1 Building Area Method. For the Building Area Method, the interior lighting power allowance is calculated as follows:

1. For each building area type inside the building, determine the applicable building area type and the allowed lighting power density for that type from Table C405.3.2(1). For building area types not listed, select the building area type that most closely represents the use of that area. For the purposes of this method, an "area" shall be defined as all contiguous spaces that accommodate or are associated with a single building area type.
2. Determine the floor area for each building area type listed in Table C405.3.2(1) and multiply this area by the applicable value from Table C405.3.2(1) to determine the allowed lighting power (watts) for each building area type. Sleeping units and dwelling units are excluded from lighting power allowance calculations by application of Section ~~C405.1.1~~ C405.3.3. The area of sleeping units and dwelling units is not included in the calculation.
3. The total interior lighting power allowance (watts) for the entire building is the sum of the lighting power from each building area type.

C405.3.2.2 Space-by-Space Method. Where a building has unfinished spaces, the lighting power allowance for the unfinished spaces shall be the total connected lighting power for those spaces, or 0.1 watts per square foot (1.08 w/m^2), whichever is less. For the Space-by-Space Method, the interior lighting power allowance is calculated as follows:

1. For each space enclosed by partitions that are not less than 80 percent of the ceiling height, determine the applicable space type from Table C405.3.2(2). For space types not listed, select the space type that most closely represents the proposed use of the space. Where a space has multiple functions, that space may be divided into separate spaces.
2. Determine the total floor area of all the spaces of each space type and multiply by the value for the space type in Table C405.3.2(2) to determine the allowed lighting power (watts) for each space type. Sleeping units and dwelling units are excluded from lighting power allowance calculations by application of Section ~~C405.1.1~~ C405.3.3. The area of sleeping units and dwelling units is not included in the calculation.
3. The total interior lighting power allowance (watts) shall be the sum of the lighting power allowances for all space types.

~~C405.1.1~~C405.3.3 Lighting power for sleeping units and dwelling units. ~~No less than 90 percent of the~~*Sleeping units* in Group I-2 occupancies that are patient rooms shall comply with C405.3.1 and C405.3.2. For all other *sleeping units* and *dwelling units*, permanently installed lighting ~~serving sleeping units and dwelling units~~including lighting integrated into range hoods and exhaust fans, shall be provided by lamps with an efficacy of not less than 65 lm/W or luminaires with an efficacy of not less than 45 lm/W.

Exceptions:

1. Lighting integral to a kitchen appliance~~or exhaust hood~~.
2. Antimicrobial lighting used for the sole purpose of disinfecting.

Reason: This proposal is based on CED1-26 as modified by the PLR (not yet heard by the E4C). CED1-26 is a reorganization for clarity of the specific requirements for sleeping units and dwelling units.

· C405.1 currently says that all "lighting systems" must comply with C405 and then goes on to list requirements specific to sleeping units and dwelling units. Read literally, sleeping units and dwelling units still must comply with everything else in C405. Obviously, that is not the intent – but that is what the code says.

· C405.1 currently says that sleeping units have to comply with C405.2.5 Specific application controls. Taken literally, this would mean if you had accent lighting or task lighting in a hotel room it would have to be controlled by an occupancy sensor or time-switch. Obviously, that is not the intent – but that is what the code says.

· An exemption to C405.1 has been added to make it clear that sleeping units and dwelling units must only comply with C405.2.10, C405.3.3, C405.6 and nothing else.

· Currently, there are two types of requirements that apply to sleeping units and dwelling units – lighting controls and lighting power. This proposal rearranges these requirements and puts them where they belong – in new sections C405.2.10 (lighting controls) and C405.3.3 (lighting power)

· An additional sentence is added to C405.3 to improve clarity. This is not a change in the requirements.

Text is added to C405.3.3 with different lighting power requirements for sleeping units in Group I-2 that are patient rooms. This is to accommodate CED1-9 which proposes to restore the patient room lighting power allowance to Table C405.3.2 (2)

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither increase nor decrease the cost of construction. These minor revisions will have no significant effect on the cost of lighting equipment required.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposal restructures the code for clarity of requirements for dwelling units and sleeping units.

Final Hearing Results

CECD1-21-22 AM

CECD1-22-22

Original Proposal

IECC: C405.2.2.1
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.2.2.1 Time-switch control function. Time-switch *controls* shall comply with all of the following:

1. ~~Automatically~~ Programmed to automatically turn off lights when the space is scheduled to be unoccupied.
2. Have a minimum 7-day clock.
3. Be capable of being set for seven different day types per week.
4. Incorporate an automatic holiday “shutoff” feature, which turns off all controlled lighting loads for not fewer than 24 hours and then resumes normally scheduled operations.
5. Have program backup capabilities, which prevent the loss of program and time settings for not fewer than 10 hours, if power is interrupted.
6. Include an override switch that complies with the following:
   6.1. The override switch shall be a manual control.
   6.2. The override switch, when initiated, shall permit the controlled lighting to remain on for not more than 2 hours.
   6.3. Any individual override switch shall control the lighting for an area not larger than 5,000 square feet (465 m^2).
7. For spaces where schedules are not available, time switch controls are programmed to a schedule that turns lights off not less than 12 hours per day.

Exception: Within mall concourses, auditoriums, sales areas, manufacturing facilities and sports arenas:

1. The time limit shall be permitted to be greater than 2 hours, provided that the switch is a captive key device.
2. The area controlled by the override switch shall not be limited to 5,000 square feet (465 m^2) provided that such area is less than 20,000 square feet (1860 m^2).

Reason: PNNL study on main non-compliance was time switches not programmed so this proposal attempts to correct that issue.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Will not increase

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal will address the issue of programming time clock controls when a schedule is not known.

Final Hearing Results	
CECD1-22-22	AS

CECD1-23-22

Original Proposal

IECC: SECTION 202 (New), C405.2, C405.2.7, C405.2.7.3, C405.2.8, C405.2.9, TABLE C405.5.2(2), TABLE C405.5.2(3)
Proponents:

2024 International Energy Conservation Code [CE Project]

Add new definition as follows:

PARKING AREA, INTERIOR. Parking spaces, drive aisles, and ramps located within a building.

PARKING AREA, EXTERIOR. Parking spaces, drive aisles and ramps which are not located within a building, or which are located on a roof.

Revise as follows:

C405.2 Lighting controls. ~~Lighting systems powered through the energy service for the building shall be provided with controls that comply with Sections C405.2.1 through C405.2.9 .~~Lighting systems in *interior parking areas* shall be provided with controls that comply with C405.2.9. All other lighting systems powered through the energy service for the building and *building site* lighting for which the building owner is responsible shall be provided with controls that comply with Sections C405.2.1 through C405.2.8.

Exceptions: Lighting controls are not required for the following:

1. Spaces where an automatic shutoff could endanger occupant safety or security.
2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency lighting that is automatically off during normal operations.
4. Emergency lighting required by the *International Building Code* in exit access components which are not provided with fire alarm systems.
5. Up to 0.02 watts per square foot (0.06 W/m^2) of lighting in exit access components which are provided with fire alarm systems.

C405.2.7 Exterior lighting controls. Exterior lighting systems shall be provided with controls that comply with Sections C405.2.7.1 through C405.2.7.4.

Exceptions:

1. Lighting for ~~covered~~ vehicle entrances to ~~and exits from~~ buildings ~~and parking structures~~ where required for eye adaptation.
2. Lighting controlled from within dwelling units.

C405.2.7.3 Lighting setback. Lighting that is not controlled in accordance with Section C405.2.7.2 shall comply with the following:

1. Be controlled so that the total wattage of such lighting is automatically reduced by not less than 50 percent by selectively switching off or dimming luminaires at one of the following times:
   1.1. From not later than midnight to not earlier than 6 a.m.
   1.2. From not later than one hour after building or business closing to not earlier than one hour before building or business opening.
   1.3. During any time where activity has not been detected for 15 minutes or more.

2. Luminaires serving ~~outdoor~~ exterior parking areas and having a rated input wattage of greater than 40 watts and a mounting height of 24 feet (7315 mm) or less above the ground shall be controlled so that the total wattage of such lighting is automatically reduced by not less than 50 percent during any time where activity has not been detected for 15 minutes or more. Not more than 1,500 watts of lighting power shall be controlled together.

~~C405.2.8~~C405.2.9 Interior parking area ~~Parking garage~~ lighting control. ~~Parking garage~~Interior parking area lighting shall be controlled by an *occupant sensor* complying with Section C405.2.1.1 or a *time-switch control* complying with Section C405.2.2.1. Additional lighting controls shall be provided as follows:

1. Lighting power of each luminaire shall be automatically reduced by not less than 30 percent when there is no activity detected within a lighting zone for 20 minutes. Lighting zones for this requirement shall be not larger than 3,600 square feet (334.5 m^2).

   Exception: Lighting zones provided with less than 1.5 footcandles of illumination on the floor at the darkest point with all lights on are not required to have automatic light-reduction controls.

2. Where lighting for eye adaptation is provided at~~covered~~ vehicle entrances to ~~and exits from~~ buildings ~~and parking structures~~, such lighting shall be separately controlled by a device that automatically reduces lighting power by at least 50 percent from sunset to sunrise.

3. The power to luminaires within 20 feet (6096 mm) of perimeter wall openings shall automatically reduce in response to daylight by at least 50 percent.

   Exceptions:

   1. Where the opening-to-wall ratio is less than 40 percent as viewed from the interior and encompassing the vertical distance from the driving surface to the lowest structural element.
   2. Where the distance from the opening to any exterior daylight blocking obstruction is less than one-half the height from the bottom of the opening or fenestration to the top of the obstruction.
   3. Where openings are obstructed by permanent screens or architectural elements restricting daylight entering the interior space.

~~C405.2.9~~C405.2.8 Demand responsive lighting controls. *Buildings* shall have controls that are capable of automatically reducing general lighting power not less than 15 percent in response to a demand response signal.

Exceptions:

1. Buildings with less than 4,000 watts of combined installed general lighting power in spaces that have more than 0.5 W/^{2}ft (5.38 W/m^2) of general lighting power.
2. *Buildings* where demand response programs are not available.
3. I-2 and I-3 occupancies.

TABLE C405.5.2(2) LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

LIGHTING ZONES				
Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	
Base Site Allowance	160 W	280 W	400 W	560 W
Uncovered Parking Areas				
Parking area , exterior areas and drives	0.015 W/ft^2	0.026 W/ft^2	0.037 W/ft^2	0.052 W/ft^2
Building Grounds				
Walkways and ramps less	0.50 W/linear foot	0.50 W/linear foot	0.55 W/linear foot	0.60 W/linear foot
Plaza areas	0.028 W/ft^2	0.049 W/ft^2	0.070 W/ft^2	0.098 W/ft^2
Dining areas	0.156 W/ft^2	0.273 W/ft^2	0.390 W/ft^2	0.546 W/ft^2
Stairways	Exempt	Exempt	Exempt	Exempt
Pedestrian tunnels	0.063 W/ft^2	0.110 W/ft^2	0.157 W/ft^2	0.220 W/ft^2
Landscaping	0.014 W/ft^2	0.025 W/ft^2	0.036 W/ft^2	0.050 W/ft^2
Building Entrances and Exits				
Pedestrian and vehicular entrances and exits	5.6 W/linear foot of opening	9.8 W/linear foot of opening	14 W/linear foot of opening	19.6 W/linear foot of opening
Entry canopies	0.072 W/ft^2	0.126 W/ft^2	0.180 W/ft^2	0.252W/ft^2

LIGHTING ZONES				
Zone 1	Zone 2	Zone 3	Zone 4	
Loading docks	0.104 W/ft^2	0.182 W/ft^2	0.260 W/ft^2	0.364 W/ft^2
Sales Canopies				
Free-standing and attached	0.20 W/ft^2	0.35 W/ft^2	0.50 W/ft^2	0.70 W/ft^2
Outdoor Sales				
Open areas (including vehicle sales lots)	0.072 W/ft^2	0.126 W/ft^2	0.180 W/ft^2	0.252 W/ft^2
Street frontage for vehicle sales lots in addition to “open area” allowance	No allowance	7.2 W/linear foot	10.3 W/linear foot	14.4 W/linear foot

1 foot = 304.8 mm, 1 watt per square foot = 10.76 watts per square meter. W = watts.

TABLE C405.5.2(3) INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

LIGHTING ZONES				
Zone 1	Zone 2	Zone 3	Zone 4	
Building facades	No allowance	0.075 W/ft^2 of gross above-grade wall area	0.113 W/ft^2 of gross above-grade wall area	0.15 W/ft^2 of gross above-grade wall area
Automated teller machines (ATM) and night depositories	90 W per location plus 35W per additional ATM per location			
Uncovered entrances and gatehouse inspection stations at guarded facilities	0.144 W/ft^2 of area	0.252 W/ft^2 of area	0.360 W/ft^2 of area	0.504 W/ft^2 of area
Uncovered loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.104 W/ft^2 of area	0.182 W/ft^2 of area	0.260 W/ft^2 of area	0.364 W/ft^2 of area
Drive-up windows and doors	53 W per drive through	92 W per drive through	132 W per drive through	185 W per drive through
Parking area near 24-hour retail entrances.	80 W per main entry	140 W per main entry	200 W per main entry	280 W per main entry

For SI: For SI: 1 watt per square foot = 10.76 watts per square meter.

W = watts.

Reason: Inconsistent language is used throughout the lighting section to refer to parking areas. For example:

- C405.2.8 Parking garage lighting controls.   These requirements have never been intended to apply to all lighting in a parking garage. They are intended to apply only to the lighting within parking areas, with separate controls requirements for stairs, elevator lobbies, electrical closets, etc.
- Table C405.5.2(2) uses the phrase “Uncovered Parking Areas” but there is no corresponding requirement for “Covered Parking Areas”, which raises the question of what LPD requirement would apply to an exterior parking lot on grade with shade structure above. This is resolved by deleting the reference to uncovered parking areas.
- C405.2.7 Exception 1 refers to a “parking structure” as something different than a building. This section also provides an exemption for daylight transition lighting at exits from a building, when this is not needed (daylight transition lighting for safety is important, but only at building entrances).
- The code has never stated that lighting on the roof of an unconditioned parking garage is considered “exterior”, while lighting within the garage is considered “interior”.

These issues are all addressed by the introduction of the defined terms “interior parking area” and “exterior parking area”, and several minor corrections to terminology throughout the body of the code.
Approval of this proposal will lead to more consistent implementation and enforcement of the lighting efficiency requirements in the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is editorial in nature and will neither increase not decrease the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal would clarify what areas are covered by parking garage lighting versus exterior lighting for controls and lighting power requirements.

Final Hearing Results

CECD1-23-22	AS

CECD1-24-22

Original Proposal

IECC: C405.3.1
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.3.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-12.

$$TCLP = [LVL + BLL + LED + TRK + \text{Other}]$$ **(Equation 4-12)**

where:

TCLP = Total connected lighting power (watts).*LVL* = For luminaires with lamps connected directly to building power, such as line voltage lamps, the rated wattage of the lamp.*BLL* = For luminaires incorporating a ballast or transformer, the rated input wattage of the ballast or transformer when operating that lamp.*LED* = For light-emitting diode luminaires with either integral or remote drivers, the rated wattage of the luminaire.*TRK* = For lighting track, cable conductor, rail conductor, and plug-in busway systems that allow the addition and relocation of luminaires without rewiring, the wattage shall be one of the following:

1. The specified wattage of the luminaires, but not less than 8 W per linear foot (25 W/lin m).
2. The wattage limit of the permanent current-limiting devices protecting the system.
3. The wattage limit of the transformer supplying the system.

Other = The wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data supplied by the manufacturer or other *approved* sources.

The connected power associated with the following lighting equipment and applications is not included in calculating total connected lighting power.

1. Emergency lighting that is automatically off during normal operations.
2. Lighting in spaces specifically designed for use by occupants with special lighting needs, including those with visual impairment and other medical and age-related issues.
3. ~~Casino gaming areas~~.
4. 3. Mirror lighting in makeup or dressing areas used for video broadcasting, video or film recording, or live theatrical and music performance.
5. 4. Task lighting for medical and dental purposes that is in addition to general lighting.
6. 5. Display lighting for exhibits in galleries, museums and monuments that is in addition to general lighting.
7. 6. Lighting in any location that is specifically used for video broadcasting, video or film recording, or live theatrical and music performance.
8. 7. Lighting for photographic processes.
9. 8. Lighting integral to equipment or instrumentation and installed by the manufacturer.
10. 9. Task lighting for plant growth or maintenance.
11. 10. Advertising signage or directional signage.
12. 11. Lighting for food warming.
13. 12. Lighting equipment that is for sale.

14. <u>13.</u> Lighting demonstration equipment in lighting education facilities.
15. <u>14.</u> Lighting approved because of safety considerations.
16. <u>15.</u> Lighting in retail display windows, provided that the display area is enclosed by ceiling-height partitions.
17. <u>16.</u> Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
18. <u>17.</u> Exit signs.
19. <u>18.</u> Antimicrobial lighting used for the sole purpose of disinfecting a space.
20. <u>19.</u> Lighting in sleeping units and dwelling units.

Reason: In PCD#1 the space-by-space lighting power allowance table C405.3.2(2) now includes space types and allowances for 4 types of casino gaming areas. When these were added, the existing exemption in IECC 2021 for "casino gaming areas" should have been removed because these are areas now have power allowances and are no longer exempt from the lighting power requirements. The proposal deletes that exemption.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No increase

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal removes an exception for a space category that has been added to the lighting power allowance table.

Final Hearing Results

CECD1-24-22 AS

CECD1-25-22

Original Proposal

IECC: C403.7.4.1
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.7.4.1 Nontransient dwelling units. Nontransient dwelling units shall be provided with outdoor air energy recovery ventilation systems complying with not less than one of the following:

1. The system shall have an *enthalpy recovery ratio* of not less than 50 percent at cooling design condition and not less than 60 percent at heating design condition.
2. The system shall have a sensible recovery efficiency (SRE) that is not less than 65 percent at 32 °F (0 °C) and, in climate zones 0A, 1A, 2A, and 3A, having a net moisture transfer (NMT) that is not less than 40 percent at 95 °F (35 °C). SRE and NMT shall be determined from a listed value or from interpolation of listed values, at an airflow not less than the design airflow, based on testing in accordance with CAN/CSA C439.

Exceptions:

1. Nontransient dwelling units in Climate Zone 3C.
2. Nontransient dwelling units with not more than 500 square feet (46 m^2) of *conditioned floor area* in Climate Zones 0, 1, 2, 3, 4C and 5C ~~and either adjoin an open-ended corridor or do not adjoin a corridor~~.
3. ~~Nontransient dwelling units with not more than 500 square feet (46 m2) of conditioned floor area that are located in Climate Zones 1A, 2B, 3B, and 3C.~~
4. 3. *Enthalpy recovery ratio* requirements at heating design condition in Climate Zones 0, 1 and 2.
5. 4. *Enthalpy recovery ratio* requirements at cooling design condition in Climate Zones 4, 5, 6, 7 and 8.

Reason: Large, central H/ERVs serving multiple dwelling units are typically certified for performance based on testing conducted in accordance with AHRI 1060, "Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment." The “enthalpy recovery ratio” of AHRI 1060 encompasses both sensible and latent performance and this proposal retains it as the first of two optional compliance paths for this section.
Smaller (and often in-suite) H/ERVs typically serving individual dwelling units are generally certified for performance (e.g., SRE for sensible energy transfer, NMT for latent energy transfer, etc.) based on testing conducted in accordance with test standard CAN/CSA C439. In practice, the test results are listed in a publicly accessible directory by a certification body (e.g., The Home Ventilating Institute). This proposal adds a second compliance option, C403.7.4.1.2, to recognize H/ERVs that are tested in accordance with CAN/CSA C439, that are expected to achieve comparable in-situ performance to units tested in accordance with AHRI 1060. The target SRE aligns with that currently required in IECC-R Section N1103.6.1 (R403.6.1) for certain dwelling units. The target net moisture transfer would only be required for hot/humid climate zones to support IAQ, where moderation of outdoor moisture levels is especially important for managing indoor humidity. The value of 40% is achievable by most models while providing a significant reduction in latent loads associated with introducing outdoor air.

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

The code change proposal could potentially decrease the cost of construction by facilitating the permitting of smaller, in-suite H/ERVs. This will provide builders and specifiers with more options for specifying compliant systems.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Adding the test method provides a path for smaller H/ERVs to comply.

Final Hearing Results

CECD1-25-22	AM

CECD1-27-22

Original Proposal

IECC: C405.14.4, C405.14.5
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.14.4 EVSE Spaces. An installed EVSE with multiple output connections shall be permitted to serve multiple EVSE spaces. Each EVSE installed to meet the requirements of Section C405.14.1, serving either a single EVSE space or multiple EVSE spaces, shall comply with all of the following:

1. Have a minimum circuit capacity in accordance with C405.14.5.
2. ~~Have a minimum charging rate in accordance with C405.14.4.1~~. Have a nameplate rating not less than 6.2kW
3. Be located within 3 feet (914 mm) of each EVSE space it serves.
4. Be installed in accordance with Section C405.14.6.

C405.14.5.1 Circuit Capacity. The electrical distribution equipment supplying the branch circuit(s) serving each EV capable space, EV ready space, and EVSE space shall comply with one of the following:

1. Have a calculated load of 7.2kVA or the nameplate rating of the equipment, whichever is larger,for each EV capable space, EV ready space, and EVSE space.
2. Meets the requirements of C405.14.5.3.1.

Reason: further clarification and to align with the definitions shown in CED1-39

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
will not increase the cost of construction

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: further clarification and to align with the definitions shown in CED1-39

Final Hearing Results

CECD1-27-22	AS

CECD1-28-22

Original Proposal

IECC: APPENDIX CH (New), SECTION CH101 (New), CH101.1 (New), CH101.2 (New), SECTION CH102 (New), SECTION CH103 (New), CH103.1 (New), CH103.1.1 (New), CH103.1.1.1 (New), CH103.1.1.2 (New), CH103.1.1.3 (New), Table CH103.1.1 (New), CH103.1.2 (New), CH103.1.2.1 (New), CH103.1.2.2 (New), CH103.1.2.3 (New), CH103.1.2.4 (New), TABLE CH103.1.2 (New), CH103.1.3 (New), CH103.1.3.1 (New), TABLE CH103.1.3.1 (New), CH103.1.3.2 (New), CH103.1.4 (New), CH103.1.4.1 (New), CH103.1.4.2 (New), CH103.1.5 (New), CH103.2 (New), CH103.3 (New)

Proponents: Greg Eades, U.S. Environmental Protection Agency, Public Sector (iecccemodeling@iccsafe.org)

2024 International Energy Conservation Code [CE Project]

Add new text as follows:

APPENDIX CH
ELECTRIC-READY COMMERCIAL BUILDING PROVISIONS

SECTION CH101
GENERAL

CH101.1 Intent. The intent of this Appendix is to amend the *International Energy Conservation Code* to reduce future retrofit costs by requiring commercial buildings with *combustion equipment* to install the electrical infrastructure for electric equipment.

CH101.2 Scope. The provisions in this appendix are applicable to commercial buildings. New construction shall comply with Section CH103.

SECTION CH102 DEFINITIONS. APPLIANCE. A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements. **COMBUSTION EQUIPMENT.** Any equipment or appliance used for space heating, service water heating, cooking, clothes drying or lighting that uses a fossil fuel. **COMMERCIAL COOKING APPLIANCES.** used in a commercial food service establishment for heating or cooking food and which produce grease vapors, steam, fumes, smoke or odors that are required to be removed through a local exhaust ventilation system. Such appliances include deep fat fryers, upright broilers, griddles, broilers, steam-jacketed kettles, hot-top ranges, under-fired broilers (charbroilers), ovens, barbecues, rotisseries, and similar appliances.

SECTION CH103
NEW COMMERCIAL BUILDING

CH103.1 Additional electric infrastructure. Electric infrastructure in buildings that contain combustion equipment shall be installed in accordance with this section.

CH103.1.1 Combustion space heating. Spaces containing combustion equipment for space heating shall comply with Sections CH103.1.1.1, CH103.1.1.2 and CH103.1.1.3.

CH103.1.1.1 Designated exterior locations for future electric space heating equipment . Spaces containing *combustion equipment* for space heating shall be provided with designated exterior location(s) shown on the plans and of sufficient size for outdoor space heating heat pump equipment, with a chase that is sized to accommodate refrigerant lines between the exterior location and the interior location of the space heating equipment, and with natural drainage for condensate from heating operation or a condensate drain located within 3 feet (914 mm) of the location of the future exterior space heating heat pump equipment.

CH103.1.1.2 Dedicated branch circuits for future electric space heating equipment. Spaces containing combustion space heating equipment with a capacity not more than 65,000 Btu/h shall be provided with a dedicated 240-volt, branch circuit with ampacity of not less than 50. The branch circuit shall terminate within 6 feet (1829 mm) of the space heating equipment and be in a location with ready access. Both ends of the branch circuit shall be labeled with the words "For Future Electric Space Heating Equipment" and be electrically isolated. Spaces containing combustion equipment for space heating with a capacity of not less than 65,000 Btu/h shall be provided with a dedicated branch circuit rated and sized in accordance with Section CH103.1.1.3, and terminating in a junction box within 3 feet (914 mm) of the location the space heating equipment in a location with ready access. Both ends of the branch circuit shall be labeled "For Future Electric Space Heating Equipment."

Exceptions:

1. Where a branch circuit provides electricity to the space heating combustion equipment and is rated and sized in accordance with Section CH103.1.1.3
2. Where a branch circuit provides electricity to space cooling equipment and is rated and sized in accordance with Section CH103.1.1.3.
3. Where future electric space heating equipment would require three-phase power and the space containing combustion equipment for space heating is provided with an electrical panel with a label stating, "For Future Electric Space Heating Equipment" and with a bus bar rated and sized in accordance with Section CH103.1.1.3.
4. Buildings where the 99.6 percent design heating temperature is not less than 50ºF (10°C)

CH103.1.1.3 Additional space heating electric infrastructure sizing.. Electric infrastructure for future electric space heating equipment shall be sized to
accommodate not less than one of the following:

1. An electrical capacity not less than the nameplate space heating combustion equipment heating capacity multiplied by the value in Table CH103.1.1

(Equation #)

$$VA_s = Q_{com} \text{ x } P_s$$

where: VA_S = The required electrical capacity of the electrical infrastructure in volt-amps
Q_{com} = The nameplate heating capacity of the combustion equipment in kBtu/h
P_S = The VA per kBtu/h from Table CH103.1 in VA/kBtu/h

2. An electrical capacity not less than the peak space heating load of the building areas served by the space heating *combustion equipment*, calculated in accordance with Section C403.1.1, multiplied by the value for the 99.6 percent design heating temperature in Table CH103.1.1 per the equation below, or

(Equation #)

$$VA_s = Q_{design} \text{ x } P_s$$

where: VA_S = The required electrical capacity of the electrical infrastructure in volt-amps
Q_{design} = The 99.6 percent design heating load of the spaces served by the combustion equipment in kBtu/h
P_S = The VA per kBtu/h from Table CH103.1.1 in VA/kBtu/h

3. An approved alternate design that uses no energy source other than electricity or on-site renewable energy.

Table CH103.1.1 ALTERNATE ELECTRIC SPACE HEATING EQUIPMENT CONVERSION FACTORS (VA/kBtu/h)

99.6% Heating Design Temperature	Ps	
Greater Than (ºF)	Not Greater Than	VA/kBtu/h
50	N/A	N/A
45	50	94
40	45	100
35	40	107
30	35	115
25	30	124
20	25	135
15	20	149
10	15	164
5	10	184
0	5	210
-5	0	243
-10	-5	289
-15	-10	293

CH103.1.2 Combustion service water heating. Spaces containing combustion equipment for service water heating shall comply with Sections CH103.1.2.1, CH103.1.2.2 and CH103.1.2.3.

CH103.1.2.1 New Code Section. For each piece of combustion equipment for water heating with an input capacity of not more than 75,000 Btu/h, the following electrical infrastructure is required:

1. An individual 240-volt branch circuit with an ampacity of not less than 30 shall be provided and terminate within 6 ft (2 m) of the water heater and shall be in a location with ready access.
2. The branch circuit overcurrent protection device and the termination of the branch circuit shall be labeled "For future electric water heater".

   -
3. The space for containing the future water heater shall include the space occupied by the combustion equipment and shall have a height of not less than 7 ft (2 m), a width of not less than 3 ft (1 m), a depth of not less than 3ft (1 m) and with a volume of not less than 700 ft3 (20 m3).

   -

Exception: Where the space containing the water heater is provides for air circulation sufficient for the operation of a heat pump water heater, the minimum room volume shall not be required.

CH103.1.2.2 Designated locations for future electric heat pump water heating equipment. .

1. Designated exterior location(s) shown on the plans and of sufficient size for outdoor water heating heat pump equipment, with a chase that is sized to accommodate refrigerant lines between the exterior location and the interior location of the water heating equipment.

2. An interior location with a minimum volume the greater of 700 cubic feet (2000 L) or 7 cubic feet (200 L) per 1,000 Btu/h combustion equipment water heating capacity. The interior location shall include the space occupied by the combustion equipment.
3. An interior location with sufficient airflow to exhaust cool air from future water heating heat pump equipment provided by no less than one 16-inch (406 mm) by 24-inch (610 mm) grill to a heated space and one 8-inch (203 mm) duct of no more than 10 feet (3048 mm) in length for cool exhaust air.

CH103.1.2.3 Dedicated branch circuits for future electric heat pump water heating equipment. Spaces containing combustion equipment for water heating with a capacity of greater than 75,000 Btu/h shall be provided with a dedicated branch circuit rated and sized in accordance with Section CH103.1.2.4 and terminating in a junction box within 3 feet (914 mm) of the location the water heating equipment in a location with ready access. Both ends of the branch circuit shall be labeled “For Future Electric Water Heating Equipment.”

Exception: Where future electric water heating equipment would require threephase power and the main electrical service panel has a reserved space for a bus bar rated and sized in accordance with Section CH103.1.2.4 and labeled “For Future Electric Water Heating Equipment.”

CH103.1.2.4 Additional water heating electric infrastructure sizing . Electric infrastructure water heating equipment with a capacity of greater than 75,000 Btu/h shall be sized to accommodate one of the following:

1. An electrical capacity not less than the combustion equipment water heating capacity multiplied by the value in Table CH103.1.2 plus electrical capacity to serve recirculating loads as shown in the equation below.

$$VA_W = (Q_{capacity} \text{ x } P_W) + (Q_{recirc} \text{ x } 293 \text{ (VA/(Btu/h))}$$

where: VA_W = The required electrical capacity of the electrical infrastructure for water heating in volt-amps **(Equation #)**
$Q_{capacity}$ = The water heating capacity of the combustion equipment in kBtu/h
Pw = The VA per kBtu/h from Table CH103.1.2 in VA/kBtu/h
Q_{recirc} = The capacity required for temperature maintenance by recirculation, if applicable, in Btu/h

2. An alternate design that complies with this code, that is approved by the authority having jurisdiction, and that uses no energy source other than electricity or *on-site renewable energy*

TABLE CH103.1.2 ALTERNATE ELECTRIC WATER HEATING EQUIPMENT CONVERSION FACTORS (VA/kBtu/h)

99.6% Heating Design Temperature -		Pw
Greater than (ºF)	Not More Than	VA/kBtu/h
55	60	118
50	55	123
45	50	129

40	45	136
35	40	144
30	35	152
25	30	162
20	25	173
15	20	185
10	15	293
5	10	293
0	5	293
Less than 0 ºF (-17.8°C)		293

CH103.1.3 Combustion cooking. Spaces containing combustion equipment for cooking shall comply with either CH103.1.3.1 or CH103.1.3.2

CH103.1.3.1 Commercial cooking. Spaces containing commercial cooking appliances shall be provided with a dedicated branch circuit with a minimum electrical capacity in accordance with Table CH103.1.3.1 based on the appliance in the space. The branch circuit shall terminate within 3 feet (914 mm) of the appliance in a location with ready access. Both ends of the branch circuit shall be labeled with the words "For Future Electric Cooking Equipment" and be electrically isolated.

TABLE CH103.1.3.1 COMMERCIAL COOKING MINIMUM BRANCH CIRCUIT CAPACITY

Commercial Cooking Appliance	Minimum Branch Circuit Capacity
Range	469 VA/kBtu/h
Steamer	114 VA/kBtu/h
Fryer	200 VA/kBtu/h
Oven	266 VA/kBtu/h
Griddle	195 VA/kBtu/h
All other commercial cooking appliances	114 VA/kBtu/h

CH103.1.3.2 All other cooking.. Spaces containing all other cooking equipment not designated as commercial cooking appliances shall be provided with a dedicated branch circuit in compliance with NFPA 70
Section 422.10. The branch circuit shall terminate within 6 feet (1829 mm) of fossil fuel ranges, cooktops and ovens and be in a location with ready access. Both ends of the branch circuit shall be labeled with the words "For Future Electric Cooking Equipment" and be electrically isolated.

CH103.1.4 Combustion clothes drying.. Spaces containing combustion equipment for clothes drying shall comply with either CH103.1.4.1 or CH103.1.4.2

CH103.1.4.1 Commercial drying.. Spaces c ontaining clothesdrying equipment, and end-uses for commercial laundry applications shall be provided with conduit that is continuous between a junction box located within 3 feet (914 mm) of the equipment and an electrical panel. The junction box, conduit and bus bar in the electrical panel shall be rated and sized to accommodate a branch circuit with sufficient capacity for an equivalent electric equipment with an equivalent equipment capacity. The electrical junction box and electrical panel shall have labels stating, "For Future Electric Clothes Drying Equipment."

CH103.1.4.2 Residential drying.. Spaces containing clothes drying equipment, appliances, and end-uses serving multiple dwelling units or sleeping areas with a capacity less than or equal to 9.2 cubic feet shall be provided with a dedicated 240-volt branch circuit with a minimum capacity of 30A and shall terminate within 6 feet (1829 mm) of fossil fuel clothes dryers and shall be in a location with ready access. Both ends of the branch circuit shall be labeled with the words "For Future Electric Clothes Drying Equipment" and be electrically isolated.

CH103.1.5 Onsite Transformers.. Enclosed spaces and underground vaults containing onsite electric transformers on the building side of the electric utility meter shall have sufficient space to accommodate transformers sized to serve the additional electric loads identified in CH103.1.1, CH103.1.2, CH103.1.3 and CH103.1.4.

CH103.2 Hydronic Heating Design Requirements.. For all hydronic space heating systems, the design entering water temperature for coils, radiant panels, radiant floor systems, radiators, baseboard heaters, and any other device that uses hot water to provide heat to a space shall be not more than 130°F (55°C).

CH103.3 Construction Documentation.. The construction documents shall provide details for additional electric infrastructure, including branch circuits, conduit, pre-wiring, panel capacity, and electrical service capacity, as well as interior and exterior spaces designated for future electric equipment.

Reason: In order for the U.S. to reach net zero carbon emissions, the country must not only reduce energy use through energy efficiency and move to utility scale and on-site renewable energy, but also begin to transition away from using combustion equipment in buildings that run on fossil fuels to electric equipment. In 2021, combustion equipment in commercial and residential buildings accounted for 35% of US greenhouse gas emissions.[1] The cost of installing electric-ready infrastructure when a building is under construction, walls are open, and the trades are already on-site, is small in comparison to the cost of retrofitting a building to install the same level of electric equipment. Having electric-ready infrastructure in place gives building owners or occupants the choice to shift to electric appliances at time of replacement or retrofit without incurring the costs and delays of retrofitting panels, opening walls to install conduit, etc. The residential 2024 IECC has included mandatory electric-ready requirements for water heating, cooktops and clothes drying into the public comment review draft #1.
The California Building Energy Efficiency Standards 2022 update (Title 24, Part 6) has also moved in this direction, including electric-ready requirements for heat pump space heating, cooktops and clothes drying in both single family homes and multifamily buildings, and for water heating in single family homes. The Chicago Energy Transformation Code has also included electric-ready requirements for residential single family and multifamily buildings in their energy code. Attached is a letter with others stating the support for this proposal from 50 organizations, 16 of which are from local or state governments and universities, 12 of which are from NGOs, and 22 of which are from design and construction industry. In addition to the letter of support, this proposal includes more than 30 coproponents.
Requiring buildings to be electric-ready will not only reduce costs for building owners who choose to electrify their building at a later date but it will also give building residents the option to improve their own health. Gas appliances release harmful pollutants like nitrogen dioxide (NO2) and carbon monoxide (CO) either indoors because of gas stoves or outdoors because of space-heating and water heating equipment. A recent study from the Harvard Chang School of Public Health and RMI shows that in Illinois in 2017, air pollution from burning fuels in buildings led to an estimated 1,123 early deaths and $12.574 billion in health impact costs.[2] These emissions can particularly affect children. In a metaanalysis analyzing the connections between gas stoves and childhood asthma, children in homes with gas stoves were 42% more likely to experience asthma symptoms, and 32% more likely to be diagnosed with asthma. [3] Therefore, ensuring all-electric appliances can be installed in our buildings in the future is critical to reducing air pollution, protecting public health, reducing utility and construction costs, and meeting climate goals.
NBI, ACEEE, and 2050 Partners on behalf of the California Investor Owned Utilities worked together to address many of the technical concerns raised when NBI's original proposal, CEPI-22, was discussed by the Commercial Consensus Committee in June of 2022. The main revisions to this proposal include:

1. Separating the original CEPI-22 proposal into three pieces, an electric-ready proposal, an allelectric appendix, and a requirement for more energy efficiency credits in buildings that do not primarily use heat pumps for space and water heating. Each piece stands alone with its own independent support, so each proposal can be discussed and voted on separately.
2. Requiring buildings with central water heating or space heating systems to have the electrical capacity but not conduit for a new system to ensure that unnecessary conduit is not placed in buildings that choose to install distributed and not central systems at a future date.
3. Clear electrical capacity requirements for electric-ready space and water heating based on occupancy type and climate zone to ensure that there is sufficient capacity to install efficient heat pumps for space heating and water heating without requiring full design and sizing of an

all-electric alternative to a fuel-based system (though that option remains for flexibility). 2050 Partners is conducting energy modeling to determine capacity requirements. This modeling is not yet complete but will be complete before this proposal is considered by the commercial consensus committee.
4. Clear capacity requirements for commercial cooking appliances based on research conducted by NBI on the minimum branch circuits needed for a variety of commercial cooking appliances.
5. Additional flexibility that allows designers to submit an alternate design for the electrical infrastructure needed for water and space heating that would allow the building to use no energy source other than electricity or on-site renewable energy in the future.
6. Restructuring of the proposal to make it easier to understand and enforce.

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

Recent analysis by NBI and partners using cost data from RSMeans for a medium office indicates that additional electrical infrastructure costs for water-heating and space-heating would cost a typical office building an additional $0.09 per square foot of conditioned floor area. [4] However, if a building owner were to have to retrofit their building from using combustion equipment to natural gas equipment costs without these requirements in place, costs could be exorbitant. California Energy Codes & Standards “2021 Reach Code Cost-Effectiveness Analysis: Non-Residential Alterations” report estimated labor costs for electrification retrofit of mechanical systems as a 25 to 50% increase from new construction labor cost due to building-specific considerations such as tight conditions, prepping surfaces, elevated work, material handling, specialty rigging, and protecting existing finishes that can vary building to building.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The proposal provides an optional Appendix for jurisdictions interested in requiring the installation of electrical infrastructure so that building owner’s would be able to cost effectively replace fossil fuel equipment with electric equipment at a future date.

Final Hearing Results

CECD1-28-22	AS

CECPI-1-21

Original Proposal

IECC®: SECTION 202 (New), C405.13 (New), C405.13.1 (New), Table C405.13.1 (New), C405.13.2 (New), C405.13.3 (New), C405.13.4 (New), C405.13.4.1 (New), C405.13.5 (New), C405.13.5.1 (New), C405.13.6 (New), UL Chapter 06 (New)
Proponents: Michael Jouaneh, Chair, IECC Commercial Electrical Power, Lighting, Renewables SC (ieccceelectrical@iccsafe.org)

2021 International Energy Conservation Code

Add new definition as follows:

AUTOMOBILE PARKING SPACE. A space within a building or private or public parking lot, exclusive of driveways, ramps, columns, office and work areas, for the parking of an automobile.

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and electric motorcycles, primarily powered by an electric motor that draws current from a building electrical service, EVSE, a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electic current.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). Equipment for plug-in power transfer including the ungrounded, grounded and equipment grounding conductors, and the *electric vehicle* connectors, attachment plugs, personal protection system and all other fittings, devices, power outlets or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the *electric vehicle*.

ELECTRIC VEHICLE SUPPLY EQUIPMENT INSTALLED SPACE (EVSE space). An *automobile parking space* that is provided with a dedicated *EVSE* connection.

ELECTRIC VEHICLE CAPABLE SPACE (EV CAPABLE SPACE). A designated *automobile parking space* that is provided with electrical infrastructure, such as, but not limited to, raceways, cables, electrical capacity, and panelboard or other electrical distribution equipment space, necessary for the future installation of an *EVSE*.

ELECTRIC VEHICLE READY SPACE (EV READY SPACE). An *automobile parking space* that is provided with a branch circuit and either an outlet, junction box or receptacle, that will support an installed *EVSE*.

Add new text as follows:

C405.13 Electric Vehicle Power Transfer Infrastructure. New parking facilities shall be provided with *electric vehicle* power transfer infrastructure in compliance with Sections C405.13.1 through C405.13.6.

C405.13.1 Quantity. The number of required *EV spaces*, *EV capable spaces* and *EV ready spaces* shall be determined in accordance with this Section and Table C405.13.1 based on the total number of *automobile parking spaces* and shall be rounded up to the nearest whole number. For R-2 buildings, the Table requirements shall be based on the total number of dwelling units or the total number of automobile parking spaces, whichever is less.

1. Where more than one parking facility is provided on a building site, the number of required *automobile parking spaces* required to have *EV* power transfer infrastructure shall be calculated separately for each parking facility.
2. Where one shared parking facility serves multiple building occupancies, the required number of spaces shall be determined proportionally based on the floor area of each building occupancy.
3. Installed *EVSE* spaces that exceed the minimum requirements of this section may be used to meet minimum requirements for *EV ready spaces* and *EV capable spaces*.
4. Installed *EV ready spaces* that exceed the minimum requirements of this section may be used to meet minimum requirements for *EV capable spaces*.

5. Where the number of *EV ready spaces* allocated for R-2 occupancies is equal to the number of dwelling units or to the number of *automobile parking spaces* allocated to R-2 occupancies, whichever is less, requirements for *EVSE spaces* for R-2 occupancies shall not apply.
6. Requirements for a Group S-2 parking garage shall be determined by the occupancies served by that parking garage. Where new automobile spaces do not serve specific occupancies, the values for Group S-2 parking garage in Table C405.13.1 shall be used.

Exception: Parking facilities, serving occupancies other than R2 with fewer than 10 automobile parking spaces.

Table C405.13.1 REQUIRED EV POWER TRANSFER INFRASTRUCTURE

OCCUPANCY	EVSE SPACES	EV READY SPACES	EV CAPABLE SPACES
GROUP A	10%	0%	10%
GROUP B	15%	0%	30%
GROUP E	2%	0%	5%
GROUP F	2%	0%	5%
GROUP H	1%	0%	0%
GROUP I	2%	0%	5%
GROUP M	10%	0%	10%
GROUP R-1	20%	5%	75%
GROUP R-2	20%	5%	75%
GROUP R-3 AND R-4	2%	0%	5%
GROUP S exclusive of parking garages	1%	0%	0%
GROUP S-2 parking garages	1%	0%	0%

C405.13.2 EV Capable Spaces. Each *EV capable space* used to meet the requirements of Section C405.13.1 shall comply with all of the following:

1. A continuous raceway or cable assembly shall be installed between an enclosure or outlet located within 3 feet (914 mm) of the *EV capable space* and a suitable panelboard or other onsite electrical distribution equipment.
2. Installed raceway or cable assembly shall be sized and rated to supply an minimum circuit capactiy in accordance with C405.13.5
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have sufficient dedicated space and spare electrical capacity for a 2-pole circuit breaker or set of fuses.
4. The electrical enclosure or outlet and the electrical distribution equipment directory shall be marked: "For future *electric vehicle supply equipment* (EVSE)."
5. Reserved capacity shall be no less than 4.1 kVA (20A 208/240V) for each *EV capable space*.

C405.13.3 EV Ready Spaces. Each branch circuit serving EV ready spaces used to meet the requirements of Section C405.13.1 shall comply with all of the following:

1. Terminate at an outlet or enclosure, located within 3 feet (914 mm) of each *EV ready space* it serves.
2. Have a minimum circuit capacity in accordance with C405.13.5.
3. The panelboard or other electrical distribution equipment directory shall designate the brach circuit as "For electric vehicle supply equipment (EVSE)" and the outlet or enclosure shall be marked "For electric vehicle supply equipment (EVSE)."

C405.13.4 EVSE Spaces. An installed *EVSE* with multiple output connections shall be permitted to serve multiple *EVSE spaces*. Each *EVSE* installed to meet the requirements of Section C405.13.1, serving either a single *EVSE space* or multiple *EVSE spaces*, shall comply with all of the following:

1. Have a minimum circuit capacity in accordance with C405.13.5.
2. Have a minimum charging rate in accordance with C405.13.4.1.
3. Be located within 3 feet (914 mm) of each *EVSE space* it serves.
4. Be installed in accordance with Section C405.13.6.

C405.13.4.1 EVSE Minimum Charging Rate. Each installed EVSE shall comply with one of the following:

1. Be capable of charging at a minimum rate of 6.2 kVA (or 30A at 208/240V).
2. When serving multiple *EVSE spaces* and controlled by an energy management system providing load management, be capable of simultaneously charing each *EVSE space* at a minimum rate of no less than 3.3 kVA.
3. When serving *EVSE spaces* allowed to have a minimum circuit capacity of 2.7 kVA in accordance with C405.13.5.1 and controlled by an energy management system providing load management, be capable of simultaneously charging each *ESVE space* at a minimum rate of no less than 2.1 kVA.

C405.13.5 Circuit Capacity. The capacity of electrical infrastructure serving each *EV capable space*, *EV ready space*, and *EVSE space* shall comply with one of the following:

1. A branch circuit shall have a rated capacity not less than 8.3 kVA (or 40A at 208/240V) for each *EV ready space* or *EVSE space* it serves.
2. The requirements of C405.13.5.1.

C405.13.5.1 Circuit Capacity Management. The capacity of each branch circuit serving multiple EVSE spaces, EV ready spaces or EV capable spaces designed to be controlled by an energy management system providing load management in accordance with NFPA 70, shall comply with one of the following:

1. Have a minimum capacity of 4.1 kVA per space.
2. Have a minimum capacity of 2.7 kVA per space when serving *EV ready spaces* or *EVSE space* for R-2 occupancies when all (100%) of the automobile parking spaces designated for R-2 occupancies are designed to be *EV ready spaces* or *EVSE spaces*.
3. Have a minimum capacity of 2.7 kVA per space when serving *EV ready spaces* or *EVSE spaces* for a building site when all (100%) of the automobile parking spaces are designed to be *EV ready* or *EVSE spaces*.

C405.13.6 EVSE Installation. *EVSE* shall be installed in accordance with NFPA 70 and shall be listed and labeled in accordance with UL 2202 or UL 2594. *EVSE* shall be accessible in accordance with International Building Code Section 1107.

Add new standard(s) as follows:

UL

UL LLC
333 Pfingsten Road
Northbrook, IL 60062

UL 2202-2009	*Electric Vehicle (EV) Charging System- with revisions through February 2018*
UL 2594-2016	*Standard for Electric Vehicle Supply Equipment*

Reason: Consensus proposal combines four EV proposals provided this cycle and will improve the effective use of energy supplied to a building by providing electrical connections for automobile spaces

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

The code change proposal will increase the cost of construction

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: based on reason statement by subcommittee

Final Hearing Results

CECPI-1-21	AS

CECPI-2-21

Original Proposal

IECC®: C103.2, SECTION 202 (New), C405.1, C405.13 (New), C405.13.1 (New), C405.13.2 (New), C405.13.2.1 (New), C405.13.2.2 (New), C405.13.3 (New), C405.13.4 (New), C406.5.1, C406.5.2, TABLE C407.4.1(1), C502.3.7 (New), Green-e (New), (New)

Proponents: Michael Jouaneh, Chair, IECC Commercial Electrical Power, Lighting, Renewables SC (ieccceelectrical@iccsafe.org)

2021 International Energy Conservation Code

Revise as follows:

C103.2 Information on construction documents. Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted where *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

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

Add new definition as follows:

COMMUNITY RENEWABLE ENERGY FACILITY. A facility that produces energy harvested from *renewable energy resources* and is qualified as a community energy facility under applicable jurisdictional statutes and rules.

FINANCIAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT. A financial arrangement between a renewable electricty generator and a purchaser wherein the purchaser pays or guarantees a price to the generator for the project's renewable generation. Also known as a "financial power purchase agreement" and "virtual power purchase agreement."

PHYSICAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT. A contract for the purchase of renewable electricity from a specific renewable electricity generator to a purchaser of renewable electricity.

RENEWABLE ENERGY CERTIFICATE (REC). A market-based instrument that represents and conveys the environmental, social, and other non-power attributes of one megawatt hour of renewable electricity generation and could be sold separately from the underlying physical electricity associated with *renewable energy resources*, also known as "energy attribute" and "energy attribute certificate" (EAC).

Revise as follows:

C405.1 General. Lighting system controls, the maximum lighting power for interior and exterior applications, and electrical energy consumption and generation shall comply with this section. *Sleeping units* shall comply with Section C405.2.5 and with either Section C405.1.1 or C405.3. *General lighting* shall consist of all lighting included when calculating the total connected interior lighting power in accordance with Section C405.3.1 and which does not require specific application controls in accordance with Section C405.2.5.Transformers, uninterruptable power supplies, motors and electrical power processing equipment in data center systems shall comply with Section 8 of ASHRAE 90.4 in addition to this code.

Add new text as follows:

C405.13 Renewable energy systems. *Buildings* in *Climate Zones* 0-7 shall comply with C405.13.1 through C405.13.4.

C405.13.1 On-site renewable energy systems. *Buildings* shall install equipment for on-site renewable electricity generation with a direct current (DC) nameplate power rating of not less than 0.75 W/ft^2 (8.1 W/m^2) multiplied by the sum of the gross conditioned floor area of all floors not to exceed the combined gross conditioned floor area of the three largest floors.

Exception: The following *buildings* or *building sites* shall comply with Section C405.13.2:

1. A *building site* located where an unshaded flat plate collector oriented toward the equator and tilted at an angle from horizontal equal to the latitude receives an annual daily average incident solar radiation less than 1.1 kBtu/ft^2 - day (3.5 kWh/m^2 - day).
2. A *building* where more than 80 percent of the roof area is covered by any combination of permanent obstructions such as, but not limited to, mechanical equipment, vegetated space, access, pathways, or occupied roof terrace.
3. Any *building* where more than 50 percent of the roof area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the buildng for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.
4. A *building* with gross conditioned floor area less than 5,000 square feet (465 m^2).

C405.13.2 Off-site renewable energy. *Buildings* that qualify for one or more of the exceptions to Section 405.13.1 and do not meet the requirements of Section 405.13.1 either in part or in full, with an *on-site renewable energy system*, shall procure off-site renewable electrical energy, in accordance with C405.13.2.1 and C405.13.2.2, that shall not be less than the total off-site renewable electrical energy determined in accordance with Equation 4-12.

$TRE_{off} = (REN_{off} * 0.75\ W/ft^2 * FLRA - IRE_{on})$ **(Equation 4-12)**
*15

where:TRE_{off} = Total off-site renewable electrical energy in kilowatt-hours (kWh) to be procured in accordance with Table

C405.13.2REN_{off} = Annual off-site renewable electrical energy from Table C405.13.2, in units of kilowatt-hours per watt of array capacityFLRA = the sum of the gross conditioned floor area of all floors not to exceed the combined floor area of the three largest floorsIRE_{on} = Annual *on-site* renewable electrical energy generation of a new *on-site renewable energy system*, to be installed as part of the *building* project, whose rated capacity is less than the rated capacity required in Section C405.13.1

Table C405.13.2 Annual Off-site Renewable Energy Requirement

Climate Zone	Annual Off-site Renewable Electrical Energy (kWh/W)
1A, 2B, 3B, 3C, 4B, and 5B	1.75 kWh/W
0A, 0B, 1B, 2A, 3A, and 6B	1.55 kWh/W
4A, 4C, 5A, 5C, 6A, and 7	1.35 kWh/W

C405.13.2.1 Off-site procurement. The building owner as defined in the *International Building Code* shall procure and be credited for the total amount of off-site renewable electrical energy, not less than required in accordance with Equation 4-12, with one or more of the following:

1. A *physical renewable energy power purchase agreement*
2. A *financial renewable energy power purchase agreement*
3. A *community renewable energy facility*
4. Off-site renewable energy system owned by the building property owner

C405.13.2.2 Off-site contract. The renewable energy shall be delivered or credited to the *building site* under an energy contract with a duration of not less than 10 years. The contract shall be structured to survive a partial or full transfer of ownership of the building property. The total required off-site renewable electrical energy shall be procured in equal installments over the duration of the off-site contract.

C405.13.3 Renewable energy certificate documentation. The property owner or owner's authorized agent shall demonstrate that where RECs or EACs are associated with on-site and off-site renewable energy production required by Sections C405.13.1 and C405.13.2 all of the following criteria for RECs and EACs shall be met:

1. Are retained and retired by or on behalf of the property owner or tenant for a period of not less than 15 years or the duration of the contract in C405.13.2.2 whichever is less;
2. Are created within a 12-month period of the use of the REC; and
3. Are from a generating asset constructed no more than 5 years before the issuance of the certificate of occupancy.

C405.13.4 Renewable energy certificate purchase. A *building* that qualifies for one or more of the exceptions to Section C405.13.1 and where it can be demonstrated to the code official that the requirements of Section C405.13.2 cannot be met, the building owner shall contract for renewable electricity products complying with the Green-e Energy National Standard for Renewable Electricity products equivalent to five times the amount of total off-site renewable energy calculated in accordance with Equation 4-12.

Revise as follows:

C406.5.1 Basic renewable credit. The total minimum ratings of on-site renewable energy systems, not including systems used for credits under Sections C406.7.2 or installed systems used for compliance with Section C405.13.1, shall be one of the following:

1. Not less than 0.86 Btu/h per square foot (2.7 W/m^2) or 0.25 watts per square foot (2.7 W/m^2) of *conditioned floor area*.
2. Not less than 2 percent of the annual energy used within the building for building mechanical and service water-heating equipment and lighting regulated in Section C405.

C406.5.2 Enhanced renewable credit. Where the total minimum ratings of on-site renewable energy systems exceeds the rating in Section C406.5.1, additional energy efficiency credits shall be determined based on Equation 4-14, rounded to the nearest whole number.

$$AEEC_{RRa} = AEEC_{2.5} \times (RR_a - RR_{REQ} - RR_{WH}) / RR_1$$ **(Equation 4-14)**

where:

$AEEC_{RRa}$ = Section C406.5.2 additional energy efficiency credits.
$AEEC_{2.5}$ = Section C406.5 credits from Tables C406.1(1) through C406.1(5).
RRa = Actual total minimum ratings of *on-site renewable energy* systems (in Btu/h, watts per square foot or W/m^2).

RR_1 = Minimum ratings of *on-site renewable energy* systems required by Section C406.5.1 (in Btu/h, watts per square foot or W/m^2).
RR_{REW} = Minimum rating of installed on-site renewable energy systems required by Section C405.13 (in BTU/h, watts per square foot or W/m^2).
RR_{WH} = Minimum rating of installed on-site renewable energy systems used for credits under Section C406.7.2.

TABLE C407.4.1(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 C405.3.2(1) or C405.3.2(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: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed
Walls, below-grade	Type: mass wall	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: as specified in Table C402.1.4 with insulation layer on interior side of walls	As proposed
Floors, above-grade	Type: joist/framed floor	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Floors, slab-on-grade	Type: unheated	As proposed
	F-factor: as specified in Table C402.1.4	As proposed
Opaque doors	Type: swinging	As proposed
	Area: Same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Vertical fenestration other than opaque doors	Area 1. The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 40 percent of above-grade wall area. 2. 40 percent of above-grade wall area; where the proposed vertical fenestration area is 40 percent or more of the above-grade wall area.	As proposed
	U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	External shading and PF: none	As proposed
Skylights	Area 1. The proposed skylight area; where the proposed skylight area is less than that permitted by Section C402.1. 2. The area permitted by Section C402.1; where the proposed skylight area exceeds that permitted by Section C402.1.	As proposed
	U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.3.2. Where the occupancy of the building is not known, the lighting power density shall be 1.0 watt per square foot 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 Tables C405.5.2(1), C405.5.2(2) and C405.5.2(3). Areas and dimensions of surfaces shall be the same as proposed.	As proposed
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. End-use load components within and associated with the building shall be modeled to include, but not be limited to, the following: exhaust fans, parking garage ventilation fans, exterior building lighting, swimming pool heaters and pumps, elevators, escalators, refrigeration equipment and cooking equipment.
Schedules	Same as proposed **Exception:** Thermostat settings and schedules for HVAC systems that utilize radiant heating, radiant cooling and elevated air speed, provided that equivalent levels of occupant thermal comfort are demonstrated by means of equal Standard Effective Temperature as calculated in Normative Appendix B of ASHRAE Standard 55.	Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays and any seasonal operation. Schedules shall model the time-dependent variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads. The schedules shall be typical of the proposed building type as determined by the designer and approved by the jurisdiction.
Mechanical ventilation	Same as proposed	As proposed, in accordance with Section C403.2.2.
Heating systems	Fuel type: same as proposed design	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	Equipment type[a]: as specified in Tables C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in the tables in Section C403.3.2.	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 C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in Tables C403.3.2(1), C403.3.2(2) and C403.3.2(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 C403.5.	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.	
On-site Renewable Energy	Where a *system* providing *on-site renewable energy* has been modeled in the *proposed design* the same system shall be modeled identically in the *standard reference design* except the rated capacity shall meet the requirements of Section C405.13.1 Where no system is designed or included in the proposed design, model an unshaded photovoltaic system with the following characteristics: **Size**: Rated capacity per Section C405.13.1 **Module Type**: Crystalline Silicone Panel with glass cover, 19.1% nominal efficiency and temperature coefficient of -0.35%/°C, Performance shall be based on a reference temperature of 77°F (25°C), airmass of 1.5 atmosphere and irradiance of 317 Btu/h x ft^2 (1000 W/m^2). **Array Type**: Rack mounted array with installed nominal operating cell temperature (INOCT) of 103°F (45°C). **Total System Losses** (DC output to AC output): 11.3%. **Tilt**: 0-degrees (mounted horizontally). **Azimuth**: 180 degrees.	As proposed

For SI: 1 watt per square foot = 10.7 w/m^2.

SWHF = Service Water Heat Recovery Factor, DWHR = Drain Water Heat Recovery.

a. Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.

b. The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.

c. Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.

d. If an economizer is required in accordance with Table C403.5(1) and where no economizer exists or is specified in the proposed design, then a supply-air economizer shall be provided in the standard reference design in accordance with Section C403.5.

e. The SWHF shall be applied as follows:

1. Where potable water from the DWHR unit supplies not less than one shower and not greater than two showers, of which the drain water from the same showers flows through the DWHR unit then SWHF = [1 **–** (DWHR 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.

Add new text as follows:

<u>**C502.3.7 Renewable energy systems.**</u> <u>Additions shall comply with Section C405.13 for the addition alone</u>.

<u>**Green-e**</u>**.** <u>Version 1.0, July 7, 2017Green-e Energy National Standard for Renewable Electricity Products</u>

Reason: This proposal adds on-site renewables to the IECC for reduced consumer cost and societal protection

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

The code change proposal will increase the cost of construction

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal adds on-site renewables to the IECC for reduced consumer cost and societal protection

Final Hearing Results

CECPI-2-21	AS

CECPI-3-21

Original Proposal

IECC®: C402.5.5, C402.5, C402.5.1, C402.5.1.1 (New), C402.5.1.1, C402.5.10, C402.5.1.2.2 (New), C402.5.1.2.2.1 (New), C402.5.1.2, C402.5.3, C402.5.2, C402.5.1.5, C402.5.1.3, C402.5.1.4, C402.5.4, TABLE C402.5.4, C402.5.6, C402.5.7, C402.5.9, C402.5.8, C402.5.11, C402.5.11.1, C406.9

Proponents: Tom Culp, IECC Commercial Envelope and Embodied Energy Subcommittee (ieccceenvelope@iccsafe.org)

2021 International Energy Conservation Code

Revise as follows:

~~C402.5.5~~ C402.1.3 Rooms containing fuel-burning appliances. In *Climate Zones* 3 through 8, where combustion air is supplied through openings in an exterior wall to a room or space containing a space-conditioning fuel-burning appliance, one of the following shall apply:

1. The room or space containing the appliance shall be located outside of the *building thermal envelope*.
2. The room or space containing the appliance shall be enclosed and isolated from conditioned spaces inside the *building thermal envelope*. Such rooms shall comply with all of the following:
   2.1. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be insulated to be not less than equivalent to the insulation requirement of below-grade walls as specified in Table C402.1.3 or Table C402.1.4.
   2.2. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be sealed in accordance with Section ~~C402.5.1.1~~ C402.5.1.2.
   2.3. The doors into the enclosed room or space shall be shall be fully gasketed.
   2.4. ~~Water lines and~~ Piping serving as part of a heating or cooling system and ducts in the enclosed room or space shall be insulated in accordance with Section C403. Service water piping shall be insulated in accordance with Section C404.
   2.5. Where an air duct supplying combustion air to the enclosed room or space passes through *conditioned space*, the duct shall be insulated to an *R*-value of not less than R-8.

Exception: Fireplaces and stoves complying with Sections 901 through 905 of the International Mechanical Code, and Section 2111.14 of the International Building Code.

C402.5 Air leakage—thermal envelope. The *building thermal envelope* shall comply with Sections C402.5.1 through Section C402.5.8.1 ~~C402.5.11.1, or the building *thermal envelope* shall be tested in accordance with Section C402.5.2 or C402.5.3. Where compliance is based on such testing, the building shall also comply with Sections C402.5.7, C402.5.8 and C402.5.9.~~

C402.5.1 Air barriers. A continuous air barrier shall be provided throughout the *building thermal envelope*. The ~~continuous air barriers shall be located on the inside or outside of the building thermal envelope, located within the assemblies composing the building thermal envelope, or any combination thereof. The air barrier shall comply with Sections C402.5.1.1, and C402.5.1.2.~~ *air barrier* is permitted to be any combination of inside, outside, or within the building thermal envelope. The *air barrier* shall comply with Sections C402.5.1.1, and C402.5.1.2. The *air leakage* performance of the *air barrier* shall be verified in accordance with Section C402.5.2.

Exception: *Air barriers* are not required in buildings located in *Climate Zone* 2B.

Add new text as follows:

C402.5.1.1 Air barrier design and documentation requirements. Design of the continuous *air barrier* shall be documented in the following manner:

1. Components comprising the continuous *air barrier* and their position within each *building thermal envelope* assembly shall be identified.
2. Joints, interconnections, and penetrations of the continuous *air barrier* components shall be detailed.
3. The continuity of the *air barrier* building element assemblies that enclose conditioned space or provide a boundary between conditioned space and unconditioned space shall be identified.
4. Documentation of the continuous air barrier shall detail methods of sealing the air barrier such as wrapping, caulking, gasketing, taping or other *approved* methods at the following locations:
   - 4.1 Joints around fenestration and door frames.
   - 4.2 Joints between walls and floors, between walls at building corners, between walls and roofs including parapets and copings, where above-grade walls meet foundations, and similar intersections.
   - 4.3 Penetrations or attachments through the continuous *air barrier* in building envelope roofs, walls, and floors.
   - 4.4 Building assemblies used as ducts or plenums.
   - 4.5 Changes in continuous *air barrier* materials and assemblies.
5. Identify where testing will or will not be performed in accordance with Section C402.5.2 Where testing will not be performed, a plan for field inspections required by C402.5.2.3 shall be provided that includes the following:
   - 5.1 Schedule for periodic inspection,
   - 5.2 Continuous air barrier scope of work,
   - 5.3 List of critical inspection items,
   - 5.4 Inspection documentation requirements, and
   - 5.5 Provisions for corrective actions where needed.

Revise as follows:

~~C402.5.1.1~~C402.5.1.2 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~~ compromise the *building 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 differentials such as those from design wind loads, stack effect and mechanical ventilation.
3. Penetrations of the *air barrier* shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Sealing shall allow for expansion, contraction and mechanical vibration. 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. ~~Joints and seams associated with penetrations shall be sealed in the same manner or taped. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.~~ Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommended by the fire sprinkler 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 ~~C402.5.10~~ C402.5.1.2.1. Where similar objects are installed that penetrate the *air barrier*, provisions shall be made to maintain the integrity of the *air barrier*.
5. Electrical and communication boxes shall comply with C402.5.1.2.2.

~~C402.5.10~~C402.5.2.1 Recessed lighting. Recessed luminaires installed in the *building thermal envelope* shall be all of the following:

1. IC-rated.
2. Labeled as having an air leakage rate of not ~~more~~ greater than 2.0 cfm (0.944 L/s) ~~when~~ where tested in accordance with ASTM E283 at a 1.57 psf (75 Pa) pressure differential.
3. Sealed with a gasket or caulk between the housing and interior wall or ceiling covering.

Add new text as follows:

C402.5.1.2.2 Electrical and communication boxes. Electrical and communication boxes that penetrate the air barrier of the *building thermal envelope*, and that do not comply with C402.5.1.2.2.1, shall be caulked, taped, gasketed, or otherwise sealed to the air barrier element being penetrated. All openings on the concealed portion of the box shall be sealed. Where present, insulation shall rest against all concealed portions of the box.

C402.5.1.2.2.1 Air-sealed boxes. Where air-sealed boxes are installed, they shall be marked in accordance with NEMA OS 4. Air-sealed boxes shall be installed in accordance with the manufacturer's instructions.

Revise as follows:

C402.5.1.2 Air leakage compliance. ~~A continuous air barrier for the opaque building envelope shall comply with the following~~:Air leakage of the *building thermal envelope* shall be tested by an *approved* third party in accordance with C402.5.2.1. The measured air leakage shall not be greater than 0.35 cfm/ft^2 (1.8 L/s x m^2) of the *building thermal envelope* area at a pressure differential of 0.3 inch water gauge (75 Pa) with the calculated *building thermal envelope* surface area being the sum of the above- and below-grade *building thermal envelope*.

Exceptions:

1. Where the measured *air leakage* rate is greater than 0.35 cfm/ft^2 (1.8 L/s x m^2) but is not greater than 0.45 cfm/ft2 (2.3 L/s x m^2), the *approved* third party shall perform a diagnostic evaluation using smoke tracer or infrared imaging. The evaluation shall be conducted while the building is pressurized along with a visual inspection of the *air barrier* in accordance with ASTM E1186. All identified leaks shall be sealed where such sealing can be made without damaging existing building components. A report specifying the corrective actions taken to seal leaks shall be deemed to establish compliance with the requirements of this section where submitted to the code official and the building owner. Where the measured *air leakage* rate is greater than 0.45 cfm/ft^2 (2.3 L/s x m^2), corrective actions must be made to the building and an additional test completed for which the results are 0.45 cfm/ft^2 (2.3 L/s x m^2), or less.
2. Buildings in Climate Zones 2B.
3. Buildings larger than 25,000 square feet (2300 m^2) floor area in Climate Zones 0 through 4, other than Group R and I occupancies, that comply with C402.5.2.3
4. As an alternative, buildings or portions of building, containing Group R and I occupancies, shall be permitted to be tested by an *approved* third party in accordance with C402.5.2.2. The reported *air leakage* of the *building thermal envelope* shall not be greater than 0.27 cfm/ft^2 (1.4 L/s x m^2) of the *testing unit enclosure* area at a pressure differential of 0.2 inch water gauge (50 Pa).

~~1. Buildings or portions of buildings, including Group R and I occupancies, shall meet the provisions of Section C402.5.2.~~

~~**Exception:** Buildings in Climate Zones 2B, 3C and 5C.~~

~~2. Buildings or portions of buildings other than Group R and I occupancies shall meet the provisions of Section C402.5.3.~~

~~**Exceptions:**~~

~~1. Buildings in Climate Zones 2B, 3B, 3C and 5C.~~

~~2. Buildings larger than 5,000 square feet (464.5 m^2) floor area in Climate Zones 0B, 1, 2A, 4B and 4C.~~

~~3. Buildings between 5,000 square feet (464.5 m^2) and 50,000 square feet (4645 m^2) floor area in Climate Zones 0A, 3A and 5B.~~

3. ~~Buildings or portions of buildings that do not complete air barrier testing shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5.~~

~~C402.5.3~~C402.5.2.1 ~~Building thermal envelope testing~~ Whole building test method and reporting. The *building thermal envelope* shall be tested for *air leakage* in accordance with ~~ASTM E779, ANSI/RESNET/ICC 380,~~ ASTM E3158 ~~or ASTM E1827~~ or an equivalent *approved* method ~~approved by the code official~~. ~~The measured air leakage shall not exceed 0.40 cfm/ft^2 (2.0 L/s × m^2) of the *building thermal envelope* area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, portions of the building shall be tested and the measured air leakages shall be area weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be tested:~~ 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.

1. ~~The entire envelope area of all stories that have any spaces directly under a roof.~~
2. ~~The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.~~
3. ~~Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space.~~

Exceptions: ~~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 infrared imaging shall be conducted while the building is pressurized along with a visual inspection of the air barrier. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section.~~

1. For buildings less than 10,000 ft^2 (1000 m^2) the entire *building thermal envelope* shall be permitted to be tested in accordance with ASTM E779, ASTM E3158, or ASTM E1827 or an equivalent *approved* method.
2. For buildings greater than 50,000 ft^2 (4645 m^2), portions of the building shall be permitted to be tested and the measured *air leakage* shall be area-weighted by the surface areas of the *building thermal envelope* in each portion. The weighted average tested *air leakage* shall not be greater than the whole building leakage limit. The following portions of the building shall be tested:
   - 2.1. The entire *building thermal envelope* area of stories that have any conditioned spaces directly under a roof.
   - 2.2 The entire *building thermal envelope* area of stories that have a building entrance, a floor over unconditioned space, a loading dock, or that are below grade.
   - 2.3 Representative above-grade portions of the building totaling not less than 25 percent of the wall area enclosing the remaining conditioned space.

C402.5.2.2 Dwelling and sleeping unit enclosure testi~~ng~~ method and reporting. The *building thermal envelope* shall be tested for *air leakage* in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent *approved* method ~~approved by the *code official*. The measured air leakage shall not exceed 0.30 cfm/ft^2 (1.5 L/s × m^2) of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa).~~ Where multiple dwelling units or sleeping units or other occupiable conditioned spaces are contained within one *building thermal envelope*, each unit shall be considered an individual testing unit, and the building air leakage shall be the weighted average of all testing unit results, weighted by each *testing unit's enclosure area*. Units shall be tested ~~separately with an unguarded blower door test as follows:~~ without simultaneously pressuring adjacent units and shall be separately tested as follows:

1. Where buildings have ~~fewer~~ less than eight testing units, each testing unit shall be tested.
2. ~~For~~ Where buildings ~~with~~ have eight or more testing units, the greater of seven units or 20 percent of the testing units in the building shall be tested, including a top floor unit, a middle floor unit, a ground floor unit and a unit with the largest testing *unit enclosure area*. For each tested unit that exceeds the maximum *air leakage* rate, an additional ~~two~~ three units shall be tested, including a mixture of testing unit types and locations.

~~C402.5.1.5~~C402.5.2.3 Building envelope design and construction ~~performance~~ verification criteria. Where Sections C402.5.2.1 and

C402.5.2.2 are not applicable, ~~T~~the installation of the continuous *air barrier* shall be verified by the *code official*, a *registered design professional* or *approved* agency in accordance with the following:

1. A review of the construction documents and other supporting data shall be conducted to assess compliance with the requirements in Section C402.5.1.
2. Inspection of continuous air barrier components and assemblies shall be conducted during construction~~while the air barrier is still accessible for inspection and repair~~ to verify compliance with the requirements of Sections ~~C402.5.1.3~~ C402.5.2.3.1 ~~and~~ or ~~C402.5.1.4.~~ C502.5.2.3.2. The *air barrier* shall remain accessible for inspection and repair.
3. A final ~~commissioning~~ inspection report shall be provided for inspections completed by the *registered design professional* or *approved* agency. The ~~commissioning~~ inspection report shall be provided to the building owner or owner's authorized agent and the *code official*. The report shall identify deficiencies found during inspection ~~the review of the construction documents and inspection~~ and details of corrective measures taken.

~~C402.5.1.3~~C402.5.2.3.1 Materials. Materials with an air permeability not greater than 0.004 cfm/ft^2 (0.02 L/s × m^2) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E2178 shall comply with this section. Materials in Items 1 through 16 below shall be deemed to comply with this section, provided that joints are sealed and materials are installed as air barriers in accordance with the manufacturer's instructions.

1. Plywood with a thickness of not less than $^3/_8$ 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 having a minimum density of 1.5 pcf (2.4 kg/m^3) and 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. 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.

~~C402.5.1.4~~C402.5.2.3.2 Assemblies. Assemblies of materials and components with an average *air leakage* not greater than 0.04 cfm/ft^2 (0.2 L/s × m^2) under a pressure differential of 0.3 inch of water gauge~~(w.g.)~~(75 Pa) ~~when~~ where tested in accordance with ASTM E2357, ASTM E1677 , ASTM D8052 or ASTM E283 shall comply with this section. Assemblies listed in Items 1 through 3 below shall be deemed to comply, provided that joints are sealed and the requirements of Section C402.5.1.1 are met.

1. Concrete masonry walls coated with either one application of block filler or two applications of a paint or sealer coating.
2. Masonry walls constructed of clay or shale masonry units with a nominal width~~of~~ greater than or equal to 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.

~~C402.5.4~~C402.5.3 Air leakage of fenestration. The *air leakage* of fenestration assemblies shall ~~meet~~ comply with ~~the provisions of~~ Table ~~C402.5.4~~C402.5.3. Testing shall be conducted ~~in accordance with the applicable reference test standard in Table C402.5.4~~by an accredited, independent testing laboratory in accordance with applicable reference test standad in Table C402.5.3and *labeled* by the manufacturer.

Exceptions:

1. Field-fabricated fenestration assemblies that are sealed in accordance with Section C402.5.12. .
2. Fenestration in buildings that ~~comply with the testing alternative of~~ are tested for air leakage in accordance withSection C402.5.2 are not required to meet the air leakage requirements in Table ~~C402.5.4~~ C402.5.3.

TABLE ~~C402.5.4~~C402.5.3 MAXIMUM AIR LEAKAGE RATE FOR FENESTRATION ASSEMBLIES

FENESTRATION ASSEMBLY	MAXIMUM RATE (CFM/FT^2)	TEST PROCEDURE
Windows	0.20[a]	AAMA/WDMA/CSA101/I.S.2/A440 or NFRC 400
Sliding doors	0.20[a]	
Swinging doors	0.20[a]	
Skylights–with condensation weepage openings	0.30	
Skylights–all other	0.20[a]	
Curtain walls	0.06	NFRC 400 or ASTM E283 at 1.57 psf (75 Pa)
Storefront glazing	0.06	
Commercial glazed swinging entrance doors	1.00	
Power-operated sliding doors and power operated folding doors	1.00	
Revolving doors	1.00	
Garage doors	0.40	ANSI/DASMA 105, NFRC 400, or ASTM E283 at 1.57 psf (75 Pa)
Rolling doors	1.00	
High-speed doors	1.30	

For SI: 1 cubic foot per minute = 0.47 L/s, 1 square foot = 0.093 m^2.

a. The maximum rate for windows, sliding and swinging doors, and skylights is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with AAMA/WDMA/CSA101/I.S.2/A440 at 6.24 psf (300 Pa).

~~C402.5.6~~C402.5.4 Doors and access openings to shafts, chutes, stairways and elevator lobbies. Doors and *access* openings from conditioned space to shafts, chutes stairways and elevator lobbies not within the scope of the fenestration assemblies covered by Section ~~C402.5.4~~C402.5.3 shall be gasketed, weather-stripped or sealed.

Exceptions:

1. Door openings required to comply with Section 716 of the*International Building Code*.
2. Doors and door openings required ~~to comply with UL 1784~~ by the *International Building Code* to comply with UL 1784.

~~C402.5.7~~C402.5.5 Air intakes, exhaust openings, stairways and shafts. Stairway enclosures, elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be provided with dampers in accordance with Section C403.7.7.

~~C402.5.9~~C402.5.6 Vestibules. Building entrances shall be protected with an enclosed vestibule~~,~~. ~~with all d~~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 through 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.

~~C402.5.8~~C402.5.7 Loading dock weather seals. Cargo door openings and loading door openings shall be equipped with weather seals that restrict ~~infiltration~~ air leakage and provide direct contact along the top and sides of vehicles that are parked in the doorway.

~~C402.5.11~~C402.5.8 Operable openings interlocking. Where occupancies utilize operable openings to the outdoors that are larger than 40 square feet (3.7 m^2) in area, such openings shall be interlocked with the heating and cooling system~~so as~~ to raise the cooling setpoint to 90°F (32°C) and lower the heating setpoint to 55°F (13°C) whenever the operable opening is open. The change in heating and cooling setpoints shall occur ~~within 10 minutes of opening the operable opening~~.when the operable opening has been open for a period not to exceed 10 minutes.

Exceptions:

1. Operable openings into s ~~S~~eparately zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy.
2. Storage occupancies ~~Warehouses~~ that utilize overhead doors for the function of the occupancy, where *approved* ~~by the code official~~.
3. ~~The first entrance d~~ Doors ~~where~~ located in the exterior wall ~~and~~ that are part of a vestibule system.

~~C402.5.11.1~~C402.5.8.1 Operable controls. Controls shall comply with Section C403.14~~3~~.

C406.9 Reduced air ~~infiltration~~leakage. *Air* ~~infiltration~~*leakage of the building thermal envelope* shall be ~~verified~~ tested by an *approved* third party ~~whole-building pressurization testing conducted~~in accordance with ~~ASTM E779 or ASTM E1827 by an independent third party~~ Section C402.5.2.1. The measured *air-leakage* ~~rate of the building envelope~~ shall not exceed 0.2~~5~~2 cfm/ft^2 (~~2.0~~ 1.1 L/s × m^2) of the *building thermal envelope*~~under~~at a pressure differential of 0.3 inches water column (75 Pa), with the calculated surface area being the sum of the above- and below-grade *building* *thermal* *envelope*. ~~A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner.~~

~~**Exception:** For buildings having over 250,000 square feet (25 000 m²) of *conditioned floor area*, air leakage testing need not be conducted on the whole building where testing is conducted on representative above-grade sections of the building. Tested areas shall total not less than 25 percent of the conditioned floor area and shall be tested in accordance with this section.~~

Reason: Reason: This proposal is a merged proposal based on parts or all of proposals CEPI-55, CEPI-56, CEPI-57, CEPI-58, CEPI-63 Pt1, and CEPI-70 aimed primarily at reorganizing the structure of Section C402.5 to reduce redundancy and improve the clarity of the section. Section C402.5 is currently one of the most intricate and potentially confusing sections of the code, and this proposal seeks to simplify it by improving the flow of the text. Reorganization focused on the re-structure of the existing testing requirements to have clear performance requirements, testing criteria requirements and whole building testing exceptions. Specifically:

· The restructuring separates sections specifying the air leakage maximum values from sections specifying the methods by which these values are tested and verified. This allows for the enhanced air leakage option in Section C406 to be tested by the same by the same test method as the basic requirements in Section C402.5. This will enable consistency between the two sections and reduce divergence as the code is developed in future code cycles. Furthermore, this section separation will allow an easier revision of the code as new technology are deployed in the industry.

· Adding a clarification that the Group R & I sleeping and dwelling unit testing is optional. Group R & I buildings are permitted to use whole building testing.

· Removes overlapping exceptions, and repeated testing references.

Some additional requirements contained in CEPI-57 and CEPI-58 are included.

Summary of changes in merged, re-structure proposal:

The restructure is shown in the table below.

· Referenced Section and Table numbers is shown in the proposal text in green to aid in review.

· Clauses/requirements/exceptions dealing with the performance level stringency and climate zone and building size test exceptions that were recommended by the SC action on overlay proposals (CEPI-71, CEPI-61 & CEPI-62) are highlighted in red. Changes in stringency from CEPI-71 are shown below.

IECC-2021

Based on CEPI-71

Whole Building leakage limit

0.40 cfm/ft^2 (2.0 L/s × m^2) @0.3 inch water gauge (75 Pa)

0.35 cfm/ft^2 (1.8 L/s × m2) @ 0.3 inch water gauge (75 Pa)

Oops clause upper limit

0.60 cfm/ft^2 (2.3 L/s × m^2) @0.3 inch water gauge (75 Pa)

0.45 cfm/ft^2 (2.3 L/s × m^2) @0.3 inch water gauge (75 Pa)

Dwelling unit leakage limit

0.30 cfm/ft^2 (1.5 L/s x m^2) @ 0.2 inch water gauge (50 Pa).

0.27 cfm/ft^2 (1.4 L/s x m^2) @ 0.2 inch water gauge (50 Pa).

C406.9 Energy credit (whole building)

0.25 cfm/ft^2 (2.0 L/s × m^2) @ 0.3 inches water column (75 Pa)

0.22 cfm/ft^2 (1.1 L/s × m^2) @ 0.3 inches water column (75 Pa)

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The restructuring aspect of this code change proposal will neither increase nor decrease the cost of construction as written, because it is just rearranging the current requirements for better clarity and usability. This reorganization also includes changes from other approved proposals (CEPI-32, CEPI-60, CEPI-68 and CEPI-69), whose cost impact statements also indicate that they will neither increase nor decrease the cost of construction.

As part of the restructuring and cleanup, this code proposal does include the results of other air leakage proposals previously approved by the envelope subcommittee that do increase the cost of construction. Please see the associated cost statements for CEPI-61 and CEPI-71, both as modified.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The restructuring aspect of this code change proposal will neither increase nor decrease the cost of construction as written, because it is just rearranging the current requirements for better clarity and usability. This reorganization also includes changes from other approved proposals (CEPI-32, CEPI-60, CEPI-68 and CEPI-69), whose cost impact statements also indicate that they will neither increase nor decrease the cost of construction

Final Hearing Results

CECPI-3-21	AM

CECPI-4-21

Original Proposal

IECC®: C103.2, SECTION 202, SECTION 202 (New), C402.1, C402.1.5, Table C402.1.5 (New), C402.6 (New), C402.6.1 (New), C402.6.2 (New), C402.6.3 (New), C402.6.4 (New), C402.6.5 (New), TABLE C407.4.1(1)

Proponents: Tom Culp, IECC Commercial Envelope and Embodied Energy Subcommittee (ieccceenvelope@iccsafe.org)

2021 International Energy Conservation Code

Revise as follows:

C103.2 Information on construction documents. Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted where *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

1. Energy compliance path.
2. Insulation materials and their *R*-values.
3. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
4. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Economizer description.
8. Equipment and system controls.
9. Fan motor horsepower (hp) and controls.
10. Duct sealing, duct and pipe insulation and location.
11. Lighting fixture schedule with wattage and control narrative.
12. Location of *daylight* zones on floor plans.
13. Air barrier and air sealing details, including the location of the air barrier.
14. <u>*Thermal bridges* as identified in Section C402.6</u>.

F-FACTOR. The perimeter heat loss factor <u>per unit perimeter length of</u> ~~for~~ slab-on-grade floors (Btu/h × ft × °F) [W/(m × K)].

Add new definition as follows:

<u>**PSI-FACTOR (Ψ-FACTOR)**</u>**.** <u>the heat loss factor per unit length of a *thermal bridge* characterized as a linear element of a *building thermal envelope* (Btu/h x ft x °F)[W/(m x K)]</u>.

<u>**CHI-FACTOR (χ-FACTOR)**</u>**.** <u>The heat loss factor for a single *thermal bridge* characterized as a point element of a *building thermal envelope* (Btu/h x °F)[W/K].</u>

<u>**THERMAL BRIDGE**</u>**.** <u>An element or interface of elements that has higher thermal conductivity than the surrounding *building thermal envelope*, which creates a path of least resistance for heat transfer</u>.

Revise as follows:

C402.1 General. *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 1 of Section C401.2.1shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the *R*-value-based method of Section C402.1.3; the *U*-, *C*- and *F*-factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.
3. Fenestration in building envelope assemblies shall comply with Section C402.4.
4. Air leakage of building envelope assemblies shall comply with Section C402.5.
5. *Thermal bridges* in *above-grade walls* shall comply with Section C402.6.

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 Item 2 of Section C401.2.1 or Section C401.2.2.Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.

C402.1.5 Component performance alternative. Building envelope values and fenestration areas determined in accordance with Equation 4-2 shall be an alternative to compliance with the *U*-, *F*-, *psi*-, *chi*-, and *C*-factors in Tables C402.1.4, C402.1.5, and C402.4 and the maximum allowable fenestration areas in Section C402.4.1. *Fenestration* shall meet the applicable SHGC requirements of Section C402.4.3.

A+B+C+D+E+T≤Zero **(Equation 4-2)**

where:

A = Sum of the (UA Dif) values for each distinct assembly type of the *building thermal envelope*, other than slabs on grade and below-grade walls.UA Dif = UA Proposed – UA Table.UA Proposed = Proposed *U*-value × Area.UA Table = (*U*-factor from Table C402.1.3, C402.1.4 or C402.4) × Area.B = Sum of the (FL Dif) values for each distinct 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.C = Sum of the (CA Dif) values for each distinct *below-grade wall* assembly type of the *building thermal envelope*.CA Dif = CA Proposed – CA Table.CA Proposed = Proposed *C*-value × Area.CA Table = (Maximum allowable *C*-factor specified in Table C402.1.4) × Area.Where the proposed vertical glazing area is less than or equal to the maximum vertical glazing area allowed by Section C402.4.1, the value of D (Excess Vertical Glazing Value) shall be zero. Otherwise:D = (DA × UV) – (DA × U Wall), but not less than zero.DA = (Proposed Vertical Glazing Area) – (Vertical Glazing Area allowed by Section C402.4.1).UA Wall = Sum of the (UA Proposed) values for each opaque assembly of the exterior wall.U Wall = Area-weighted average *U*-value of all above-grade wall assemblies.UAV = Sum of the (UA Proposed) values for each vertical glazing assembly.UV = UAV/total vertical glazing area.Where the proposed skylight area is less than or equal to the skylight area allowed by Section C402.4.1, the value of E (Excess Skylight Value) shall be zero. Otherwise:E = (EA × US) – (EA × U Roof), but not less than zero.EA = (Proposed Skylight Area) – (Allowable Skylight Area as specified in Section C402.4.1).U Roof = Area-weighted average *U*-value of all roof assemblies.UAS = Sum of the (UA Proposed) values for each skylight assembly.US = UAS/total skylight area.

T= Sum of the (ΨL Dif) and (χN Dif) values for each type of *thermal bridge* condition of the *building thermal envelope* as identified in Section C402.6. For the purposes of this section, the ΨL Dif and χN Dif values for *thermal bridges* caused by materials with a thermal conductivity less than or equal to 3.0 Btu-in/h-ft^2-F shall be assigned as zero. For buildings or structures located in Climate Zones 0 through 3, the value of T shall be assigned as zero.

ΨL Dif=ΨL Proposed -ΨL Table.

ΨL Proposed = Proposed *psi-factor* x length of the *thermal bridge* elements in the proposed *building thermal envelope*.ΨL Table = (*psi-factor* specified as "compliant" in Table C402.1.5) x length of the *thermal bridge* linear elements.χN Dif=χN Proposed-χN Table.χN Proposed = Proposed *chi-factor* x number of the *thermal bridge* point elements other than fasteners, ties, or brackets in the proposed *building thermal envelope*.χN Table=(*chi-factor* specified as "compliant" in Table C402.1.5) x number of the *thermal bridge* point elements.A proposed *psi*- or *chi-factor* for each *thermal bridge* shall comply with one of the following as applicable:

1. Where the proposed mitigation of a *thermal bridge* is compliant with the requirements of Section C402.6, the value identified as compliant in Table C402.1.5 shall be used for the proposed *psi*- or *chi-factors*.
2. Where a *thermal bridge* is mitigated such that it does not comply with Section C402.6, the values identified as non-compliant in Table C402.1.5 shall be used for the proposed *psi*- or *chi-factors*.

3. Where the proposed mitigation of a *thermal bridge* provides a *psi-* or *chi-factor* less than the values identified as compliant in Table C402.1.5, the proposed *psi-* or *chi-factor* shall be determined by thermal analysis, testing, or other *approved* methods.

Add new text as follows:

Table C402.1.5 PSI- and CHI-FACTORS TO DETERMINE THERMAL BRIDGES FOR THE COMPONENT PERFORMANCE ALTERNATIVE

Thermal Bridge per Section C402.6	Thermal Bridge Compliant with Section C402.6		Thermal Bridge Non-Compliant with Section C402.6	
	psi-factor (Btu/h-ft-°F)	chi-factor (Btu/h-ft-°F)	psi-factor (Btu/h-ft-°F)	chi-factor (Btu/h-ft-°F)
C402.6.1 Balconies, slabs, and decks	0.2	n/a	0.5	n/a
C402.6.2 Cladding supports	0.2	n/a	0.3	n/a
C402.6.3 Structural beams and columns	n/a	1.0-carbon steel 0.3-concrete	n/a	2.0-carbon steel 1.0-concrete
C402.6.4 Vertical fenestration	0.15	n/a	0.3	n/a
C402.6.5 Parapets	0.2	n/a	0.4	n

For SI: W/m-K = 0.578 Btu/h-ft-°F; 1 W/K = 1.90 Btu/h-°F

n/a = not applicable

C402.6 Thermal bridges in above-grade walls. *Thermal bridges* in *above-grade walls* shall comply with the section or an *approved* design.

Exceptions:

1. Buildings and structures located in Climate Zones 0 through 3.
2. Any thermal bridge with a material thermal conductivity not greater than 3.0 Btu/h-ft-°F.
3. Blocking, coping, flashing, and other similar materials for attachment of roof coverings.
4. *Thermal bridges* accounted for in the *U-factor* or *C-factor* for a *building thermal envelope*.

C402.6.1 Balconies and floor decks. Balconies and concrete floor decks shall not penetrate the *building thermal envelope*. Such assemblies shall be separately supported or shall be supported by structural attachments or elements that minimize thermal bridging through the building thermal envelope.

Exceptions: Balconies and concrete floor decks shall be permitted to penetrate the *building thermal envelope* where:

1. an area-weighted *U-factor* is used for *above-grade wall* compliance which includes a *U-factor* of 0.8 Btu/h-°F-ft^2 for the area of the *above-grade wall* penetrated by the concrete floor deck, or
2. an *approved* thermal break device of not less than R-10 is installed in accordance with the manufacturer's instructions.

C402.6.2 Cladding supports. Linear elements supporting opaque cladding shall be off-set from the structure with attachments that allow the *continuous insulation*, where present, to pass behind the cladding support element.

Exceptions:

1. An *approved* design where the *above-grade wall U-factor* used for compliance accounts for the cladding support element *thermal bridge*.
2. Anchoring for *curtain wall* and window wall systems.

C402.6.3 Structural beams and columns. Structural steel and concrete beams and columns that project through the *building thermal envelope* shall be covered with not less than R-5 insulation for not less than 2 feet (610 mm) beyond the interior or exterior surface of an insulation component within the *building thermal envelope*.

Exceptions:

1. Where an *approved* thermal break device is installed in accordance with the manufacturer's instructions.
2. An *approved* design where the *above-grade wall U-factor* used to demonstrate compliance accounts for the beam or column *thermal bridge*.

C402.6.4 Vertical fenestration. Vertical fenestration intersections with *above grade walls* shall comply with one or more of the following:

1. Where *above-grade* walls include *continuous insulation*, the plane of the exterior glazing layer or, for metal frame fenestration, a non-metal thermal break in the frame shall be positioned within 2 inches (610 mm) of the interior or exterior surface of the *continuous insulation*.
2. Where *above-grade walls* do not include *continuous insulation*, the plane of the exterior glazing layer or, for metal frame fenestration, a non-metal thermal break in the frame shall be positioned within the thickness of the integral or *cavity insulation*.
3. The surface of the rough opening, not coved by the fenestration frame, shall be insulated with insulation of not less than R-3 material or covered with a wood buck that is not less than 1.5 inches (457 mm) thick.
4. For the intersection between vertical fenestration and opaque spandrel in a shared framing system, manufacturer's data for the spandrel *U-factor* shall account for *thermal bridges*.

Exceptions:

1. Where an *approved* design for the *above-grade wall U-factor* used for compliance accounts for *thermal bridges* at the intersection with the vertical fenestration.
2. Doors

C402.6.5 Parapets. Parapets shall comply with one or more of the following as applicable:

1. Where continuous insulation is installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the continuous insulation shall extend up both sides of the parapet not less than 2 feet (610 mm) above the roof covering or to the top of the parapet, whichever is less. Parapets that are an integral part of a fire-resistance rated wall, and the exterior *continuous insulation* applied to the parapet, shall comply with the fire resistance ratings of the building code.
2. Where *continuous insulation* is installed on the exterior side of the above-grade wall and the roof insulation is below the roof deck, the *continuous insulation* shall extend up the exterior side of the parapet to not less than the height of the top surface of the roof assembly.

3. Where *continuous insulation* is not installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the wall cavity or integral insulation shall extend into the parapet up to the exterior face of the roof insulation or equivalent R-value insulation shall be installed not less than 2 feet (610 mm) horizontally inward on the underside of the roof deck.

4. Where *continuous insulation* is not installed on the exterior side of the *above-grade wall* and the roof insulation is below the roof deck, the wall and roof insulation components shall be adjacent to each other at the roof-ceiling-wall intersection.

Exception: An *approved* design where the *above-grade wall U-factor* used for compliance accounts for the parapet *thermal bridge*.

Revise as follows:

TABLE C407.4.1(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 C405.3.2(1) or C405.3.2(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: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
	Thermal bridges: Account for heat transfer consistent with compliant *psi-* and *chi-factors* from Table C402.1.5 for *thermal bridges* as identified in Section C402.6 that are present in the *proposed design.*	As proposed; *psi-* and *chi-factors* for proposed *thermal bridges* shall be determined in accordance with requirements in Section C402.1.5.
	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed
Walls, below-grade	Type: mass wall	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: as specified in Table C402.1.4 with insulation layer on interior side of walls	As proposed
Floors, above-grade	Type: joist/framed floor	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Floors, slab-on-grade	Type: unheated	As proposed
	F-factor: as specified in Table C402.1.4	As proposed
Opaque doors	Type: swinging	As proposed
	Area: Same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Vertical fenestration other than opaque doors	Area 1. The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 40 percent of above-grade wall area. 2. 40 percent of above-grade wall area; where the proposed vertical fenestration area is 40 percent or more of the above-grade wall area.	As proposed
	U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	External shading and PF: none	As proposed
Skylights	Area 1. The proposed skylight area; where the proposed skylight area is less than that permitted by Section C402.1. 2. The area permitted by Section C402.1; where the proposed skylight area exceeds that permitted by Section C402.1.	As proposed
	U-factor: as specified in Table C402.4	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.3.2. Where the occupancy of the building is not known, the lighting power density shall be 1.0 watt per square foot 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 Tables C405.5.2(1), C405.5.2(2) and C405.5.2(3). Areas and dimensions of surfaces shall be the same as proposed.	As proposed
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. End-use load components within and associated with the building shall be modeled to include, but not be limited to, the following: exhaust fans, parking garage ventilation fans, exterior building lighting, swimming pool heaters and pumps, elevators, escalators, refrigeration equipment and cooking equipment.
Schedules	Same as proposed **Exception:** Thermostat settings and schedules for HVAC systems that utilize radiant heating, radiant cooling and elevated air speed, provided that equivalent levels of occupant thermal comfort are demonstrated by means of equal Standard Effective Temperature as calculated in Normative Appendix B of ASHRAE Standard 55.	Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays and any seasonal operation. Schedules shall model the time-dependent variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads. The schedules shall be typical of the proposed building type as determined by the designer and approved by the jurisdiction.
Mechanical ventilation	Same as proposed	As proposed, in accordance with Section C403.2.2.
Heating systems	Fuel type: same as proposed design	As proposed
	Equipment type[a]: as specified in Tables C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in the tables in Section C403.3.2.	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 C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in Tables C403.3.2(1), C403.3.2(2) and C403.3.2(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 C403.5.	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 Where no service water hot water system exists or is specified in the proposed design, no service hot water heating shall be modeled.	As proposed

For SI: 1 watt per square foot = 10.7 w/m^2.

SWHF = Service Water Heat Recovery Factor, DWHR = Drain Water Heat Recovery.

a. Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.

b. The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.

c. Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.

d. If an economizer is required in accordance with Table C403.5(1) and where no economizer exists or is specified in the proposed design, then a supply-air economizer shall be provided in the standard reference design in accordance with Section C403.5.

e. The SWHF shall be applied as follows:

1. Where potable water from the DWHR unit supplies not less than one shower and not greater than two showers, of which the drain water from the same showers flows through the DWHR unit then SWHF = [1 – (DWHR 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: As requested by the sub-committee, this proposal is a combination of CEPI-33, 40, 45 which now provides prescriptive, component performance alternative and total building performance compliance paths and a requirement to note thermal bridges on the construction documents. It combines the best of the individual proposals, plus improvements and modifications provided by the subcommittee and other interested parties. It also adds language for the component performance alternative compliance path, which was not present in the individual proposals.

The key rationale for specifying the minimum performance of thermal bridges at key interfaces is that currently they are ignored in the IECC, which therefore assumes no thermal performance degradation at assembly interfaces and penetrations of the building thermal envelope.

Ignoring thermal bridges at interfaces leads us to believe that our building thermal envelopes perform much better than they do, and to the widely recognized performance gap between as-designed/code compliant design and as-built [1]. According to the Building Envelope Thermal Bridging Guide created by Morrison Hershfield for BC Housing [2], thermal bridging can reduce the thermal performance of the opaque building envelope by between 20-70%. Non-thermally broken cladding attachments can degrade the thermal performance of opaque panel assemblies by 50% [2]. Morrison Hershfield have also found that 13% of the heat loss through a typical steel stud wall with punched opening windows is due to the window to wall transition and they found it to be even higher with poorer edge details. This is a huge degradation in performance that the code is currently ignoring and must be addressed to improve the energy performance of as-built structures.

Also, in the 2021 IECC, the definition for above-grade wall (shown below) was changed in a way that supports a need to address thermal bridging at intersections of above-grade walls with floors, roofs, and fenestration, which were previously ignored.

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

In order to achieve net-zero performance we need to address these significant energy losses through thermal bridges at the building thermal envelope. This proposal seeks to take a small step towards recognizing and accounting for thermal bridges that are typically present in conventional construction. It seeks to recognize and account for current design and construction practices, not to drive a large change in construction practices. The proponents believe that this is a good first step to move building thermal envelope performance and to get the design and construction industry thinking about thermal bridges in the design process.

Inclusion in construction documents

The inclusion of thermal bridge details on construction documents will encourage design teams to identify and address thermal bridging. The requirements for what thermal bridges to identify on the construction documents is referenced to section C402.6 where the types of thermal bridges are identified. This will ensure that only the main thermal bridges need be shown. A definition for thermal bridges is also proposed to support the proposal.

Definitions

New definitions psi-factor and chi-factor are introduced to describe linear and point thermal bridges in the*building thermal envelope* in a similar way to the existing F-factor for heat loss for slab-on-grade floors. These definitions are used in the component performance alternative and the performance compliance paths. We have chosen to call them psi and chi-factors as this is how they are commonly referred to, and we wanted to avoid confusion.

A new definition for thermal bridges is included and incorporates comments from the subcommittee.

Prescriptive path

In the prescriptive path, we have taken the route of CEPI-33 in creating a simple yet flexible approach, focusing on a few thermal bridge conditions that have the most impact, and which have practical and available means to effectively manage the bridging. In every case, alternative means and methods are permitted with an approved design to avoid any unnecessary restriction or inflexibility. The proponents feel that this is an appropriately abbreviated and enforceable way to address this topic in the energy code.

The goal was to create a simple, prescriptive, effective, and flexible means to begin to address and reasonably mitigate the effects of major thermal bridges which are now identified in the new definition (IECC 2021) for above-grade walls. To inform the proposed prescriptive requirements, various thermal bridging studies, detailing guides, and provisions developed domestically and internationally were reviewed [2-7].

Component performance alternative

In this section the linear and point thermal bridges (psi-, chi- factors) are included in the formula in a similar way to the existing U-, F- and C- factors. A table of psi- and chi-factors are provided to be used in this section, for the five prescriptive categories of thermal bridges. There are values proposed for thermal bridges compliant or non-compliant with the prescriptive path. The values provided for thermal bridges compliant with the prescriptive path are reflective of those details (which are not very stringent). The values provided for non-compliant are reflective of poorer interface details. The psi- and chi-factors of thermal bridges which exceed the prescriptive requirement are permitted to be determined by thermal analysis, testing or other approved sources.

Including values of thermal bridging in this section will ensure that any trade-offs in between envelope assemblies will account for thermal bridging.

Note that this section will need to be rationalized with CEPI-46 which addresses a problem with the current component performance alternative equation, if both are accepted by the committee.

Performance path

The performance path language ensures that the reference design accounts for thermal bridging rather than assuming no thermal bridges exist and that the interfaces are “perfect”. This allows for good thermal bridging details in the proposed design to show improved energy performance.

The reference design uses the psi- and chi-factors from the component performance alternative section for those thermal bridges which are present in the proposed design. The proposed building uses psi- and chi- factors for thermal bridges calculated according to the methods allowed in the component performance alternative.

Bibliography: [1] https://en.wikipedia.org/wiki/Performance gap

[2] BC Housing, Thermal Bridging Guide, Version 1.5, 2020, https://www.bchousing.org/research-centre/library/residential-design-construction/building-envelope-thermal-bridging-guide

[3] Morrison Hershfield Ltd. (2011)

[4] ASHRAE 1365-RP Thermal Performance of Building Envelope Construction Details for Mid- and High-Rise Buildings. Atlanta, GA: American Society of Heating, Refrigeration and Air-Conditioning Engineers Inc

[5] ISO Standard 14683: 2007, Thermal Bridges in Building Construction – Linear thermal transmittance (simplified methods and default Chi-factors).

[6] AISC/SEI, Thermal Bridging Solutions: Minimizing Structural Steel's Impact on Building Envelope Energy Transfer, A Supplement to Modern Steel Construction, March 2012, American Institute for Steel Construction (AISC) & Structural Engineering Institute (SEI).

[7] USACE, "Development of Thermal Bridging Factors for Use in Energy Models," ERDC/CERL TR-15-10, June 2015, U.S. Army Corp of Engineers, Engineer Research and Development Center, Construction Engineering Research Laboratory.

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

The code change proposal will increase the cost of construction.

Perfect mitigation or no thermal bridging at interfaces is implied by code. However, current practice is to ignore them or provide no or little mitigation. So, any proposal to reduce thermal bridging will increase the cost of construction relative to current practices. This proposal provides a way of practical mitigation which does not require significant changes to current practices, setting a relatively low performance bar.

We could also consider there to be no change in construction cost (or even a reduction in cost) as this proposal enforces the intent of code and closes the gap between what is being built today and what code intends to be built. But, of course, perfect mitigation is not representative of current practices. By quantifying the impact of thermal bridges, we provide the option to address them, albeit not perfectly, in each compliance path.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: In addition to the detailed reason statement in the proposal, CECPI-4 addresses a significant thermal performance degradation which is currently ignored and impacts the energy performance of buildings.

Final Hearing Results

CECPI-4-21 AM

CECPI-5-21

Original Proposal

IECC®: CC101.1, SECTION 202 (New), SECTION 202, CC103.1, TABLE CC103.1, TABLE CC103.1 (New), CC103.2, CC103.2.1 (New), CC103.3.1, CC103.3.2, CC103.3.3, CC103.3.3.1 (New), TABLE CC103.3.3

Proponents: Greg Eades, IECC CE Economics, Modeling, Metrics Subcommittee, IECC CE Economics, Modeling, Metrics Subcommittee (iecccemodeling@iccsafe.org)

2021 International Energy Conservation Code

Revise as follows:

CC101.1 Purpose. The purpose of this appendix is to supplement the *International Energy Conservation Code* and require renewable energy systems of adequate capacity to achieve net zero ~~carbon~~energy.

Add new definition as follows:

COMMUNITY RENEWABLE ENERGY FACILITY. A facility that produces energy from renewable energy systems and is qualified as a community energy facility under applicable jurisdictional statutes and rules.

DIRECT ACCESS TO WHOLESALE MARKET. An agreement by the owner and a renewable energy developer to purchase renewable energy from the wholesale market.

DIRECT OWNERSHIP. An *off-site renewable energy system* under the ownership or control of the building project owner.

Revise as follows:

~~**ENERGY UTILIZATION INTENSITY (EUI).** The site energy for either the baseline building or the proposed building divided by the gross *conditioned floor area* plus any semiheated floor area of the building. For the baseline building, the EUI can be divided between regulated energy use and unregulated energy use.~~

Add new definition as follows:

FINANCIAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT (FPPA). A financial arrangement between a renewable electricity generator and a purchaser wherein the purchaser pays or guarantees a price to the generator for the project's renewable generation. Also known as a "financial power purchase agreement" and "virtual power purchase agreement."

GREEN RETAIL PRICING. A program by the retail electricity provider to provide 100-percent renewable energy to the buildng project owner.

MINIMUM RENEWABLE ENERGY REQUIREMENT. the minimum amount of on-site or adjusted off-site renewable energy needed to comply with this appendix.

Revise as follows:

OFF-SITE RENEWABLE ENERGY SYSTEM. Renewable energy system ~~not located on the building project~~.which serves the building project and is not an *on-site renewable energy system.*

ON-SITE RENEWABLE ENERGY SYSTEM. Renewable energy systems ~~on the building project~~.located on any of the following:
1. the building.
2. the property upon which the building is located.
3. a property that shares a boundary with and is under the same ownership or control as the property on which the building is located, or

4. a property that is under the same ownership or control as the property on which the building is located and is separated only by a public right-of-way on which the building is located.

Add new definition as follows:

PHYSICAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT (PPPA). A contract for the purchase of renewable electricity from a specific renewable electricity generator to a purchaser of renewable electricity.

RENEWABLE ENERGY CERTIFICATE (REC). A market-based instrument that represents and conveys the environmental, social, and other non-power attributes of one megawatt hour of renewable electricity generation and could be sold separately from the underlying physical electricity associated with renewable energy systems; also known as an energy attribute and energy attribute certificate (EAC).

RENEWABLE ENERGY INVESTMENT FUND (REIF). A fund established by the local government or other entity to accept payment from building owners to construct or acquire qualifying renewable energy (along with RECs) on their behalf.

Revise as follows:

RENEWABLE ENERGY SYSTEM. Photovoltaic, solar thermal, geothermal energy extracted from hot fluid or steam, ~~and~~ wind, or other approved renewable energy production systems used to generate energy.

~~**ZERO ENERGY PERFORMANCE INDEX (ZEPIPB,EE).** The ratio of the proposed building EUI without renewables to the baseline building EUI, expressed as a percentage.~~

CC103.1 Renewable energy. On-site renewable energy systems shall be installed, or adjusted off-site renewable energy shall be procured to meet the *minimum renewable energy requirement* ~~offset the building energy as calculated in Equation CC-1~~.

$$RE_{onsite} + RE_{offsite} \geq E_{building}$$ **(Equation CC-1)**

$RE_{onsite} + RE_{offsite} \geq RE_{min}$ ~~building~~

where:

RE_{onsite} = Annual site energy production from on-site renewable energy systems (see Section CC103.2,) including installed *on-site renewable energy systems* for compliance with C405.13.1 and C406.5.

$RE_{offsite}$ = Adjusted annual ~~site~~ energy production from *off-site renewable energy systems* that may be credited against ~~building energy use~~ the *minimum renewable energy requirement* (see Section CC103.3), including off-site renewable energy purchased for compliance with C405.13.2.

RE_{min}~~$_{building}$~~ = Minimum renewable energy requirement ~~Building energy use without consideration of renewable energy systems~~.

When Section C401.2.1(1) is used for compliance with the *International Energy Conservation Code*, the *minimum renewable energy requirement* ~~building energy~~ shall be determined by multiplying the gross *conditioned floor area* plus the gross semiheated floor area of the proposed building by the prescriptive renewable energy requirement ~~an EUI selected~~ from Table CC103.1. An area ~~Use a~~ weighted average shall be used for mixed-use buildings.When Section C401.2.1, Item 2 or Section C401.2.2 is used for compliance with the *International Energy Conservation Code*, the *minimum renewable energy requirement* shall be equal to the building energy ~~shall be~~ as determined from energy simulations.

~~**TABLE CC103.1 ENERGY UTILIZATION INTENSITY FOR BUILDING TYPES AND CLIMATES**~~ **(~~kBtu/ft² – yr~~)**

BUILDING AREA TYPE	CLIMATE ZONE																
	0A/1A	0B/1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	~~7~~	~~8~~
	kBtu/ft² – yr																
Healthcare/hospital (I-2)	119	120	119	113	116	109	106	116	109	106	118	110	105	126	116	131	142
Hotel/motel (R-1)	73	76	73	68	70	67	65	69	66	65	71	68	65	77	72	81	89
Multiple-family (R-2)	43	45	41	41	43	42	36	45	43	41	47	46	41	53	48	53	59
Office (B)	31	32	30	29	29	28	25	28	27	25	29	28	25	33	30	32	36
Restaurant (A-2)	389	426	411	408	444	420	395	483	437	457	531	484	484	589	538	644	750

Retail (M)	46	50	45	46	44	44	37	48	44	44	52	50	46	60	52	64	77
School (E)	42	46	42	40	40	39	36	39	40	40	39	43	37	44	40	45	54
Warehouse (S)	~~9~~	12	~~9~~	11	12	11	10	17	13	14	23	17	15	32	23	32	32
All others	55	58	54	53	53	51	48	54	52	51	57	54	50	63	57	65	73

Add new text as follows:

TABLE CC103.1 PRESCRIPTIVE RENEWABLE ENERGY REQUIREMENT FOR BUILDING TYPES AND CLIMATES (kWh/ft^2-yr)

	Building Area Type											
Climate Zone	Multifamily (R-2)	Healthcare/hospital (I-2)	Hotel/Motel (R-2)	Office (B)	Restaurant (A-2)	Retail (M)	School (E)	Warehouse (S)	Grocery Store (M)	Laboratory (B)	Assembly (A)	All others
0A	13	35	23	10	129	17	16	3	27	41	5	17
0B	12	34	22	10	123	17	15	3	26	40	5	16
1A	11	32	20	9	113	14	13	3	24	36	4	15
1B	11	32	20	9	118	15	14	3	24	37	5	15
2A	11	32	20	8	114	13	12	3	22	34	4	14
2B	11	30	18	8	108	12	11	3	22	33	4	13
3A	11	30	18	8	117	13	11	3	21	31	4	13
3B	10	29	18	8	110	12	10	3	20	31	4	13
3C	9	28	18	7	100	10	9	2	18	27	3	12
4A	12	31	18	8	123	15	11	6	21	32	4	14
4B	11	29	18	7	113	12	10	4	20	30	4	13
4C	10	28	17	7	111	13	10	4	18	28	3	13
5A	12	31	19	8	133	17	11	8	22	34	4	15
5B	11	29	18	8	125	14	11	5	21	31	4	14
5C	10	29	17	7	116	13	10	4	18	27	3	13
6A	14	33	20	10	151	20	13	11	26	39	5	17
6B	13	33	19	8	137	17	11	7	22	34	4	16
7	14	37	21	9	164	20	13	10	25	37	5	18
8	15	40	22	11	190	23	16	10	28	43	5	20

Revise as follows:

CC103.2 Calculation of on-site renewable energy. The annual energy production from on-site renewable energy systems shall be determined using ~~the PVWatts software or other~~ software approved by the code official.

Add new text as follows:

CC103.2.1 Renewable energy certificates. renewable energy certificates and other environmental attributes associated with the*on-site renewable energy system* shall be assigned to the initial and subsequent building owner(s) for a period of not less than 15 years. The building owner(s) may transfer renewable energy certificates to building tenants while they are occupying the building.

Revise as follows:

CC103.3.1 Qualifying off-site procurement methods. The following are ~~considered~~ qualifying off-site renewable energy procurement methods:

1. *Community renewables energy facility*~~: an off-site renewable energy system for which the owner has purchased or leased renewable energy capacity along with other subscribers.~~
2. *Renewable energy investment fund*~~: an entity that installs renewable energy capacity on behalf of the owner~~.
3. *Financial renewable energy* ~~*Virtual*~~ *power purchase agreement*~~: a power purchase agreement for off-site renewable energy where the owner agrees to purchase renewable energy output at a fixed price schedule.~~
4. Direct ownership~~: an off-site renewable energy system owned by the building project owner~~.

5. Direct access to wholesale market~~: an agreement between the owner and a renewable energy developer to purchase renewable energy.~~
6. *Green retail* pricing ~~tariffs: a program by the retail electricity provider to provide 100-percent renewable energy to the owner~~.
7. *Unbundled Renewable Energy Certificates (RECs)*~~: certificates purchased by the owner representing the environmental benefits of renewable energy generation that are sold separately from the electric power.~~
8. *Physical renewable energy power purchase agreement*

CC103.3.2 Requirements for all procurement methods. The following requirements shall apply to all off-site renewable energy procurement methods:

1. The building owner shall sign a legally binding contract or other approved agreement to procure qualifying *off-site renewable energy*.
2. The procurement contract shall have duration of not less than 15 years and shall be structured to survive a partial or full transfer of ownership of the property.
3. RECs and other environmental attributes associated with the procured *off-site renewable energy* shall meet all of the following requirements: ~~be assigned to the building project for the duration of the contract~~.

   3.1 Are retained or retired by or on behalf of the property owner or tenant for a period of not less than 15 years.

   3.2 Are created within a 12-month period of use of the REC; and

   3.3 Are from a generating asset constructed no more than 5 years before the issuance of the certificate of occupancy.

4. The ~~*renewable energy*~~ generating source shall be a *renewable energy system*. ~~include one or more of the following: photovoltaic systems, solar thermal power plants, geothermal power plants and wind turbines.~~
5. The generation source shall be located where the energy can be delivered to the *building site* by any of the following: ~~the same utility or distribution entity, the same independent system operator (ISO) or regional transmission organization (RTO), or within integrated ISOs (electric coordination council).~~

   5.1 By direct connection to the off-site renewable energy facility.

   5.2 By the local utility or distribution entity

   5.3 By an interconnected electrical network where energy delivery capacity between the generator and the building site is available

6. ~~The *off-site renewable energy* producer shall maintain transparent accounting that clearly assigns production to the building.~~ Records on power sent to or purchased by the building project shall be retained by the building owner and made available for inspection by the code official upon request.

CC103.3.3 Adjusted off-site renewable energy. The process for calculating the adjusted *off-site renewable energy* is shown in Equation 2.

$$RE_{offsite} = \sum_{i=1}^{n} PF_i \times RE_i = PF_1 \times RE_1 + PF_2 \times RE_2 + \ldots + PF_n \times RE_n$$ **(Equation CC-2)**

where:

$RE_{offsite}$ = Adjusted off-site renewable energy.
PF_i = Procurement factor for the i^{th} renewable energy procurement method ~~or class taken from~~ per ~~Table CC103.3.3~~ Section CC103.3.3.1.
RE_i = Annual energy production for the i^{th} renewable energy procurement method ~~or class~~.
n = The number of renewable energy procurement ~~options or classes~~ methods considered.

Add new text as follows:

CC103.3.3.1 Procurement factors. When installed on-site renewable energy capacity is 7.5 W/ft^2 of roof area or greater, the procurement factor is 1.00, otherwise, the procurement factor is 0.75, except for unbundled renewable energy certificates which shall have a procurement factor of 0.20. A procurement factor of 1.0 may also be used when the conditions of exceptions 1, 2, or 3 to Section C405.13.1 are satisfied.

Revise as follows:

~~TABLE CC103.3.3 DEFAULT OFF-SITE RENEWABLE ENERGY PROCUREMENT METHODS, CLASSES AND COEFFICIENTS~~

CLASS	PROCUREMENT FACTOR (PF)	PROCUREMENT OPTIONS	ADDITIONAL REQUIREMENTS (see also Section CC103.3.2)
~~1~~	0.75	Community solar	—
		REIFs	Entity must be managed to prevent fraud or misuse of funds.
		Virtual PPA	—
		Self-owned off-site	Provisions shall prevent the generation from being sold separately from the building.
~~2~~	0.55	Green retail tariffs	The offering shall not include the purchase of unbundled RECs.
		Direct access	The offering shall not include the purchase of unbundled RECs.
~~3~~	0.20	Unbundled RECs	The vintage of the RECs shall align with building energy use.

Reason: Revises Appendix CC to align with CECPI-2-21 (Section 405.13), updates prescriptive minimum renewable energy requirements, revises offsite renewable energy procurement factors and makes miscellaneous simplifications and language cleanups.

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

This code change will increase the cost of construction

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Revises Appendix CC to align with CECPI-2-21 (Section 405.13), updates prescriptive minimum renewable energy requirements, revises offsite renewable energy procurement factors and makes miscellaneous simplifications and language cleanups.

Final Hearing Results

CECPI-5-21 AS

CECPI-6-21

Original Proposal

IECC®: SECTION 202 (New), C403.7.2

Proponents: Blake Shelide, IECC CE HVACR & Water Heating Subcommittee, IECC CE HVACR & Water Heating Subcommittee (iecccehvacr@iccsafe.org)

2021 International Energy Conservation Code

Add new definition as follows:

PARKING GARAGE SECTION. A part of a parking garage that is separated from all other parts of the garage by full-height solid walls or operable openings that are intended to remain closed during normal operation and where vehicles cannot pass to other parts of the garage. It may include multiple floors if there are ramps to allow vehicles to pass between the floors.

Revise as follows:

C403.7.2 ~~Enclosed p~~Parking garage ventilation systems ~~controls~~. ~~Enclosed~~ Ventilation systems employed in parking garages ventilation systems used for storing or handling automobiles operating under their own power shall ~~employ~~ meet all of the following: ~~carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors and automatic controls configured to stage fans or modulate fan average airflow rates to 50 percent or less of design capacity, or intermittently operate fans less than 20 percent of the occupied time or as required to maintain acceptable contaminant levels in accordance with International Mechanical Code provisions. Failure of contamination-sensing devices shall cause the exhaust fans to operate continuously at design airflow.~~

1. Separate ventilation systems and control systems shall be provided for each *parking garage section*.
2. Control systems for each *parking garage section* shall automatically detect and control contaminant levels in accordance with the *International Mechanical Code*, and shall be capable of and configured to reduce fan airflow to 20 percent or less of the design capacity.
3. The ventilation system for each *parking garage section* shall have controls and devices that result in fan motor demand of no more than 30 percent of design wattage at 50 percent of the design airflow.

Exceptions:

1. Garage ventilation systems serving a single *parking garage section* having a total ventilation system motor nameplate horsepower (ventilation system motor nameplate kilowatt) not exceeding 5 hp (3.7 kW) at fan system design conditions and where the *parking garage section* has no mechanical cooling or mechanical heating. ~~Garages with a total exhaust capacity less than 8,000 cfm (3,755 L/s) with ventilation systems that do not utilize heating or mechanical cooling.~~
2. ~~Garages that have a garage area to ventilation system motor nameplate power ratio that exceeds 1,125 cfm/hp (710 L/s/kW) and do not utilize heating or mechanical cooling.~~

Reason: The current requirements for garage ventilation are lenient. The changes to C403.7.2 are based on addendum d to ASHRAE 90.1-2019 for parking garage ventilation. This proposal increases stringency for these systems, with additional requirements for pollutant sensors
and fan variable speed drives that SSPC 90.1 has determined to be cost-effective.

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

determined to be cost-effective.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The current requirements for garage ventilation are lenient. The changes to C403.7.2 are based on addendum d to ASHRAE 90.1-2019 for parking garage ventilation. This proposal increases stringency for these systems, with additional requirements for pollutant sensorsand fan variable speed drives that SSPC 90.1 has determined to be cost-effective.

Final Hearing Results	
CECPI-6-21	AS

CECPI-7-21

Original Proposal

IECC®: TABLE C405.3.2(1), TABLE C405.3.2(2), C405.3.2.2.1

Proponents: Michael Jouaneh, IECC CE Electrical Power, Storage, Renewables Subcommittee, IECC Commercial Electrical Power, Lighting, Renewables SC (ieccceelectrical@iccsafe.org)

2021 International Energy Conservation Code

Revise as follows:

TABLE C405.3.2(1) INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (w/ft^2)
Automotive facility	0.750.73
Convention center	0.64
Courthouse	0.790.75
Dining: bar lounge/leisure	0.800.74
Dining: cafeteria/fast food	0.760.70
Dining: family	0.710.65
Dormitory~~[a, b]~~	0.530.52
Exercise center	0.72
Fire station[a]	0.56
Gymnasium	0.760.75
Health care clinic	0.810.77
Hospital[a]	0.960.92
Hotel/Motel~~[a, b]~~	0.560.53
Library	0.83
Manufacturing facility	0.82
Motion picture theater	0.440.43
Multiple-family[c]	0.450.46
Museum	0.550.56
Office	0.640.62
Parking garage	0.180.17
Penitentiary	0.690.65
Performing arts theater	0.840.82
Police station	0.660.62
Post office	0.650.64
Religious building	0.670.66
Retail	0.840.78
School/university	0.720.70
Sports arena	0.760.73
Town hall	0.690.67
Transportation	0.500.56
Warehouse	0.45
Workshop	0.910.86

For SI: 1 watt per square foot = 10.76 w/m^2.

~~a. Where sleeping units are excluded from lighting power calculations by application of Section R404.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.~~

~~b. Where dwelling units are excluded from lighting power calculations by application of Section R404.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.~~

~~c. Dwelling units are excluded. Neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.~~

TABLE C405.3.2(2) INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE TYPES[a]	LPD (watts/ft²)
Atrium	

COMMON SPACE TYPES	LPD (watts/ft²)
Less than 40 feet in height	~~0.48~~0.41
Greater than 40 feet in height	~~0.60~~0.51
Audience seating area	
In an auditorium	~~0.61~~0.57
In a gymnasium	0.23
In a motion picture theater	0.27
In a penitentiary	~~0.67~~0.56
In a performing arts theater	~~1.16~~1.09
In a religious building	0.72
In a sports arena	~~0.33~~0.27
Otherwise	0.33
Banking activity area	~~0.61~~0.56
Breakroom (See Lounge/breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	~~0.89~~0.74
Otherwise	~~0.71~~0.72
Computer room, data center	~~0.94~~0.75
Conference/meeting/multipurpose room	~~0.97~~0.88
Copy/print room	~~0.31~~0.56
Corridor	
In a facility for the visually impaired (and not used primarily by the staff[b])	0.71
In a hospital	~~0.71~~0.61
Otherwise	~~0.41~~0.44
Courtroom	~~1.20~~1.08
Dining area	
In bar/lounge or leisure dining	~~0.86~~0.76
In cafeteria or fast food dining	~~0.40~~0.36
In a facility for the visually impaired (and not used primarily by the staff[b])	~~1.27~~1.22
In family dining	~~0.60~~0.52
In a penitentiary	~~0.42~~0.35
Otherwise	~~0.43~~0.42
Electrical/mechanical room	~~0.43~~0.71
Emergency vehicle garage	~~0.52~~0.51
Food preparation area	~~1.09~~1.19
~~Guestroom[c, d]~~	~~0.41~~
Laboratory	
In or as a classroom	~~1.11~~1.05
Otherwise	~~1.33~~1.21
Laundry/washing area	~~0.53~~0.51
Loading dock, interior	0.88
Lobby	
For an elevator	~~0.65~~0.64
In a facility for the visually impaired (and not used primarily by the staff[b])	~~1.69~~1.44
In a hotel	~~0.51~~0.48
In a motion picture theater	~~0.23~~0.20
In a performing arts theater	~~1.25~~1.21
Otherwise	~~0.84~~0.80
Locker room	~~0.52~~0.43
Lounge/breakroom	
In a healthcare facility	~~0.42~~0.77
Mother's Wellness Room	0.68
Otherwise	~~0.59~~0.55
Office	
Enclosed	~~0.74~~0.73
Open plan	~~0.61~~0.56
Parking area daylight transition zone	1.06
Parking area, interior	~~0.15~~0.11
Pharmacy area	~~1.66~~1.59
Restroom	
In a facility for the visually impaired (and not used primarily by the staf[b]f	~~1.26~~0.96
Otherwise	~~0.63~~0.74
Sales area	~~1.05~~0.85
Seating area, general	~~0.23~~0.21
Security screening general areas	0.64
Security screening in transportation facilities	0.93
Security screening transportation waiting area	0.56
Stairwell	~~0.49~~0.47
Storage room	~~0.38~~0.35
Vehicular maintenance area	~~0.60~~0.59
Workshop	~~1.26~~1.17
BUILDING TYPE SPECIFIC SPACE TYPES[a]	**LPD (watts/ft²)**

COMMON SPACE TYPES	LPD (watts/ft²)
Automotive (see Vehicular maintenance area)	
Convention Center–exhibit space	~~0.61~~0.50
~~Dormitory–living quarters~~[~~c, d~~]	~~0.50~~
Facility for the visually impaired[b]	
In a chapel (and not used primarily by the staff)	~~0.70~~0.58
In a recreation room (and not used primarily by the staff)	~~1.77~~1.20
~~Fire Station–sleeping quarters~~[~~c~~]	~~0.23~~
Gaming establishments	
High limits game	1.68
Slots	0.54
Sportsbook	0.82
Table games	1.09
Gymnasium/fitness center	
In an exercise area	~~0.90~~0.82
In a playing area	~~0.85~~0.82
Healthcare facility	
In an exam/treatment room	~~1.40~~1.33
In an imaging room	0.94
In a medical supply room	~~0.62~~0.56
In a nursery	~~0.92~~0.87
In a nurse's station	~~1.17~~1.07
In an operating room	2.26
~~In a patient room~~[~~c~~]	~~0.68~~
In a physical therapy room	~~0.91~~0.82
In a recovery room	~~1.25~~1.18
In a telemedicine room	1.44
Library	
In a reading area	~~0.96~~0.86
In the stacks	1.18
Manufacturing facility	
In a detailed manufacturing area	~~0.80~~0.75
In an equipment room	~~0.76~~0.73
In an extra-high-bay area (greater than 50 feet floor-to-ceiling height)	~~1.42~~1.36
In a high-bay area (25-50 feet floor-to-ceiling height)	1.24
In a low-bay area (less than 25 feet floor-to-ceiling height)	0.86
Museum	
In a general exhibition area	0.31
In a restoration room	~~1.10~~1.24
Performing arts theater–dressing room	~~0.41~~0.39
Post office–sorting area	~~0.76~~0.71
Religious buildings	
In a fellowship hall	~~0.54~~0.50
In a worship/pulpit/choir area	~~0.85~~0.75
Retail facilities	
In a dressing/fitting room	~~0.51~~0.45
Hair salon	0.65
Nail salon	0.75
In a mall concourse	~~0.82~~0.57
Massage space	0.81
Sports arena–playing area	
For a Class I facility[~~e~~c]	~~2.94~~2.86
For a Class II facility[~~f~~d]	~~2.01~~1.98
For a Class III facility[~~g~~e]	~~1.30~~1.29
For a Class IV facility[~~h~~f]	0.86
Sports arena-Pools	
For a Class I facility	2.20
For a Class II facility	1.47
For a Class III facility	0.99
For a Class IV facilty	0.59
Transportation facility	
Airport hanger	1.36
At a terminal ticket counter	~~0.51~~0.40
In a baggage/carousel area	~~0.39~~0.28
Passenger loading area	0.71
In an airport concourse	~~0.25~~0.49
Warehouse–storage area	
For medium to bulky, palletized items	0.33
For smaller, hand-carried items	0.69

For SI: 1 foot = 304.8 mm, 1 watt per square foot = 10.76 w/m^2.

a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply.

b. A ‘Facility for the Visually Impaired’ is a facility that is licensed or will be licensed by local or state authorities for senior long-term care, adult daycare, senior support or people with special visual needs.

c. ~~Where sleeping units are excluded from lighting power calculations by application of Section R404.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.~~

d. ~~Where dwelling units are excluded from lighting power calculations by application of Section R404.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.~~

e. c. Class I facilities consist of professional facilities; and semiprofessional, collegiate, or club facilities with seating for 5,000 or more spectators.

f. d. Class II facilities consist of collegiate and semiprofessional facilities with seating for fewer than 5,000 spectators; club facilities with seating for between 2,000 and 5,000 spectators; and amateur league and high school facilities with seating for more than 2,000 spectators.

g. e. Class III facilities consist of club, amateur league and high school facilities with seating for 2,000 or fewer spectators.

h. f. Class IV facilities consist of elementary school and recreational facilities; and amateur league and high school facilities without provision for spectators.

C405.3.2.2.1 Additional interior lighting power. Where using the Space-by-Space Method, an increase in the interior lighting power allowance is permitted for specific lighting functions. Additional power shall be permitted only where the specified lighting is installed and controlled in accordance with Section C405.2.5. This additional power shall be used only for the specified luminaires and shall not be used for any other purpose. An increase in the interior lighting power allowance is permitted in the following cases:

1. For lighting equipment to be installed in sales areas specifically to highlight merchandise, the additional lighting power shall be determined in accordance with Equation 4-11.

Additional interior lighting power allowance = 1000 W + (Retail Area 1 × 0.45 W/ft^2) + (Retail Area 2 × 0.45W/ft^2) + (Retail Area 3 × 1.05 W/ft^2) + (Retail Area 4 × 1.87 W/ft^2)

For SI units:

Additional interior lighting power allowance = 1000 W + (Retail Area 1 × 4.8 W/m^2) + (Retail Area 2 × 4.84 W/m^2) + (Retail Area 3 × 11 W/m^2) + (Retail Area 4 × 20 W/m^2)

Additional lighting power allowance = ~~1000~~ 750 W + (Retail Area 1 x ~~0.45~~ 0.40 W/ft^2) + (Retail Area 2 x ~~0.45~~ 0.40 W/ft^2) + (Retail Area 3 x ~~1.05~~ 0.70 W/ft^2) + (Retail Area 4 x ~~1.87~~ 1.00 W/ft^2)For SI units:Additional lighting power allowance = ~~1000~~ 750 W + (Retail Area 1 x ~~4.8~~ 4.3 W/m^2) + (Retail Area 2 x ~~4.8~~ 4.3 W/m^2) + (Retail Area 3 x ~~11~~ 7.5 W/m^2) + (Retail Area 4 x ~~20~~ 10.8 W/m^2)

(Equation 4-11)

where:Retail Area 1 = The floor area for all products not listed in Retail Area 2, 3 or 4R etail Area 2 = The floor area used for the sale of vehicles, sporting goods and small electronics.Retail Area 3 = The floor area used for the sale of furniture, clothing, cosmetics and artwork.Retail Area 4 = The floor area used for the sale of jewelry, crystal and china.

Exception: Other merchandise categories are permitted to be included in Retail Areas 2 through 4, provided that justification documenting the need for additional lighting power based on visual inspection, contrast or other critical display is approved by the code official.

2. For spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance or for highlighting art or exhibits, provided that the additional lighting power shall be not more than ~~0.9~~ 0.66 W/ft^2 (~~9.7~~ 7.1 W/m^2) in lobbies and not more than ~~0.75~~ 0.55 W/ft^2 (~~8.1~~ 5.9 W/m^2) in other spaces.

Reason: combined correlated committee proposal based upon recommendations of other LPD proposals

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
correlation of recommended code change proposals

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal consolidates actions by the SC of the following CEPI-178, 179, 180, 182, 183, and 184 into one consensus proposal by improving indoor lighting efficiency for buildings.

Final Hearing Results

CECPI-7-21	AM

CED1-1-22

Original Proposal

IECC: SECTION C101, C101.1, C101.2, C101.3, C101.5, C101.5.1, SECTION C102 (New), C101.4, C101.4.1, C108.3, C108.2, C108.1, C108.1.1, C108.1.2, C107.1, SECTION C107, SECTION C108

Proponents: Mike Nugent, Chair, Building Code Action Committee (bcac@iccsafe.org); Anthony Floyd, Chair of SEHPCAC, Chair of SEHPCAC (sehpcac@iccsafe.org)

2024 International Energy Conservation Code [CE Project]

SECTION C101
SCOPE AND GENERAL REQUIREMENTS

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

C101.2 Scope. This code applies to *commercial buildings* and the buildings' sites and associated systems and equipment.

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

Revise as follows:

~~**C101.5**~~ **C101.4** **Compliance.** *Residential buildings* shall meet the provisions of IECC–Residential Provisions. *Commercial buildings* shall meet the provisions of IECC–Commercial Provisions.

~~**C101.5.1**~~ **C101.4.1** **Compliance materials.** The *code official* shall be permitted to approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this code.

Add new text as follows:

SECTION C102
APPLICABILITY

Revise as follows:

~~**C101.4**~~ **C102.1** **Applicability.** Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.

~~**C101.4.1**~~ **C102.1.1** **Mixed residential and commercial buildings.** Where a building includes both *residential building* and *commercial building* portions, each portion shall be separately considered and meet the applicable provisions of IECC–Commercial Provisions or IECC –Residential Provisions.

~~**C108.3**~~ **C102.2** **Other laws.** The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law.

~~**C108.2**~~ **C102.3** **Applications of references.** References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this code.

~~C108.1~~ C102.4 Referenced codes and standards. The codes and standards referenced in this code shall be those listed in Chapter 6, and such codes and standards shall be considered as part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections ~~C108.1.1~~ C102.4.1 and ~~C108.1.2~~ C102.4.2.

~~C108.1.1~~ C102.4.1 Conflicts. Where conflicts occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.

~~C108.1.2~~ C102.4.2 Provisions in referenced codes and standards. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

~~C107.1~~ C102.5 ~~General~~ Partial invalidity. If a portion of this code is held to be illegal or void, such a decision shall not affect the validity of the remainder of this code.

Delete without substitution:

~~SECTION C107~~
~~VALIDITY~~

~~SECTION C108~~
~~REFERENCED STANDARDS~~

Reason: Right now many jurisdictions delete Chapter 1 of the codes and write their own unified Administrative provisions. Part of the reason for this is that it is not easy to see where the administrative provisions are similar or different. Chapter 1 of the I-codes should be different where applicable. However, if the administrative provisions are the same, it is important for the authority having jurisdiction to be able to identify that quickly. As we work on this throughout the codes, it is hoped that jurisdictions will use the Chapter 1's in the relative code.

The intent of this change is to have the provision in Section 101, Scope and General Requirements, and Section 102, Applicability, to contain the same basic points for all the codes. This will make compliance easier. For the IECC, this would involve some reorganization, including movement of the sections dealing with references standards (C108) and validity (C107). There are no changes to requirements. A similar proposal will be submitted for IECC Residential.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is a reorganization of administrative provisions with no change to technical requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: To correlate Chapter 1 of the IECC-C with the other family of I-Codes.

Final Hearing Results

CED1-1-22 AS

CED1-2-22

Original Proposal

IECC: SECTION C101, C101.2, 101.2.1 (New)

Proponents: Mike Nugent, Chair, Building Code Action Committee (bcac@iccsafe.org)

2024 International Energy Conservation Code [CE Project]

SECTION C101
SCOPE AND GENERAL REQUIREMENTS

C101.2 Scope. This code applies to *commercial buildings* and the buildings' sites and associated systems and equipment.

Add new text as follows:

101.2.1 Appendices. Provisions in the appendices shall not apply unless specifically adopted.

Reason: Appendices are in all of the codes except for IZC. The intent is to put information about their adoption for inclusion in the same location in all of the codes immediately following the section on scope. This is already the case in the IBC, IFC, IMC, IPSDC and IWUIC. ADM7-22 has added this section to ICCPC, IGCC, IPMC, and ISPSC. This section was relocated in the IEBC, IFGC, IPC and IRC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is an editorial coordination item.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: To correlate Chapter 1 of the IECC-C with the other family of I-Codes

Final Hearing Results

CED1-2-22 AS

CED1-3-22

Original Proposal

IECC: SECTION 103 (New), 103.1 (New), 103.2 (New), 103.3 (New)

Proponents: Mike Nugent, Chair, Building Code Action Committee (bcac@iccsafe.org); Anthony Floyd, Chair of SEHPCAC, Chair of SEHPCAC (sehpcac@iccsafe.org)

2024 International Energy Conservation Code [CE Project]

Add new text as follows:

SECTION 103
CODE COMPLIANCE AGENCY

103.1 Creation of enforcement agency. The [INSERT NAME OF DEPARTMENT] is hereby created and the official in charge thereof shall be known as the authority having jurisdiction (AHJ). The function of the agency shall be the implementation, administration and enforcement of the provisions of this code.

103.2 Appointment. The authority having jurisdiction (AHJ) shall be appointed by the chief appointing authority of the jurisdiction.

103.3 Deputies. In accordance with the prescribed procedures of this jurisdiction and with the concurrence of the appointing authority, the authority having jurisdiction (AHJ) shall have the authority to appoint a deputy authority having jurisdiction (AHJ) , other related technical officers, inspectors and other employees. Such employees shall have powers as delegated by the authority having jurisdiction (AHJ).

Reason: This section include provisions for the creation of the code compliance agency. Similar language is in the IBC, IFC, IPC, IMC, IFGC, IEBC, IPMC, IPSDC, IWUIC, IRC and IGCC.

The department's responsibilities are more than just 'enforcement' of the code. The fill in the blank for the name allows for the agency to develop a name appropriate to their jurisdiction and responsibilities. This also allows for the code official to appoint staff where needed.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is an editorial change with no change to construction requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: To correlate Chapter 1 of the IECC-C with the other family of I-Codes

Final Hearing Results

CED1-3-22	AS

CED1-5-22

Original Proposal

IECC: C105.2.2, C105.2.4

Proponents: Greg Johnson, Johnson & Associates Consulting Services, Johnson & Associates Consulting Services (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [CE Project]

Delete and substitute as follows:

~~**C105.2.2 Thermal envelope.** Inspections shall verify the correct type of insulation, *R*-values, location of insulation, fenestration, *U*-factor, SHGC and VT, and that air leakage controls are properly installed, as required by the code, *approved* plans and specifications~~.

C105.2.2 Building thermal envelope. Inspections shall verify the type of insulation, *R*-values, location of insulation, fenestration, *U*-factor, SHGC and VT, and that air leakage controls are installed, as required by the code, *approved* plans and specifications.

~~**C105.2.4 Mechanical system.** Inspections shall verify the installed HVAC equipment for the correct type and size, controls, insulation, *R*-values, system and damper air leakage, minimum fan efficiency, energy recovery and economizer as required by the code, *approved* plans and specifications.~~

C105.2.4 Mechanical system. Inspections shall verify the installed HVAC equipment for the type and size, controls, insulation, *R*-values, system and damper air leakage, minimum fan efficiency, energy recovery and economizer as required by the code, *approved* plans and specifications.

Reason: The stricken terms are subjective - always problematic - and unneeded. Inspections according to the approved plans addresses 'correct' and 'proper' installations.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This is an administrative issue. There is no impact on construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: To remove subjective and unenforceable terms I the two inspection requirements.

Final Hearing Results

CED1-5-22	AM

CED1-6-22

Original Proposal

IECC: SECTION C110, C110.1, C110.2, C110.3, 110.4 (New)

Proponents: Mike Nugent, Chair, Building Code Action Committee (bcac@iccsafe.org); Anthony Floyd, Chair of SEHPCAC, Chair of SEHPCAC (sehpcac@iccsafe.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

SECTION C110
~~BOARD~~ MEANS OF APPEALS

C110.1 General. In order to hear and decide appeals of orders, decisions or determinations made by the *code official* relative to the application and interpretation of this code, there shall be and is hereby created a board of appeals. ~~The *code official* shall be an ex officio member of said board but shall not have a vote on any matter before the board.~~ The board of appeals shall be appointed by the ~~applicable~~ governing ~~body~~ authority and shall hold office at its pleasure. The board shall adopt rules of procedure for conducting its business, and shall render all decisions and findings in writing to the appellant with a duplicate copy to the *code official*.

C110.2 Limitations on authority. An application for appeal shall be based on a claim that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an ~~equally good~~ equivalent or better form of construction is proposed. The board shall not have authority to waive requirements of this code.

C110.3 Qualifications. The board of appeals shall consist of members who are qualified by experience and trainingon matters pertaining to the provisions of this code and are not employees of the jurisdiction.

Add new text as follows:

110.4 Administration. The code official shall take action in accordance with the decisions of the board.

Reason: ADM40-19 was approved for IBC, IEBC, IFC, IWUIC, IPC, IMC, IFGC, ISPSC, IPMC, IPSDC, IECC-R and IGCC for revisions to the section on Means of Appeals. This item was disapproved for IECC Commercial and IRC. The result is an inconsistency with IECC Commercial and IRC.

The intent of this proposal is coordination for the means of appeals within the family of codes. Most of this was accomplished through ADM40-19 during the last cycle. Comments during the testimony, from the code development committees and subsequent discussions have suggested some minor improvements that were accomplished in ADM48-22 As Modified by Public Comments 1 and 2.

The change to the title is because the Administrative Chapter sets up the process and right to appeal. IECC-Commercial (and all the I-Codes) have an appendix for the Board of Appeals that can be use for guidance for forming that board.

General: The sentence about the code official not being a voting member of the board of appeals is proposed to be deleted. The fact about city employees not being a voting member of the board is already included in the section on qualifications. The code official is an important advisor for the Board of Appeals and this is addressed in the Appendix. The deletion of this sentence will not change that.

Limitation on authority. This is an editorial change for better English and code language.

Qualifications: The phrase for experience and training is slightly different in each code. Adding this idea to all codes would provide consistency.

Administration: The board, or jurisdiction can set a reasonable timeframe for the code official to act on the boards decision.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These are administration requirements, so there will be no change in construction requirements.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: To remove subjective and unenforceable language and to correlate Chapter 1 of the IECC-C with the other family of I-Codes.

Final Hearing Results

CED1-6-22	AM

CED1-9-22

Original Proposal

IECC: TABLE C405.3.2(2)

Proponents: Michael Myer, PNNL, Pacific Northwest National Laboratory (michael.myer@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C405.3.2(2) INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE TYPES[a]	LPD (watts/ft²)
Atrium	
Less than 40 feet in height	0.41
Greater than 40 feet in height	0.51
Audience seating area	
In an auditorium	0.57
In a gymnasium	0.23
In a motion picture theater	0.27
In a penitentiary	0.56
In a performing arts theater	1.09
In a religious building	0.72
In a sports arena	0.27
Otherwise	0.33
Banking activity area	0.56
Breakroom (See Lounge/breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	0.74
Otherwise	0.72
Computer room, data center	0.75
Conference/meeting/multipurpose room	0.88
Copy/print room	0.56
Corridor	
In a facility for the visually impaired (and not used primarily by the staff[b])	0.71
In a hospital	0.61
Otherwise	0.44
Courtroom	1.08
Dining area	
In bar/lounge or leisure dining	0.76
In cafeteria or fast food dining	0.36
In a facility for the visually impaired (and not used primarily by the staff[b])	1.22
In family dining	0.52
In a penitentiary	0.35
Otherwise	0.42
Electrical/mechanical room	0.71
Emergency vehicle garage	0.51
Food preparation area	1.19
Laboratory	
In or as a classroom	1.05
Otherwise	1.21
Laundry/washing area	0.51
Loading dock, interior	0.88
Lobby	
For an elevator	0.64
In a facility for the visually impaired (and not used primarily by the staff[b])	1.44
In a hotel	0.48
In a motion picture theater	0.20
In a performing arts theater	1.21
Otherwise	0.80
Locker room	0.43
Lounge/breakroom	
In a healthcare facility	0.77
Mother's Wellness Room	0.68
Otherwise	0.55
Office	

COMMON SPACE TYPES	LPD (watts/ft²)
Enclosed	0.73
Open plan	0.56
Parking area daylight transition zone	1.06
Parking area, interior	0.11
Pharmacy area	1.59
Restroom	
In a facility for the visually impaired (and not used primarily by the staf[b]f	0.96
Otherwise	0.74
Sales area	0.85
Seating area, general	0.21
Security screening general areas	0.64
Security screening in transportation facilities	0.93
Security screening transportation waiting area	0.56
Stairwell	0.47
Storage room	0.35
Vehicular maintenance area	0.59
Workshop	1.17
BUILDING TYPE SPECIFIC SPACE TYPES[a]	**LPD (watts/ft²)**
Automotive (see Vehicular maintenance area)	
Convention Center—exhibit space	0.50
Dormitory - Living Quarters	0.48
Facility for the visually impaired[b]	
In a chapel (and not used primarily by the staff)	0.58
In a recreation room (and not used primarily by the staff)	1.20
Fire Station - Sleeping Quarters	0.23
Gaming establishments	
High limits game	1.68
Slots	0.54
Sportsbook	0.82
Table games	1.09
Gymnasium/fitness center	
In an exercise area	0.82
In a playing area	0.82
Healthcare facility	
In an exam/treatment room	1.33
In an imaging room	0.94
In a medical supply room	0.56
In a nursery	0.87
In a nurse's station	1.07
In an operating room	2.26
Patient Room	0.78
In a physical therapy room	0.82
In a recovery room	1.18
In a telemedicine room	1.44
Library	
In a reading area	0.86
In the stacks	1.18
Manufacturing facility	
In a detailed manufacturing area	0.75
In an equipment room	0.73
In an extra-high-bay area (greater than 50 feet floor-to-ceiling height)	1.36
In a high-bay area (25-50 feet floor-to-ceiling height)	1.24
In a low-bay area (less than 25 feet floor-to-ceiling height)	0.86
Museum	
In a general exhibition area	0.31
In a restoration room	1.24
Performing arts theater—dressing room	0.39
Post office—sorting area	0.71
Religious buildings	
In a fellowship hall	0.50
In a worship/pulpit/choir area	0.75
Retail facilities	
In a dressing/fitting room	0.45
Hair salon	0.65
Nail salon	0.75
In a mall concourse	0.57
Massage space	0.81
Sports arena—playing area	
For a Class I facility[c]	2.86
For a Class II facility[d]	1.98
For a Class III facility[e]	1.29

COMMON SPACE TYPES	LPD (watts/ft²)
For a Class IV facility[f]	0.86
Sports arena-Pools	
For a Class I facility	2.20
For a Class II facility	1.47
For a Class III facility	0.99
For a Class IV facility	0.59
Transportation facility	
Airport hanger	1.36
At a terminal ticket counter	0.40
In a baggage/carousel area	0.28
Passenger loading area	0.71
In an airport concourse	0.49
Warehouse–storage area	
For medium to bulky, palletized items	0.33
For smaller, hand-carried items	0.69

For SI: 1 foot = 304.8 mm, 1 watt per square foot = 10.76 watts per square meter.

a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply.

b. A 'Facility for the Visually Impaired' is a facility that is licensed or will be licensed by local or state authorities for senior long-term care, adult daycare, senior support or people with special visual needs.

c. Class I facilities consist of professional facilities; and semiprofessional, collegiate, or club facilities with seating for 5,000 or more spectators.

d. Class II facilities consist of collegiate and semiprofessional facilities with seating for fewer than 5,000 spectators; club facilities with seating for between 2,000 and 5,000 spectators; and amateur league and high school facilities with seating for more than 2,000 spectators.

e. Class III facilities consist of club, amateur league and high school facilities with seating for 2,000 or fewer spectators.

f. Class IV facilities consist of elementary school and recreational facilities; and amateur league and high school facilities without provision for spectators.

Reason: The 2021 version had a provision that allowed lighting power density to not be determined for sleeping unit spaces; however there was no clear efficacy requirement. A 2024 proposal removed the lighting power density values for dormitory, fire quarters - sleeping units, and patient rooms. This 2024 proposal required sleeping unit spaces to have luminaires with an efficacy of not less than 45 lm/W.

45 lm/W is very low - linear fluorescent, CFL, HID, and LED luminaires all can meet this requirement. The models used to develop the LPD for those spaces used luminaires ranging from 80 - 120 lm/W. Removing the LPD requirement and establishing a luminaire efficacy minimum is expected to result in a decrease in energy efficiency in two different ways.

Reduction in energy efficiency #1: Luminaires providing the same amount of light would could use 1.9x more power. For example, a 3,000 lumen fixture at 83 lm/W would draw 36 W. The 2024 proposal would allow a fixture with a 45 lm/W minimum. Thus, the new 3,000 lumen fixture could draw 66 W. This represents a 1.8x increase in power assuming the 2021 and 2024 project were providing the same amount of light and similar type of fixtures.

Reduction in energy efficiency #2: Removes the LPD altogether. Spaces are allowed to trade power between the different spaces and do not need to meet each LPD value per space. However, the overall lighting power allowance limits the total amount of power. Removing the LPD requirement for these sleeping units no longer sets a limit on the total amount of power that could be installed in a space. If a designed space exceeds the LPD value in the table, the exceeded power must be offset elsewhere in the building. Removing the LPD requirement eliminates the offset elsewhere in the building. Therefore, those spaces could use more power regardless of the luminaires installed.

Beyond the reduction in energy efficiency considerations, there is a secondary issue. The Building Area Method values (Table C405.3.2(1)) are developed by applying a weighted average of the space LPD values (Table C405.3.2(2)). Eliminating the specific space LPD values would require the Building Area Method LPD values for Dormitory, Fire Station, Hospital, and Hotel all to be changed.

Bibliography: No bibliography

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Proposed code change restores text omitted - no cost impact.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposal accommodates the specific lighting needs of patient rooms.

Final Hearing Results

CED1-9-22	AM

CED1-12-22

Original Proposal

IECC: C505.1, C505.2

Proponents: Daniel Carroll, New York State, Department of State DBSC (daniel.carroll@dos.ny.gov); Emma Gonzalez-Laders, New York State, Dept. of State/DBSC (emma.gonzalez-laders@dos.ny.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C505.1 General. Spaces undergoing a change in occupancy from F, H, S or U occupancy classification shall comply with Section C503. Buildings or portions of buildings undergoing a change of occupancy without alterations shall comply with Section ~~C502.2~~C505.2.

Exception: Where the total building performance option in Section C407 is used to comply with this section, the annual energy cost of the proposed design shall not be greater than 110 percent of the annual energy cost otherwise permitted by Section C407.3.

C505.2 Energy use intensities. Building envelope, space heating, cooling, ventilation, lighting and service water heating shall comply with Sections C505.2.1 through C505.2.4.

Exceptions:

1. Where it is demonstrated by analysis approved by the*code official* that the change will not increase energy use intensity.
2. Where the occupancy or use change is less than 5,000 square feet (464 m^2) in area.

Reason: Section C505.1 currently references Section C502.1, which addresses nonconditioned and low-energy space altered to become conditioned space, an addition. The correct reference should be Section C505.2, which addresses energy use intensities.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change is editorial.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: To correct pointer to the applicable section required for compliance.

Final Hearing Results

CED1-12-22	AS

CED1-13-22

Original Proposal

IECC: ASHRAE Chapter 06

Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

140~~-2014~~2020:	~~Standard~~ Method of Test for Evaluating~~the Evaluation of~~ Building Performance Simulation Software~~Energy Analysis Computer Programs~~

Reason: Since publication of ANSI/ASHRAE 140-2014 (the most recently referenced version by IECC 2021), the following major revisions have occurred:

- Air-Side HVAC Equipment Analytical Verification Tests (140-2020 Section 5.5) are added
- Building Thermal Envelope and Fabric Load Tests (140-2020, Sections 5.2.1, 5.2.2, and 5.2.3) are updated with new test cases included.

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

The expected additional cost impact on the software development industry is minimal for updating the reference in IECC 2024 to Standard 140-2020. The primary cost of applying the Standard 140 test suites is for software developers to create input files for the new test cases, analyze the results, and then report their output. However, most major software developers have already run the new and updated test suites, either during simulation trials of the new and updated test suites or as part of other software qualification requirements (e.g., forthcoming updates to Standard 140 acceptance criteria).

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: To ensure compliance with the most current requirements of the referenced standard.

Final Hearing Results

CED1-13-22	AS

CED1-15-22

Original Proposal

IECC: APPENDIX CG (New), SECTION CG101 (New), CG101.1 (New), CG101.2 (New), SECTION CG102 (New), CG102 (New), SECTION CG103 (New), CG103.1 (New), CG103.2 (New), CG103.2.1 (New), CG103.2.2 (New), CG103.2.3 (New), CG103.2.4 (New), CG103.2.5 (New), CG103.2.5.1 (New), CG103.2.5.2 (New), CG103.2.6 (New), CG103.2.7 (New), CG103.2.8 (New), CG103.3 (New), CG103.4 (New), CG103.5 (New), CG103.6 (New), SECTION CG104 (New), CG104.1 (New), CG104.2 (New), CG104.3 (New), CG104.4 (New), CG104.5 (New), CG104.6 (New), ASHRAE Chapter 06 (New)

Proponents: Diana Burk, New Buildings Institute, New Buildings Institute (diana@newbuildings.org); Michael Waite, American Council for an Energy-Efficient Economy, American Council for an Energy-Efficient Economy (mwaite@aceee.org); John Bade, 2050 Partners, California Investor Owned Utilities (johnbade@2050partners.com); Rachael Dorothy, PE, self, self (dorothy.2@osu.edu); Stephanie Greene, RMI, RMI (esherman@rmi.org); Melissa Kops, CT Green Building Council, CT Green Building Council (melissa@ctgbc.org); Andy Woommavovah, Trinity, Healthcare (andy.woommavovah@trinity-health.org); Jenny Amanda Hernandez, City of Las Cruces, Las Cruces Sustainability (jehernandez@las-cruces.org); Khaled Mansy, Oklahoma State University, self (khaled.mansy@okstate.edu); Brad Smith, City of Fort Collins, City of Fort Collins (brsmith@fcgov.com); Brad Hill, Honeywell, Honeywell International Inc. (brad.hill@honeywell.com); David Goldstein, NRDC, Natural Resources Defense Council (dgoldstein.nrdc@gmail.com)

2024 International Energy Conservation Code [CE Project]

Add new text as follows:

APPENDIX CG
ALL-ELECTRIC COMMERCIAL BUILDING PROVISIONS

SECTION CG101
GENERAL

CG101.1 Intent. The intent of this Appendix is to amend the *International Energy Conservation Code* to reduce greenhouse gas emissions from buildings and improve the safety and health for commercial building occupants by requiring new *all-electric buildings* and efficient electrification of existing buildings.

CG101.2 Scope. The provisions in this appendix are applicable to commercial buildings. New construction shall comply with Section CG103. *Additions*, *alterations*, *repairs* and *changes of occupancy* to existing buildings shall comply with Chapter 5 and Section CG104.

SECTION CG102
DEFINITIONS

CG102 ALL-ELECTRIC BUILDING. A building using no purchased energy other than electricity when utility power is available.

CG102 APPLIANCE. A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements.

CG102 COMBUSTION EQUIPMENT. Anyequipment or *appliance* used for space heating, *service water heating*, cooking, clothes drying, humidification, or lighting that uses *fuel gas* or *fuel oil*. **CG102 PURCHASED ENERGY.** Energy or power purchased for consumption and delivered to the building site.

CG102 SUBSTANTIAL IMPROVEMENT. Any *repair*, reconstruction, rehabilitation, *alteration*, *addition* or other improvement of a building or structure, the cost of which equals or is more than 50 percent of the market value of the structure before the improvement. Where the structure has sustained *substantial damage*, as defined in the International Building Code, any repairs are considered substantial improvement regardless of the actual *repair* work performed. Substantial improvement does not include the following:

1. Improvement of a *building* required to correct health, sanitary or safety code violations ordered by the*building official, or*
2. A*lteration* of a *historic building* where the *alteration* will not affect the building's designation as a *historic building.*

SECTION CG103
NEW COMMERCIAL BUILDINGS

CG103.1 Application. New commercial buildings shall be *all-electric buildings* and comply with Sections C401.2.1 or C401.2.2.

1. Purchased energy other than electricity shall be permitted where it has been demonstrated to the building official that the building is required by an applicable law or regulation to provide space heating with an emergency power system or a standby power system.
2. Purchased energy shall be permitted for an emergency power system or a standby power system.

CG103.2 Electric resistance heating equipment. The sole use of electric resistance equipment and appliances for space and water heating shall be prohibited other than for *buildings* or portions of *buildings* that comply with not less than one of Sections CG103.2.1 through CG103.2.8.

CG103.2.1 Low space heating capacity. Electric resistance appliances or equipment shall be permitted in buildings or areas of buildings not served by a mechanical cooling system and with a total space heating capacity not greater than 4.0 BTU/h (1.2 watts) per square foot of *conditioned space.*

CG103.2.2 Small systems. Buildings in which electric resistance *appliances* or equipment comprise less than 5 percent of the total system heating capacity or serve less than 5 percent of the *conditioned floor area.*

CG103.2.3 Specific conditions. Portions of buildings or specific equipment and appliances that require electric resistance heating that cannot practicably be served by electric heat pumps as approved.

CG103.2.4 Kitchen make-up air. Make-up air for commercial kitchen exhaust systems required to be tempered by Section 508.1.1 of the International Mechanical Code is permitted to be heated by electric resistance.

CG103.2.5 Freeze protection. The use of electric resistance heat for freeze protection shall comply with Sections CG103.2.5.1 through CG103.2.5.2.

CG103.2.5.1 Low indoor design conditions. Space heating systems sized for spaces with indoor design conditions of not greater than 40°F (4.5°C) and intended for freeze protection, including temporary systems in unfinished spaces, shall be permitted to use electric resistance. The building envelope of any such space shall be insulated in compliance with Section C402.1.

CG103.2.5.2 Freeze protection systems. Freeze protection systems shall comply with Section C403.13.3.

CG103.2.6 Pre-heating of outdoor air. Systems with energy recovery ventilation shall be permitted to utilize electric resistance to preheat outdoor air for defrost or temper air entering the energy recovery device to not more than 45°F (7.2°C). Hydronic systems without energy recovery ventilation shall be permitted to utilize electric resistance to temper air entering the energy recovery device to not more than 40°F (4.5°C).

CG103.2.7 Small buildings. Buildings with a conditioned floor area of not more than 250 square feet (23.2 m^2) and not served by a mechanical space cooling system shall be permitted to use electric resistance *appliances* or equipment for space heating.

CG103.2.8 Supplemental heat. Electric resistance heat shall be permitted as supplemental heat when installed with heat pumps sized in accordance with Section CG103.3 and when operated only when a heat pump cannot provide the necessary heating energy to satisfy the thermostat setting.

CG103.3 Heat pump sizing for space heating. Heat pump space heating systems shall be sized to meet the*building* heating load at the greater of 0°F (-18°C) or the 99 Percent Annual Heating Dry-Bulb for the nearest weather station provided in the ASHRAE Handbook of Fundamentals. The heat pump space heating system shall not require the use of supplemental electric heat at or above this temperature other than for defrosting. Lower capacity heat pumps that operate in conjunction with thermal storage shall be permitted if the system meets the requirements of this section.

CG103.4 Heat pump sizing for water heating. Heat pump *service heating system*s shall be sized to meet not less than the*building service water heating* load at the greater of 15°F (-9.5°C) or the 99 Percent Annual Heating Dry-Bulb for the nearest weather station provided in the latest edition of the ASHRAE Fundamentals Handbook. Supplemental electric heat shall not be required at or above this temperature other than for temperature maintenance in recirculating systems and defrosting.

CG103.5 Heating outside a building. Systems for heating outside a building shall comply with C403.13.1.

CG103.6 Low capacity cooling equipment. Air conditioners with capacity less than 240,000 Btu/hr (70 kW) shall be electric heat pump equipment sized and configured to provide both space cooling and space heating.

SECTION CG104
EXISTING COMMERCIAL BUILDINGS

CG104.1 Combustion equipment in additions. *Additions shall use no purchased energy other than electricity and new equipment installed to serve additions shall use no purchased energy other than electricity. Where existing systems using purchased energy other than electricity serve an addition, the existing building and addition together shall use no more purchased energy other than electricity than the existing building alone.*

CG104.2 Substantial improvement. Buildings undergoing *substantial improvements* shall be *all-electric buildings*, comply with C402.5 and meet a site EUI by building type in accordance with ASHRAE Standard 100 Table 7-2a. **Exception:** Compliance with Standard 100 shall not be required where Group R occupancies achieve an ERI score of 80 or below without on-site renewable energy included in accordance with RESNET/ICC 301, for each dwelling unit.

CG104.3 Cooling equipment. New and replacement air conditioners shall be electric heat pump equipment sized and configured to provide both space cooling and space heating. Any existing space heating systems other than existing heat pump equipment that serve the same zone as the new equipment shall be configured as supplementary heat in accordance with Section CG104.6.

CG104.4 Service water heating equipment. Where water heaters are added or replaced, they shall use no purchased energy other than electricity.

CG104.5 Furnace replacement. Newly installed warm air furnaces provided for space heating shall only be permitted as supplementary heat controlled in accordance with Section CG104.6.

CG104.6 Heat pump supplementary heat. Heat pumps having *combustion equipment* or electric resistance equipment for supplementary space or *service water heating* shall have controls that limit supplemental heat operation to only those times when one of the following applies:

1. The heat pump is operating in defrost mode.
2. The vapor compression cycle malfunctions.

3. For space heating systems, the thermostat malfunctions.
4. For space heating systems, the vapor compression cycle cannot provide the necessary heating energy to satisfy the thermostat setting.
5. The outdoor air temperature is less than the design temperature determined in accordance with Section CG103.3.
6. For *service water heating*, the heat pump *water heater* cannot maintain an output water temperature of not less than 120°F (49°C) .
7. For temperature maintenance in *service water heating* systems.

New supplementary space and *service water heating* systems for heat pump equipment shall not be permitted to have a heating output capacity greater than the heating output capacity of the heat pump equipment.

Add new standard(s) as follows:

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

100-2018 Energy Efficiency in Existing Buildings

Reason: In order for the U.S. to reach net zero carbon emissions, the country must not only reduce energy use through energy efficiency and move to utility scale and on-site renewable energy, but also begin to transition away from using combustion equipment in buildings that runs on fossil fuels to electric equipment. In 2021, combustion equipment in commercial and residential buildings accounted for 35% of US greenhouse gas emissions.[1] The purpose of a model code is to provide cities and states with a starting point on which each jurisdiction can base their energy code. Growing interest in establishing all-electric building requirements is evidenced by several cities and states passing ordinances banning fossil fuel combustion equipment in buildings including Washington DC, New York City, Ithaca, New York; Brookline, Massachusetts; Berkeley, Los Angeles, Sacramento, San Francisco, Oakland and San Jose, California; and Washington State. Including an appendix in the 2024 IECC that specifies requirements for all-electric commercial construction will streamline adoption and implementation of all-electric construction for policy makers and the building industry. We strongly encourage that the code language in this appendix minimizes the use of inefficient electric resistance heat for space heating in new buildings to avoid an unintended consequence of higher operational costs and carbon emissions for the life of the building. Attached is a letter with others stating the support for this proposal from 50 organizations, 16 of which are from local or state governments and universities, 12 of which are from NGOs, and 22 of which are from design and construction industry. In addition to the letter of support, this proposal includes more than 30 co-proponents.

All-electric buildings not only reduce carbon emissions but are also healthier for building occupants. Gas appliances release harmful pollutants like nitrogen dioxide (NO2) and carbon monoxide (CO) either indoors because of gas stoves or outdoors because of space-heating and water heating equipment. A recent study from the Harvard Chang School of Public Health and RMI shows that in Illinois in 2017, air pollution from burning fuels in buildings led to an estimated 1,123 early deaths and $12.574 billion in health impact costs.[2] These emissions can particularly affect children. In a meta-analysis analyzing the connections between gas stoves and childhood asthma, children in homes with gas stoves were 42% more likely to experience asthma symptoms, and 32% more likely to being diagnosed with asthma.[3]Therefore, ensuring all-electric appliances are installed is critical to reducing air pollution, protecting public health, reducing utility and construction costs, and meeting climate goals.NBI, ACEEE, and 2050 Partners on behalf of the California Investor Owned Utilities worked together to address many of the technical concerns raised when NBI's original proposal, CEPI-22, was discussed in June of 2022. The main revisions to this proposal include:

1. Separating the original CEPI-22 proposal into three pieces, an electric-ready proposal, an all-electric appendix, and a requirement for more energy efficiency credits in buildings that do not primarily use heat pumps for space and water heating. Each piece stands alone with its own independent support, so each proposal can be discussed and voted on separately.
2. Ensuring that jurisdictions encourage efficient electrification by only allowing the use of electric resistance heat for space and water heating in certain applications.
3. Additional requirements on appropriately sizing heat pumps for space heating and water heating are included so that electric resistance heat for supplementary heat is reduced. 2050 partners is conducting additional modeling to for a variety of building types in multiple climate zones to determine if additional requirements are needed. This modeling is not yet complete but will be complete before

the commercial consensus committee considers this proposal.

4. A new section addressing the use of combustion equipment in existing buildings. This new section:

a. Does not permit new combustion equipment in additions

b. Requires buildings undergoing a substantial improvement, defined as work that exceeds 50% of the market value of the structure to both be all-electric and meet EUI targets outlined in ASHRAE Standard 100.

c. Incentivizes heat pumps in new buildings by requiring buildings undergoing a substantial energy alteration to achieve additional energy efficiency credits.

d. Requires new and replacement cooling equipment to be electric heat pump equipment configured to provide both space cooling and space heating and requires existing space heating systems that are not heat pump systems are required to provide supplementary heat.

e. Requires new or replacement service hot water equipment to be electric.

f. Requires new furnaces provided for space heating to only be permitted to be used as supplementary heat.

g. Reduces the use of electric resistance and combustion equipment for supplementary heat through the use of improved controls.

Bibliography: [1] "U.S. Energy Information Administration - EIA - Independent Statistics and Analysis."*Energy and the Environment Explained: Where Greenhouse Gases Come From*, U.S. Energy Information Administration (EIA), https://www.eia.gov/energyexplained/energy-and-the-environment/where-greenhouse-gases-come-from.php#:~:text=In%202021%2C%20petroleum%20accounted%20for,energy%2Drelated%20CO2%20emissions.

[2] *Health Air Quality Impacts of Buildings Emissions*. RMI, 5 May 2021, rmi.org/health-air-quality-impacts-of-buildings-emissions#MI.

[3] *Gas Stoves: Health and Air Quality Impacts and Solutions.* RMI, 1 Feb. 2021, rmi.org/insight/gas-stoves-pollution-health/.

[4] *Cost Study of the Building Decarbonization Code* , New Buildings Institute, Apr. 2022, https://newbuildings.org/wp-content/uploads/2022/04/BuildingDecarbCostStudy.pdf.

[5] "U.S. Energy Information Administration - EIA - Independent Statistics and Analysis."*Commercial Buildings Energy Consumption Survey (CBECS)*, Energy Information Administration (EIA), 2018, https://www.eia.gov/consumption/commercial/data/2018/pdf/CBECS_2018_Building_Characteristics_Flipbook.pdf.

[6] Slanger, Dan. *Reality Check: The Myth of Stable and Affordable Natural Gas Prices*, RMI, 5 May 2022, https://rmi.org/the-myth-of-stable-and-affordable-natural-gas-prices/.

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

All-electric commercial buildings are less expensive to build than mixed fuel buildings because electric appliances and equipment are typically less expensive than combustion equipment and appliances. In additional developers avoid the cost of installing natural-gas lines and meters. Recent analysis by NBI and partners utilizing data from RS Means indicates that an all-electric 53,000 s.f. office building with a central heat pump water heater and minimum code compliant air source heat pump costs $0.07/s.f. to $0.24/s.f. less to build than a mixed-fuel office building of the same size. [4] Additional analyses from a recent CASE study indicate that all-electric high-rise multifamily buildings are also less expensive to build and operate than mixed-fuel buildings. HVAC costs, for example, are on the order of $2,504 to $7,131 lower per dwelling unit depending on the HVAC system installed. Installing electric space heating and water heating equipment instead of natural gas equipment in the majority of California's climate zones also yielded a positive benefit to cost ratio over the 15- year analysis period despite California's high electricity rates. This is perhaps why close to half of commercial buildings currently do not use natural gas. [5] Moving to all-electric construction also results in more stable utility bills because electricity prices are not as volatile as natural gas prices. [6]

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Provides the optional ability for jurisdictions to adopt all-electric provisions to support further reducing carbon emissions and healthier buildings.

Final Hearing Results

CED1-15-22	AM

CED1-27-22

Original Proposal

IECC: C405.1, C405.2.5, C405.2.10 (New), C405.2.10.1 (New), C405.2.10.2 (New)
Proponents: Jack Bailey, ONE LUX STUDIO, INTERNATIONAL ASSOCIATION OF LIGHTING DESIGNERS (jbailey@oneluxstudio.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.1 General. Electrical power and lighting systems and generation shall comply with this section. *Sleeping units* and *dwelling units* in hotels, motels, congregate living, and vacation timeshare properties shall comply with Section ~~C405.2.5~~ C405.2.10 and with Section C405.1.1 . *General lighting* shall consist of all lighting included when calculating the total connected interior lighting power in accordance with Section C405.3.1 and which does not require specific application controls in accordance with Section C405.2.5.

C405.2.5 Specific application controls. Specific application controls shall be provided for the following:

1. The following lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a time-switch control complying with Section C405.2.2.1. In addition, a manual control shall be provided to control such lighting separately from the general lighting in the space:
   1.1. Luminaires for which additional lighting power is claimed in accordance with Section C405.3.2.2.1.
   1.2. Display and accent lighting, including lighting in display cases.
   1.3. Lighting in display cases.
   1.3 Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting.
   1.4 Lighting equipment that is for sale or demonstration in lighting education.
2. ~~*Sleeping units* shall have control devices or systems that are configured to automatically switch off all installed luminaires and switched receptacles within 20 minutes after all occupants have left the unit.~~

   ~~**Exceptions:**~~

   ~~1. Lighting and switched receptacles controlled by card key controls in buildings containing fewer than 50 sleeping units.~~
   ~~2. Spaces where patient care is directly provided.~~

~~3.~~ 2. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a time switch control complying with Section C405.2.2.1 that is independent of the controls for other lighting within the room or space.

~~4.~~ 3. Task lighting for medical and dental purposes that is in addition to *general lighting* shall be provided with a *manual control*.

Add new text as follows:

C405.2.10 Sleeping unit and dwelling unit lighting and switched receptacle controls. *Sleeping units* and *dwelling units* shall be provided with lighting controls and switched receptacles as specified in C405.2.10.1 and C405.2.10.2.

C405.2.10.1 Sleeping units and dwelling units in hotels, motels, and vacation timeshare properties. *Sleeping units* and *dwelling units* in hotels motels and vacation timeshare properties shall be provided with the following:

1. At least two 125V, 15- and 20- amp switched receptacles per room, except for bathrooms, kitchens, foyers, hallways, and closets.

2. Lighting controls that automatically turn off all lighting and switched receptacles within 20 minutes after all occupants have left the unit

Exception: Automatic shutoff is not required where *captive key override* controls all lighting and switched receptacles in units with 5 or fewer permanently installed lights and switched receptacles.

C405.2.10.2 Sleeping units in congregate living facilities. *Sleeping units* in *congregate living facilities* shall be provided with the following controls:

1. Lighting in bathrooms shall be controlled by an *occupant sensor control* that automatically turns lights off within 20 minutes after all occupants have left the space.
2. Each unit shall have a *manual* control by the entrance that turns off all lighting and switched receptacles in the unit, except for lighting in bathrooms. The *manual* control shall be clearly labeled.

Reason: To improve usability, cost-effectiveness, energy efficiency, and functionality.

Usability

C405.2.5 "Specific Application Controls" includes requirements for special lighting applications which are found throughout many different space types on a project. When we have control requirements that are specific to a space type (like Parking Garages) this should be a separate subsection of C405.2, rather than being added to the list in C405.2.5.

The phrase "control devices or systems that are configured to automatically switch off..." is edited to "lighting controls that automatically switch off..."

The term "card key controls" is replaced with the defined term "*captive key override*" which has been in the code for the last couple of cycles.

Cost-Effectiveness

The exception that allows *captive key override* controls to be used instead of a more complicated and expensive occupancy-based control system is changed from hotels with 50 or fewer units to units with 6 or fewer lights and switched receptacles to control. This will allow basic guest rooms (two lights in the bathroom + a light at the door + a light on the ceiling + two switched receptacles) to continue to use *captive key override* controls, and will limit the requirement to use more expensive systems to larger units with more lighting to control. The number of units in the hotel is not related to how many lights are installed in each room.

Energy Efficiency

When a guest room in a hotel or motel has both a kitchen and a bathroom, it is a dwelling unit. Therefore the code currently has no requirement that lighting controls be provided in larger hotel suites, only in smaller guest rooms. This is backwards. By applying the controls requirements in hotels to include "dwelling units" we increase the stringency of the code.

"Vacation Timeshare Properties" is a classification in Group R-2 in the IBC. These properties are often indistinguishable from hotels and motels and share the characteristics of being pre-furnished and not having separately metered power for each unit. By adding "vacation timeshare properties" to the scope of these requirements we will improve energy efficiency.

Most lighting in hotel and motel guest rooms is plugged in. This lighting is not required to be shown when filing for permit, and is not subject to enforcement during inspections. In other words, the hotel owner is free to plug whatever they want into guest room receptacles when they furnish the room. This means that our energy code provisions related to guest room lighting controls are not terribly effective as they probably miss more than half of the lighting that actually goes into these rooms. This proposal would remedy that problem by requiring switched receptacles to be provided in bedrooms and living / sitting rooms. Two receptacles are required per room. These receptacles would be energized when the lighting system for the room is energized.

Functionality

The existing code language would require automatic control systems to be provided in all sleeping units except for I-2. This includes following space types: Alcohol and Drug Centers, Halfway Houses, Social Rehabilitation Facilities, Group Homes, and Prisons. People under custodial care in these facilities may not even have the ability to lock or unlock their own door. The code should not include specific lighting control requirements for these types of spaces - this should be determined exclusively by the functional requirements of the space.

"Congregate Living Facilities" is a defined term in Group R in the IBC. This includes Dormitories, Fraternities and Sororities, and similar occupancies. Living units in these occupancies are really more like dwelling units in their lighting control needs. Rather than requiring that these be controlled like hotel guest rooms, this proposal would require that they are provided with a master off switch by the door, similar to the requirement in L05 (Residential Light Control). For added efficiency, an occupant sensor is required in the bathroom.

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

Provisions in this proposal will increase costs in some projects, and decrease costs in others. On the whole, the sensitivity to reducing costs in smaller, cheaper hotel rooms + the simplification of controls requirements in congregate living facilities will outweigh the additional cost in hotel suites and vacation timeshare properties and result in a net cost savings.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Improves efficiency while providing reasonable exceptions for some sleeping units to not install occupant sensors.

Final Hearing Results

CED1-27-22	AM

CED1-29-22

Original Proposal

IECC: C405.1.1

Proponents: Diana Burk, New Buildings Institute, New Buildings Institute (diana@newbuildings.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.1.1 Lighting for dwelling units. ~~No less than 90 percent of the p~~Permanently installed lighting serving sleeping units and dwelling units shall be provided by lamps with an efficacy of not less than 65 lm/W or luminaires with an efficacy of not less than 45 lm/W.

Exceptions:

1. Lighting integral to a kitchen appliance or exhaust hood.
2. Antimicrobial lighting used for the sole purpose of disinfecting.
3. Luminaires with an input rating of less than 3W.

Reason: This proposal seeks to align the lighting requirements of multifamily dwelling units between the residential and commercial codes in order to ensure consistency between substantially similar multifamily buildings. Currently there are discrepancies in the lighting provisions between a three-story multifamily building and a four-story multifamily building. This leads to market confusion, enforcement inconsistencies, and large potential untapped energy savings. This revision seeks to close this gap by incorporating lighting requirements approved by the 2024 IECC residential consensus committee and create a common set of lighting requirements for multifamily buildings.

The 2022 version of Title 24 has created a new section to regulate multifamily buildings - similar to a more "omnibus" proposal submitted by NBI previously. Based on feedback from that submission, which advised not creating a new section, this proposal instead works to align the sections that currently exist.

Attached is a letter stating support for this proposal from 40 organizations, 9 of which are from local or state governments and universities, 11 of which are from NGOs, and 20 of which are from design and construction industry.

Bibliography: https://newbuildings.org/resource/multifamily-building-guide/
https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These changes match current market availability of products and should not change the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: to provide consistency with the residential code for dwelling units and add an exception for very low wattage luminaires.

Final Hearing Results

CED1-29-22 AM

CED1-30-22

Original Proposal

IECC: C405.13, C405.13.2, TABLE C405.13.2, C405.13.3, C405.13.4, C405.13.5, C405.13.6, C405.13.7, C405.13.8
Proponents: Anthony Floyd, Chair of SEHPCAC, Chair of SEHPCAC (sehpcac@iccsafe.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.13 Energy monitoring. New buildings ~~Buildings~~ with a gross conditioned floor area of not less than 10,000 square feet (929 m^2) shall be equipped to measure, monitor, record and report energy consumption data in compliance with Sections C405.13.1 through C405.13.5. A plan for quantifying annual energy type and end-use disclosure in compliance with Sections C405.13.1 through C405.13.8 shall be submitted with the construction documents.

Exceptions:

~~1. *Buildings* less than 10,000 square feet (929 m^2).~~

~~2. Existing buildings~~

~~3.~~ 1. R-2 occupancies ~~with less than 10,000 square feet (929 m^2) of *common area*~~.

~~4.~~ 2. Individual tenant spaces are not required to comply with this section provided that the space has its own utility services and meters and has less than 5,000 square feet (464.5 m^2) ~~with their own utility service and meter~~. of conditioned floor area.

C405.13.2 End-use ~~electric~~ metering categories. Meters or other approved measurement devices shall be provided to collect energy use data for each end-use category indicated in Table C405.13.2. Where multiple meters are used to measure any end-use category, the data acquisition system shall total all of the energy used by that category. Not more than 5 percent of the measured load for each of the end-use categories indicated in Table C405.13.2 shall be permitted to be from a load that is not within that category.

Exceptions:

1. HVAC and water heating equipment serving only an individual dwelling unit shall not require end-use metering.
2. End-use metering shall not be required for fire pumps, stairwell pressurization fans or any system that operates only during testing or emergency.
3. End-use metering shall not be required for an individual tenant space having a floor area not greater than 2,500 square feet (232 m^2) where a dedicated source meter complying with Section C405.13.3 is provided.

TABLE C405.13.2 ~~ELECTRICAL~~ ENERGY USE CATEGORIES

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	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 but not limited to data centers, manufacturing equipment and commercial kitchens.
Electric vehicle charging	*Electric vehicle* charging loads that are powered through the *building* service.

Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.
Electric hot water heating for uses other than space conditioning	Electricity used to generate hot water. **Exception:** Electric water heating with design capacity that is less than 10 percent of building service rating

C405.13.3 ~~Electrical~~ Meters. Meters or other measurement devices required by this section shall be configured to automatically communicate energy consumption data to the data acquisition system required by Section C405.13.4. Source meters shall be allowed to be any digital-type meter. Lighting, HVAC or other building systems that can self-monitor their energy consumption shall be permitted instead of meters. Current sensors shall be permitted, provided that they have a tested accuracy of ±2 percent. Required metering systems and equipment shall have the capability to provide at least hourly data that is fully integrated into the data acquisition system and graphical energy report in accordance with Sections C405.13.4 and C405.13.5.Non-intrusive load monitoring (NILM) packages that extract energy consumption data from detailed electric waveform analysis ~~can~~shall be permitted to substitute ~~substituted~~ for individual meters if the equivalent data ~~can be made~~ is available for collection in Section C405.13.4 and reporting in Section C405.13.5.

C405.13.4 Electrical energy data acquisition system. A data acquisition system shall have the capability to store the data from the required meters and other sensing devices for a minimum of 36 months. The data acquisition system shall have the capability to store real-time energy consumption data and provide hourly, daily, monthly and yearly logged data for each end-use category required by Section C405.13.2.The data acquisition system shall have the capability of providing building total peak electric demand and the time(s) of day and time(s) ~~of year~~ per month at which the peak occurs. Peak demand shall be integrated over the same time period as the underlyingwhole building meter reading rate~~, which is typically 15 minutes but shall be no longer than one hou~~.r

C405.13.5 Graphical energy report. A permanent and readily accessible reporting mechanism shall be provided in the building that is accessible by building operation and management personnel. The reporting mechanism shall have the capability to graphically provide the electrical energy consumption for each end-use category required by Section C405.13.2 ~~at least~~ not less than every hour, day, month and year for the previous 36 months. The graphical report shall ~~also~~ incorporate natural gas interval data or the ability to enter gas utility bills into the report.

C405.13.6 Non-electrical energy metering. Consumption of non-electrical fuel or energy sources including district heating or cooling, ~~energy such as gas, district heating or cooling, unregulated fuel sources, or other non-renewable energy~~shall be ~~automatically~~ metered in accordance with Section C405.13.2 and C405.12.3.~~or a method developed for usage calculation annually or more frequently from energy bills. Natural gas usage shall be monitored through on site interval metering or from utility interval data.~~

C405.13.7 Renewable energy. ~~The ability to measure the production of~~ on-site renewable energy sources shall be ~~provided~~ metered with ~~the same or greater~~ not less frequency ~~as~~ than non-renewable energy ~~metered~~ systems in accordance with Section C405.13.3**.**

C405.13.8 Plan for disclosure. The plan for annual energy use data gathering and disclosure shall include the following:

1. Property information including: ~~building type, total gross floor area, year built or year planned for construction completion, and occupancy type~~.

~~1.1~~ Address

~~1.2~~ Gross floor area

~~1.3~~ Year occupied

~~1.4~~ Occupancy classifications, with respective floor areas

2. Total annual building site energy use ~~per~~ by unit area ~~(square foot) of gross floor area~~ as collected or documented through Section C405.13.5 ~~(electrical)~~ and Section C405.13.6 ~~(non-electrical)~~ sources, separated by energy and fuel type ~~(electric, gas, district cooling or heating, unregulated fuel sources etc.). Electrical energy shall be further broken down by load type as identified in Table C405.13.2~~.

3. Annual site generated renewable energy ~~per~~ by unit area ~~(square foot) of gross floor area~~.

4. ~~Peak electric demand per unit area (square foot) of gross floor area, with an estimate of relative building system contribution to that peak, and the time and date of the peak.~~
5. ~~For projects using the Section C407 Simulated Building Performance approach to show compliance, include the following information from the building simulation:~~

   ~~5.1 Modeling software used~~.

   ~~5.2 Assumptions made that impact the simulated annual energy use per unit (square foot or square meter) of gross floor area (e.g. occupancy schedules, daylighting assumptions, climate file, plug loads, envelope performance including use of shading systems).~~

   ~~5.3 Simulated annual energy use per unit (square foot or square meter) of gross floor area~~.

   ~~5.4 Peak load, the time of date and time of peak and the hourly load profile on the day that experiences peak load~~.

Reason: The initial proposal under CEPI-203 altered the sub-metering requirements to focus solely on electrical and renewable systems with non-electric systems only requiring a utility meter. This is a substantial content change that regressed metering requirements for non-electric metering in way that does not support efficient building operation. The proposed revisions would reinstate the non-electric metering requirements present in the code today while refining the language proposed for the additional electric submetering added by CEPI-203. This revision also revised the original proposed language for the Plan for Disclosure section, recommending removal of language typically used for simulated measurement and verification that is out of place in a section dedicated to metering. An additional change was made to the exceptions as currently listed in the code that serves to clarify the intent of those exceptions.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is editorial in nature

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposal will clarify application of metering requirements to include all energy.

Final Hearing Results

CED1-30-22 AM

CED1-31-22

Original Proposal

IECC: C405.13, SECTION 202

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.13 Energy monitoring. Buildings shall be equipped to measure, monitor, record and report energy consumption data in compliance with Sections C405.13.1 through C405.13.5.A plan for quantifying annual energy type and use disclosure in compliance with Sections C405.13.1 through C405.13.8 shall be submitted with the construction documents.

Exceptions:

1. *Buildings* less than 10,000 square feet (929 m^2).
2. Existing buildings
3. <u>*Dwelling units i*n R-2 occupancies.</u>

~~3.~~ <u>4.</u> R-2 occupancies with less than 10,000 square feet (929 m^2) of *common area*.

~~4.~~ <u>5.</u> Individual tenant spaces less than 5,000 square feet (464.5 m^2) with their own utility service and meter.

COMMON AREA. All <u>conditioned spaces within</u> ~~portions of~~ Group R<u>occupancy buildings</u> ~~occupancies~~ that are not *dwelling units* or *sleeping units*.

Reason: Section C405.6 already requires a meter for each R-2 dwelling unit. We are not seriously considering benchmarking for dwelling units, are we? That's just another disincentive for code adoption.

The 'common area' definition is imprecise. Does it include pool equipment houses? Utility rooms? Parking garages? Given that each dwelling unit has its own meter, there is little reason to believe that metering 'common area' will save any energy; rather it will just add expense.

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

A low value - from an energy savings perspective - dwelling unit monitoring and reporting system is not required, reducing construction costs.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The addition of the exception for dwelling units in R-2 buildings addresses the unique situation of actual living units in how they work in practice.

Final Hearing Results

CED1-31-22 AM

CED1-36-22

Original Proposal

IECC: TABLE C405.13.2

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

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C405.13.2 ELECTRICAL ENERGY USE CATEGORIES

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	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 but not limited to data centers, manufacturing equipment and commercial kitchens.
Electric vehicle charging	*Electric vehicle* charging loads **that are powered through the *building's* electrical service**.
Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.
Electric hot water heating	Electricity used to generate hot water. **Exception:** Electric water heating with design capacity that is less than 10 percent of building service rating

Reason: At many commercial buildings, there will be EV charging provided by third parties, such as EV charging companies or cities or counties or utilities. These charging stations will be metered and billed separately from the building, and the building owner will have no say or control over their use of energy.

This provision is needed to avoid unnecessary wiring and metering of third party systems.

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

This will reduce costs for buildings that are provided EV charging by third parties.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Ensures the monitoring of EV charging loads does not include equipment and systems that are supplied by a separate service from an energy monitored building.

Final Hearing Results

CED1-36-22 AS

CED1-39-22

Original Proposal

IECC: SECTION 202, C405.14, C405.14.2, C405.14.3, C405.14.4, C405.14.4.1, C405.14.5, C405.14.5.1
Proponents: Bryan P. Holland, National Electrical Manufacturers Association (NEMA), National Electrical Manufacturers Association (NEMA) (bryan.holland@nema.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

ELECTRIC VEHICLE CAPABLE SPACE (EV CAPABLE SPACE). An ~~designated~~ automobile parking space ~~that is~~ provided with electrical infrastructure, such as, but not limited to, raceways, cables, enclosures, electrical capacity, and ~~panelboard or other~~ electrical distribution equipment space, necessary for ~~the future installation of an~~ connection to EVSE.

ELECTRIC VEHICLE READY SPACE (EV READY SPACE). An automobile parking space ~~that is~~ provided with a branch circuit and either an outlet or enclosure~~, junction box or receptacle, that will support an installed~~for connection to EVSE.

ELECTRIC VEHICLE SUPPLY EQUIPMENT INSTALLED SPACE (EVSE SPACE). An automobile parking space ~~that is provided with a dedicated~~ where operational EVSE has been installed ~~connection~~.

C405.14 Electric Vehicle Power Transfer Infrastructure. ~~New~~ Parking facilities shall be provided with electric vehicle power transfer infrastructure in ~~compliance~~ accordance with Sections C405.14.1 through C405.14.6.

C405.14.2 EV Capable Spaces. Each EV capable space used to meet the requirements of Section C405.14.1 shall comply with ~~all of~~ the following:

1. A continuous raceway or cable assembly shall be installed between an enclosure or outlet located within 3 feet (914 mm) of the EV capable space and ~~a suitable panelboard or other onsite~~ electrical distribution equipment.
2. Installed raceway or cable assembly shall be sized and rated to supply an minimum circuit capactiy in accordance with C405.14.5
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have ~~sufficient~~ dedicated overcurrent protection device space and ~~spare~~ electrical capacity to supply a calculated load in accordance with C405.14.5. ~~for a 2-pole circuit breaker or set of fuses.~~
4. The ~~electrical~~ enclosure or outlet and the electrical distribution equipment directory shall be marked: "For ~~future~~ electric vehicle supply equipment (EVSE)."
5. ~~Reserved capacity shall be no less than 4.1 kVA (20A 208/240V) for each EV capable space~~.

C405.14.3 EV Ready Spaces. Each branch circuit serving EV ready spaces used to meet the requirements of Section C405.14.1 shall comply with ~~all of~~ the following:

1. Terminate at an outlet or enclosure, located within 3 feet (914 mm) of each EV ready space it serves.
2. Have a minimum system and circuit capacity in accordance with C405.14.5.
3. The ~~panelboard or other~~ electrical distribution equipment directory shall designate the branch circuit as "For electric vehicle supply equipment (EVSE)" and the outlet or enclosure shall be marked "For electric vehicle supply equipment (EVSE)."

C405.14.4 EVSE Spaces. An installed EVSE with multiple output connections shall be permitted to serve multiple EVSE spaces. Each EVSE installed to meet the requirements of Section C405.14.1, serving either a single EVSE space or multiple EVSE spaces, shall comply with ~~all of~~ the following:

1. Have a minimum system and circuit capacity in accordance with C405.14.5.
2. ~~Have a minimum charging rate in accordance with C405.14.4.1~~.
3. Be located within 3 feet (914 mm) of each EVSE space it serves.
4. Be installed in accordance with Section C405.14.6.

~~**C405.14.4.1 EVSE Minimum Charging Rate.**~~ ~~Each installed EVSE shall comply with one of the following~~:

1. ~~Be capable of charging at a minimum rate of 6.2 kVA (or 30A at 208/240V)~~.
2. ~~When serving multiple EVSE spaces and controlled by an energy management system providing load management, be capable of simultaneously sharing each EVSE space at a minimum rate of no less than 3.3 kVA.~~
3. ~~When serving EVSE spaces allowed to have a minimum circuit capacity of 2.7 kVA in accordance with C405.14.5.1 and controlled by an energy management system providing load management, be capable of simultaneously charging each ESVE space at a minimum rate of no less than 2.1 kVA.~~

C405.14.5 System and Circuit Capacity. C405.14.5.1 System Capacity. The electrical distribution equipment supplying the branch circuit(s) serving each EV capable space, EV ready space, and EVSE space shall comply with one of the following:

1. Have a calculated load of 7.2 kVA or the nameplate rating of the equipment, whichever is larger.
2. Meets the requirements of C405.14.5.3.1

C405.14.5.2 Circuit Capacity. The branch circuit ~~capacity of electrical infrastructure~~ serving each EV capable space, EV ready space, and EVSE space shall comply with one of the following:

1. ~~A branch circuit shall~~ Have a rated capacity not less than ~~8.3 kVA (or 40A at 208/240V)~~ 50 amperes or the nameplate rating of the equipment, whichever is larger. ~~for each EV ready space or EVSE space it serves~~.
2. Meets the requirements of C405.14.5..3.2.

C405.14.5.3 System and Circuit Capacity Management. C405.14.5.3.1 System Capacity Management. The maximum equipment load on the electrical distribution equipment supplying the branch circuits(s) serving EV capable spaces, EV ready spaces, and EVSE spaces controlled by an energy management system shall be the maximum load permitted by the energy management system, but not less than 3.3 kVA per space. **C405.14.5.3.2 Circuit Capacity Management.** ~~The capacity of~~ Each branch circuit serving multiple EVSE spaces, EV ready spaces or EV capable spaces ~~designed to be~~ controlled by an energy management system ~~providing load management in accordance with NFPA 70,~~ shall comply with one of the following:

1. Have a minimum capacity of ~~4.1 kVA~~ 25 amperes per space.
2. Have a minimum capacity of ~~2.7 kVA~~ 20 amperes per space ~~when serving EV ready spaces or EVSE space~~ for R-2 occupancies when all ~~(100%) of the~~ automobile parking spaces ~~designated for R-2 occupancies~~ are ~~designed to be~~ EV ready spaces or EVSE spaces.

Reason: 1. Editorial revisions are made to the three definitions for added clarity and conciseness.

~~2.~~ The term “new” is unnecessary in C405.14 for a Chapter 4 rule as requirements for existing buildings are located in Chapter 5.

~~3.~~ List items 1-4 in C405.14.2 have been revised for conciseness and more technically correct terminology. List item 5 is no longer necessary as this is addressed in the revised list item 3.

~~4.~~ C405.14.3 and C405.14.4 have been revised for clarity and conciseness.

~~5.~~ C405.14.4.1 has been deleted as the EVSE “charging rate” is not the correct metric and better addressed in the revised C405.14.5 criteria.

~~6.~~ C405.14.5 has been expanded into four sections covering system capacity and circuit capacity, with or without energy management.

This aligns the criteria with the minimum requirements of the NEC while providing backstops to ensure effective system and circuit capacity is provided when the power rating of the EVSE is unknown or where an energy management system is utilized to reduce EVSE load demand.

~~7.~~ C405.14.5.1 ensures the service or feeder that supplies EVSE branch circuits has the minimum required capacity as required by section 220.57 and 625.42 of the NEC.

~~8.~~ C405.14.5.2 ensures the individual branch circuits that supply EVSE have the minimum required capacity as required by the 625.42 of the NEC.

~~9.~~ C405.14.5.3.1 provides both a maximum and minimum calculated load for the service or feeder that supplies EVSE branch circuits controlled by an energy management system.

~~10.~~ C405.14.5.3.2 ensures a minimum calculate load is provided for branch circuits controlled by and energy management system supplying more than EVSE as permitted in 625.40 of the NEC.

Here are examples of the calculations proposed in the public comment:

Example A: 10 EVSE spaces (kVA unknown)

C405.14.5.1 System Capacity: 10 x 7,200 VA = 72kVA capacity added to the service/feeder supplying EVSE branch circuits

C405.14.5.2 Circuit Capacity: 50A rated capacity for each of the 10 EVSE space branch circuits

Example B: 10 EVSE spaces, EMS installed having maximum EVSE capacity of 25kVA (kVA unknown)

C405.14.5.3.1 System Capacity Management: Maximum calculated load on the service/feeder supplying EVSE branch circuits is 25kVA with the minimum calculated load being 10 x 3,300 VA = 33 kVA.

C405.14.5.3.2 Circuit Capacity Management:

1. Each Branch Circuit, other than Group R-2, supplying 2 EVSE spaces each: 2 x 25A = 50A rated capacity for each of the 5 branch circuits

2. Each Branch Circuit, at Group R-2, supplying 2 EVSE spaces each: 2 x 20 A = 40A rated capacity for each for each of the 5 branch circuits.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This code change proposal will not increase nor decrease the cost of construction as it simply provides more compliance options to choose from.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Provides important technical revisions, clarity and more enforceable language for EV charging.

Final Hearing Results

CED1-39-22 AS

CED1-45-22

Original Proposal

IECC: TABLE C405.14.1

Proponents: Sam Bauer, AHG, SWTCH (sam@theadhocgroup.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C405.14.1 REQUIRED EV POWER TRANSFER INFRASTRUCTURE

Occupancy	EVSE Spaces	EV Ready Spaces	EV Capable Spaces
Group A	10%	0%	10%
Group B	15%	0%	30%
Group E	<u>2%</u> <u>15%</u>	0%	<u>5%30%</u>
Group F	2%	0%	5%
Group H	1%	0%	0%
Group I	<u>2%15%</u>	0%	<u>5%30%</u>
Group M	<u>10%15%</u>	0%	<u>10%30%</u>
Group R-1	20%	5%	75%
Group R-2	20%	5%	75%
Group R-3 and R-4	2%	0%	5%
Group S exclusive of parking garages	1%	0%	0%
Group S-2 parking garages	<u>1%</u>15%	0%	<u>0%30%</u>

Reason: We recommend that all public-facing Commercial S-2 parking garages have the same EVSE and EV capable requirements, matching what has been proposed for garages associated with Business (B) occupancies. There are two reasons that we believe justify this change:

1. There is no reason for the distinction between a parking garage associated with a business (B), a school (E), or a parking garage which serves a commercial district (S-2). All are commercial facilities with public-facing uses. There is precedent for considering these commercial building types together: the Denver EV infrastructure requirements require the same levels of EV-installed, EV-ready, and EV-capable for A, B, E, I M, and S-2 building types.[1] The Southwest Energy Efficiency Project (SWEEP) also considers Commercial buildings (Groups A, B, E, I, M, S-2) collectively, recommending at least 20% of the total parking spaces as EV Capable.[2]

2. Retrofits are significantly more costly than EV-enabled or EV-capable spaces from new construction. For example, a study by Energy Solutions (2019) showed that retrofits can cost as much as $4,600 more per space than those installed during construction.[3] Recent estimates suggest that half of all vehicles sold by 2030 will be electric.[4] New garage construction should be future-proofed to meet the needs of EV owners over the next 10 years – 1% of parking spaces with EVSE will not suffice, and retrofitting to meet the coming demand would be unnecessarily costly.

Bibliography:

1. Electric Vehicle Charging for Residential and Commercial Energy Codes, Technical Brief, 2021.

,https://www.energycodes.gov/sites/default/files/2021-07/TechBrief_EV_Charging_July2021.pdf>
2. EV Infrastructure Building Codes: Adoption Toolkit, SWEEP. <https://www.swenergy.org/transportation/electric-vehicles/building-codes#:~:text=Progressive%20Requirements%3A&text=Denver's%20new%20building%20codes%20require,installation%20of%20an
3. Electric Vehicle Infrastructure Cost Analysis Report for Peninsula Clean Energy (PCE) & Silicon Valley Clean Energy (SVCE), Energy Solutions, 2019. <https://www.peninsulacleanenergy.com/wp-content/uploads/2020/08/PCE_SCVE-EV-Infrastructure-Cost-Analysis-Report-2019.11.05.pdf>
4. "More Than Half of US Car Sales Will Be Electric by 2030," Bloomberg, September 20, 2022. <https://www.bloomberg.com/news/articles/2022-09-20/more-than-half-of-us-car-sales-will-be-electric-by-2030#xj4y7vzkg>

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

This code change would increase the initial cost of construction. However, as we noted in our reason statement this code change would ultimately save building owners as much as $4,600 per space compared to retrofitting.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal would harmonize the requirements for B, E, I and M and S-2 and reduces the long-term costs associated with EV charging.

Final Hearing Results

CED1-45-22 AS

CED1-50-22

Original Proposal

IECC: C405.15.1, C405.15.2, C405.15.2.1, C405.15.2.2, C405.15.3, C405.15.4, SECTION 202

Proponents: Diana Burk, New Buildings Institute, New Buildings Institute (diana@newbuildings.org); Rachael Dorothy, PE, self, self (dorothy.2@osu.edu); Melissa Kops, CT Green Building Council, CT Green Building Council (melissa@ctgbc.org); Andy Woommavovah, Trinity, Healthcare (andy.woommavovah@trinity-health.org); Khaled Mansy, Oklahoma State University, self (khaled.mansy@okstate.edu); Brad Smith, City of Fort Collins, City of Fort Collins (brsmith@fcgov.com); Brad Hill, Honeywell, Honeywell International Inc. (brad.hill@honeywell.com); Emma Gonzalez-Laders, New York State, Dept. of State/DBSC (emma.gonzalez-laders@dos.ny.gov); David Goldstein, NRDC, Natural Resources Defense Council (dgoldstein.nrdc@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.15.1 On-site renewable energy systems. *Buildings* shallbe provided with ~~install equipment for~~ on-site renewable electricity generation systems with a direct current (DC) nameplate power rating of not less than 0.75 W/f^{2}t (8.1 W/m^2) multiplied by the sum of the gross conditioned floor area of all floors not to exceed the combined gross conditioned floor area of the three largest floors.

Exceptions: The following buildings or building sites shall comply with Section C405.15.2:

1. A building site located where an unshaded flat plate collector oriented toward the equator and tilted at an angle from horizontal equal to the latitude receives an annual daily average incident solar radiation less than 1.1 kBtu/ft^2 - day (3.5 kWh/m^2 - day).
2. A *building* where more than 80 percent of the roof area is covered by any combination of permanent obstructions such as, but not limited to, mechanical equipment, vegetated space, access, pathways, or occupied roof terrace.
3. Any building where more than 50 percent of the roof area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the building for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.
4. A *building* with gross conditioned floor area less than 5,000 square feet (465 m^2).

C405.15.2 Off-site renewable energy. *Buildings* that qualify for one or more of the exceptions to Section 405.15.1 and do not meet the requirements of Section 405.15.1 ~~either in part or in full~~, with an on-site renewable energy system, shall procure off-site renewable electrical energy, in accordance with C405.15.2.1 and C405.15.2.2, that shall not be less than the total off-site renewable electrical energy determined in accordance with Equation 4-14.

(Equation 4-14)

$$\text{TREoff} = (\text{RENoff} \times 0.75\ \text{W/ft}^2 \times \text{FLRA} - \text{IREon}) \times 15$$

TREoff = Total off-site renewable electrical energy in kilowatt-hours (kWh) to be procured in accordance with Table C405.15.2
RENoff = Annual off-site renewable electrical energy from Table C405.15.2, in units of kilowatt-hours per watt of array capacity
FLRA = the sum of the gross conditioned floor area of all floors not to exceed the combined floor area of the three largest floors
IREon = Annual on-site renewable electrical energy generation of a new on-site renewable energy system, to be installed as part of the building project, whose rated capacity is less than the rated capacity required in Section C405.15.1

C405.15.2.1 Off-site procurement. The building owner as defined in the *International Building Code* shall procure and be credited for the total amount of off-site renewable electrical energy, not less than required in accordance with Equation 4-14, with one or more of the following:

1. A *physical renewable energy power purchase agreement*
2. A *financial renewable energy power purchase agreement*
3. A *community renewable energy facility*

4. Off-site renewable energy system owned by the building property owner

The generation source shall be located where the energy can be delivered to the building*site* by any of the following:

1. Direct connection to the off-site renewable energy facility
2. The local utility or distribution entity
3. An interconnected electrical network where energy delivery capacity between the generator and the building*site* is available

C405.15.2.2 Off-site contract. The *renewable energy* shall be delivered or credited to the building site under an energy contract with a duration of not less than 10 years. The contract shall be structured to survive a partial or full transfer of ownership of the building property. ~~The total required off-site renewable electrical energy shall be procured in equal installments over the duration of the off-site contract~~.

C405.15.3 Renewable energy certificate documentation. The property owner or owner's authorized agent shall demon-strate that where RECs or EACs are associated with on-site and off-site renewable energy production required by Sections C405.15.1 and C405.15.2 all of the following criteria for RECs and EACs shall be met:

1. The RECS and EACS ~~Are~~ are retained and retired by or on behalf of the property owner or tenant for a period of not less than 15 years or the duration of the contract in C405.15.2.2 whichever is less;
2. The RECS and EACS ~~Are~~ are created within a 12-month period of the use of the REC; and
3. The RECS and EACS ~~Are~~ are from a generating asset ~~constructed~~ placed in service no more than 5 years before the issuance of the certificate of occupancy.

C405.15.4 Renewable energy certificate purchase. A *building* that qualifies for one or more of the exceptions to Section C405.15.1 and where it can be demonstrated to the *code official* that the requirements of Section C405.15.2 cannot be met, the building owner shall contract for the purchase of renewable electricity products before the certificate of occupancy complying with the Green-e Energy National Standard for Renewable Electricity products equivalent to five times the amount of total off-site renewable energy calculated in accordance with Equation 4-14.

Appendix CC ~~COMMUNITY RENEWABLE ENERGY FACILITY~~. ~~A facility that produces energy from renewable energy systems and is qualified as a community energy facility under applicable jurisdictional statutes and rules.~~

Appendix CC ~~FINANCIAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT (FPPA)~~. ~~A financial arrangement between a renewable electricity generator and a purchaser wherein the purchaser pays or guarantees a price to the generator for the project's renewable generation. Also known as a "financial power purchase agreement" and "virtual power purchase agreement."~~

Appendix CC ~~PHYSICAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT (PPPA)~~. ~~A contract for the purchase of renewable electricity from a specific renewable electricity generator to a purchaser of renewable electricity.~~

Appendix CC ~~RENEWABLE ENERGY CERTIFICATE (REC)~~. ~~A market-based instrument that represents and conveys the environmental, social, and other non-power attributes of one megawatt hour of renewable electricity generation and could be sold separately from the underlying physical electricity associated with renewable energy systems; also known as an energy attribute and energy attribute certificate (EAC)~~.

RENEWABLE ENERGY INVESTMENT FUND (REIF). A fund established by a jurisdiction ~~the local government or other entity~~ to accept payment from ~~building~~ *building project* owners to construct or acquire interests in qualifying renewable energy systems, together with their associated RECS, ~~(along with RECs) on their~~onthe *building project* owners' behalf.

Reason: NBI is proposing several suggested revisions to the off-site renewable energy requirements in the draft 2024 IECC. First, it is important that if a building installs off-site renewable energy to meet the on-site renewable energy requirement, those systems should be installed in a location where the off-site renewable energy can arguably contribute electricity to the building site. This can be done either with a direct connection from the off-site renewable energy system to the building site, or a direct connection to the local utility or distribution entity or in an interconnected electrical network. By requiring the off-site renewables are installed in one of these three locations, a state adopting the 2024 IECC can ensure that the renewable requirements whether installed on-site or off-site will reduce that building and state's carbon emissions and result in improved air quality and a grid that is less reliant on fossil fuels. This language is based on a similar requirement for off-site renewables in the 2021 IgCC.

NBI is also proposing changes to section C405.15.2 requiring that contracts procure renewable energy in equal installments over the duration of the off-site contract. The majority of contracts for off-site renewable energy will not be equal either in energy or in cost because renewable energy system generation varies slightly on an annual basis and because many contracts include small annual adjustments to the cost paid per kWh. NBI is also clarifying that building owners purchase renewable energy credits before the certificate of occupancy because unbundled RECS are typically purchased at one time.

Finally, NBI is proposing small tweaks to the language in Section C405.15.3 for readability and clarity, deleting unneeded definitions in Appendix CC and clarifying the definition for the renewable energy investment fund.

NBI strongly believes that the renewable energy requirements are a new critical addition to the 2024 IECC. In 2020, 21% of the electricity used in the United States was sourced from renewable energy, primarily wind, an intermittent source of energy. [1] The Inflation Reduction Act of 2022 (IRA), which provides reliable tax credits for renewable energy until at least 2032, is estimated to double the deployment of renewable energy technology by making it more cost effective than ever. [2] This proposal requires new commercial buildings to place renewables on the building site, which will support more reliable distributed energy generation and aligns with the incentives being provided in the IRA.

Requiring renewables on new commercial buildings with only certain exceptions will:1) Economically benefit individuals and communities as the country transitions towards a low-carbon economy;2) Increase the resilience of communities during disruptions to centrally supplied power;

3) Reduce the impact of utility-scale renewables on critical wildlife habitat; and

4) Reduce building carbon emissions and improve air quality by ensuring that approximately 10% of a building's energy use is from renewable energy sources.

In addition, this proposal will expand good paying jobs in one of the nation's fastest growing employment sectors. According to the Bureau of Labor Statistics, the two fastest growing occupations in the U.S. in 2019 were solar PV installers and wind turbine service technicians. [3] Because of the IRA, renewable energy manufacturers will be incentivized to locate their business in the U.S., and both renewable energy manufacturers and installers will be incentivized to provide good wages. This provision to require renewable energy on new commercial buildings will broaden and extend the IRA's positive impacts on the U.S. economy and positively impact our communities.

Attached is a letter stating support for this proposal from 40 organizations, 9 of which are from local or state governments and universities, 11 of which are from NGOs, and 20 of which are from design and construction industry.

Bibliography: [1] Renewables Became the Second-Most Prevalent U.S. Electricity Source in 2020 , U.S. Energy Information Administration, https://www.eia.gov/todayinenergy/detail.php?id=48896.

[2] Esposito, Daniel. "Inflation reduction act benefits: Clean Energy Tax Credits could double deployment." Forbes Magazine. 23 Aug. 2022, https://www.forbes.com/sites/energyinnovation/2022/08/23/inflation-reduction-act-benefits-clean-energy-tax-credits-could-double-deployment/?sh=6e7381c76727

[3] The National Solar Job Census 2020, Interstate Renewable Energy Council, May 2021,

Richardson, Jake. Solar and Wind Tech Are the Fastest Growing Jobs in US, Red, Green, and Blue, 28 Jan. 2019, http://redgreenandblue.org/2019/01/27/solar-wind-tech-fastest-growing-jobs-us/.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal will not affect the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Adds clarity to renewable electricity generation requirements, and removes redundant definitions.

Final Hearing Results

CED1-50-22	AM

CED1-55-22

Original Proposal

IECC: C405.15.2.1, C202 (New)

Proponents: Charles Eley, Eley Consulting, Architecture 2030 (charles@eley.com)

2024 International Energy Conservation Code [CE Project]

Update standard(s) as follows:

C405.15.2.1 Off-site procurement. The building owner as defined in the *International Building Code* shall procure and be credited for the total amount of off-site renewable electrical energy, not less than required in accordance with Equation 4-14, with one or more of the following:

1. ~~A~~ *Physical renewable energy power purchase agreement*
2. ~~A~~*F* ~~i~~*nancial renewable energy power purchase agreement*
3. ~~A~~ *Community renewable energy facility*
4. Off-site renewable energy system owned by the building property owner
5. *Green retail tariff*

Add new definition as follows:

C202 Green retail tariff. An electricity-rate structure qualified under applicable statutes or rules contracted by an electricity service provider to the *building project* owner to provide electricity generated with 100% *renewable energy resources* without the purchase of unbundled RECs.

Reason: A green retail tariff is a special program offered by electric service providers (utilities) whereby they acquire 100% renewable energy to meet the electricity demands of a participating customer. The customer typically pays a premium in the range of one to two cents per kilowatt-hour (similar to participation in a community solar program). The delivered renewable energy is in addition to that required to meet applicable renewable portfolio standards and the RECs associated with the renewable energy are retired on behalf of the participating customer (as required by C405.15.3).

Section C405.15.2.2 would apply to green retail tariffs as it does to all off-site procurement options. A contract is required: (1) with a duration of at least 10 years, (2) that is structured to survive a transfer of ownership, and (3) and that acquires renewable energy in concert with energy consumption.

Retail green pricing is the most common method for procuring off-site renewable energy and the only option available to many building owners/managers. This is the option most widely used in Boston, San Francisco and other cities where the purchase of off-site renewable energy is already required for some building types and sizes.

Off-site renewable energy purchases are recognized in three places in the standard and this code change proposal strives to make the methods more consistent in section C405.15, Appendix CC and Appendix CD.

Not including this option will limit the ability of building owners to purchase off-site renewable energy and undermine the effectiveness of Section C405.15.

Bibliography: ZERO Code 2.0, Off-Site Procurement of Renewable Energy, Technical Support Document, December 2020. Clickhere.

Clean Electricity, A practical path to zero-carbon buildings, Charles Eley, September 2022. Clickhere.

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

The cost premium for 100% renewable energy through a green retail tariff is comparable to participation in a community renewables program. Providing more options for off-site procurement has the potential to reduce compliance costs.

Public Hearing Results

Committee Action	**As Modified**

Final Hearing Results

CED1-55-22	AM

CED1-56-22

Original Proposal

IECC: C405.15.2.1, SECTION 202 (New)

Proponents: Charles Eley, Eley Consulting, Architecture 2030 (charles@eley.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.15.2.1 Off-site procurement. The building owner as defined in the *International Building Code* shall procure and be credited for the total amount of off-site renewable electrical energy, not less than required in accordance with Equation 4-14, with one or more of the following:

1. ~~A P~~*hysical renewable energy power purchase agreement*
2. ~~A~~*Financial renewable energy power purchase agreement*
3. ~~A~~ *Community renewable energy facility*
4. Off-site renewable energy system owned by the building property owner
5. <u>*Renewable energy investment fund*</u>

Add new definition as follows:

<u>**RENEWABLE ENERGY INVESTMENT FUND (REIF).** A fund established by a jurisdiction to accept payment from building project owners to construct or acquire interests in qualifying renewable energy systems, together with their associated RECS, on the building project owners' behalf.</u>

Reason: A renewable energy investment fund is recognized in Appendix CC and Appendix CD. For consistency, it should be included in C405.15.2.1.

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

Providing more options for acquiring off-site renewable energy will not increase the cost of compliance and could result in a reduction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: When on-site renewables is not feasible as defined by the exceptions, this proposal would offer an additional path for purchasing off-site renewables from the jurisdiction. This would offer more flexibility and lower cost.

Final Hearing Results

CED1-56-22 AM

CED1-57-22

Original Proposal

IECC: C405.16, C405.16.1, C405.16.2, C405.16.2.1, C405.16.2.2, C405.16.2.3, C405.16.2.4 (New)
Proponents: Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov); Michael Rosenberg, Pacific Northwest National Laboratory, Pacific Northwest National Laboratory (michael.rosenberg@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.16 Electrical energy storage system. *Buildings* shall comply with ~~the one of~~ Section C405.16.1 or Section C405.16.2.

C405.16.1 Electrical energy storage energy capacity. Each *building* shall have one or more ESS with a total rated energy capacity and rated power capacity as follows:

1. ESS rated energy capacity (kWh)≥1.0 x Installed PV System Rated Power (kWDC)
2. ESS rated power capacity (kW)≥0.25 x Installed PV System Rated Power (kWDC).

Where installed, DC coupled battery systems shall meet the requirements for rated energy capacity alone.

Revise as follows:

C405.16.2 Electrical energy storage system ready. Each *building* shall have one or more reserved ESS-ready areas to accommodate future electrical storage in accordance ~~complying~~ with SectionsC405.16.2.1 through C405.16.2.4.~~the following:~~

1. ~~Energy storage system rated energy capacity (kWH) ≥ Conditioned floor area of the three largest stories (ft^2) x 0.0008 kWh/ft^2~~
2. ~~Energy storage system rated power capacity (kW) ≥ Conditioned floor area of three largest stories (ft^2) x 0.0002 kWh/ft^2~~ -

C405.16.2.1 ESS-ready location. Each ESS-ready area shall be located in accordance with Section 1207 of the *International Fire Code.*

Revise as follows:

C405.16.2.2 ESS-ready minimum area requirements. Each ESS-ready area shall be sized in accordance with the spacing requirements of Section 1207 of the *International Fire Code* and the UL9540 or UL9540A designated rating of the planned system. Where rated to UL9540A, the area shall be sized in accordance with the manufacturer's instructions.

C405.16.2.3 Electrical distribution equipment. The onsite electrical distribution equipment shall have sufficient capacity, rating, and space to allow installation of overcurrent devices and circuit wiring in accordance with NFPA 70 for future electrical ESS installation complying with the capacity criteria of Section C405.16.2.4.

Add new text as follows:

C405.16.2.4 ESS-ready minimum system capacity. Compliance with ESS-ready requirements in Sections C405.16.2.1 through C405.16.2.3 shall be based on a minimum total energy capacity and minimum rated power capacity as follows:

1. ESS rated energy capacity (kWh) ≥ gross conditioned floor area of the three largest floors (ft^2) x 0.0008 kWh/ft^2
2. ESS rated power capacity (kWh) ≥ gross conditioned floor area of the three largest floors (ft^2) x 0.0002 kWh/ft^2

Reason: This proposal is editorial and recommends language to reduce ambiguity.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is editorial and does not impact cost effectiveness of this requirement.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal adds clarity to the requirements by relocating system capacity requirements to a more-appropriate subsection. The modification includes editorial improvements.

Final Hearing Results

CED1-57-22	AM

CED1-62-22

Original Proposal

IECC: C405.16.1, C405.16.2

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

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.16.1 Electrical energy storage energy capacity. Each *building* shall have one or more ESS with a total rated energy capacity and rated power capacity as follows:

1. ESS rated energy capacity (kWh)≥1.0 x Installed ~~PV~~ <u>On-site Renewable Electric Energy</u> System Rated Power (kWDC)
2. ESS rated power capacity (kW)≥0.25 x Installed ~~PV~~ <u>On-Site Renewable Electric Energy</u> System Rated Power (kWDC).

Where installed, DC coupled battery systems shall meet the requirements for rated energy capacity alone.

C405.16.2 Electrical energy storage system ready. Each *building* shall have one or more reserved ESS-ready areas to accommodate future electrical storage complying with the following:

1. Energy storage system rated energy capacity (~~kWH~~ <u>kWh</u>) ≥ <u>Gross conditioned</u> ~~Conditioned~~ floor area of the three largest ~~stories~~ <u>floors</u> (ft^2) x 0.0008 kWh/ft^2
2. Energy storage system rated power capacity (kW) ≥ ~~Conditioned~~ <u>Gross conditioned</u> floor area of three largest ~~stories~~ <u>floors</u> (ft^2) x 0.0002 ~~kWh~~ <u>kW</u>/ft^2

Reason: As currently written, battery energy storage systems are only required when PV systems are installed, so other renewable energy systems would be exempt. This revision would make the requirement applicable to all qualified on-site renewable energy systems that produce electricity.

The other part of the proposal makes technical corrections to the equations shown.

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

For buildings that install on-site renewable energy systems that are not PV systems.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal makes necessary technical corrections and allows the use of other on-site renewable electric energy production systems.

Final Hearing Results

CED1-62-22 AM

CED1-65-22

Original Proposal

IECC: C405.2, C405.5.1, C405.5.2

Proponents: Bryan P. Holland, National Electrical Manufacturers Association (NEMA), National Electrical Manufacturers Association (NEMA) (bryan.holland@nema.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.2 Lighting controls. Lighting systems powered through the energy service for the *building* and *building site* lighting for which the building owner is responsible shall be provided with controls that comply with Sections C405.2.1 through C405.2.9 .

Exceptions: Lighting controls are not required for the following:

1. Spaces where an automatic shutoff could endanger occupant safety or security.
2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency lighting that is automatically off during normal operations.
4. Emergency lighting required by the *International Building Code* in exit access components which are not provided with fire alarm systems.
5. Up to 0.02 watts per square foot (0.06 W/m^2) of lighting in exit access components which are provided with fire alarm systems.

C405.5.1 Total connected ~~exterior building~~ exterior lighting power. The total exterior connected lighting power shall be the total maximum rated wattage of all exterior lighting that is powered through the energy service for the *building* and *building site* lighting for which the building owner is responsible.

Exception: Lighting used for the following applications shall not be included.

1. Lighting *approved* because of safety considerations.
2. Emergency lighting that is automatically off during normal operations .
3. Exit signs.
4. Specialized signal, directional and marker lighting associated with transportation.
5. Advertising signage or directional signage.
6. Integral to equipment or instrumentation and installed by its manufacturer.
7. Lighting in any location that is specifically used for video broadcasting, video or film recording, or live theatrical and music performance.
8. Athletic playing areas.
9. Temporary lighting.
10. Industrial production, material handling, transportation sites and associated storage areas.
11. Theme elements in theme/amusement parks.
12. Used to highlight features of art, public monuments and the national flag.
13. Lighting for water features and swimming pools.
14. Lighting controlled from within sleeping units and dwelling units, .
15. Lighting of the exterior means of egress as required by the *International Building Code*.

C405.5.2 Exterior lighting power allowance. The exterior lighting power allowance (watts) is calculated as follows:

1. Determine the Lighting Zone (LZ) for the building according to Table C405.5.2(1), unless otherwise specified by the code official.
2. For each exterior area that is to be illuminated by lighting that is powered through the energy service for the *building* and *building site* lighting for which the building owner is responsible, determine the applicable area type from Table C405.5.2(2). For area types not listed, select the area type that most closely represents the proposed use of the area.
3. Determine the total area or length of each area type and multiply by the value for the area type in Table C405.5.2(2) to determine the lighting power (watts) allowed for each area type.
4. The total exterior lighting power allowance (watts) is the sum of the base site allowance determined according to Table C405.5.2(2), plus the watts from each area type.

Reason: This proposal establishes energy efficiency for exterior lighting on a buildings site regardless of where the power for the lighting is being sourced and closes an existing loophole that circumvents the energy code.
This provision will:

1. Increase energy efficiency
2. Close a loophole in the code
3. Establish consistency in code implementation
4. Simplifies compliance as does not require new or revised code provisions
5. Supports enforceability uniformly

The energy code currently limits the ability of the code to cover lighting on buildings sites where the electrical power distribution is separated from the building. Such applications, even though under the ownership and control of one entity, may have exterior lighting which should be under the code's governance. Some examples are parking lots on many retail, institutional, transportation and entertainment venue locations where the electrical distribution comes from a free-standing pedestal mounted electrical service. Additional applications are exterior lighting on plazas, walkways, outdoor amphitheaters, and similar that are part of a building site, but powered separately from the building.

Note that lighting controls are NOT required to follow energy code provisions per new language in the 2024 DRAFT section C405.2. Inserted into the draft (via a new proposal introduced as CEPI-150) is the following: "not powered through the electrical service of the building".

The intent of this proposal would remove or negate this new draft language.

From a technical perspective, exterior lighting located on building sites should be applied and be similarly just as efficient, no matter where the electrical power is served. This proposal would apply energy efficiency the same to all exterior lighting on a building site.

Exempting exterior lighting not powered through the electrical service of a building presents a loophole for enforcement. By choosing to set the electrical service separated from a building on a free-standing pedestal can be done simply to avoid energy efficiency compliance. This is a design practice in retail strip malls where a "house panel" will be set separate from the retail buildings, and power all lighting in mall parking areas.

As currently written and proposed by CEPI-150, exterior lighting on a building site powered separately from the building, may use any efficacy lighting and operate without the energy savings controls would provide. Essentially, this exterior lighting would be allowed to operate full on 24 hours a day, seven days a week without limits and without the code control provisions.

To resolve these inefficient situations, increase efficiency, reduce confusion and simplify enforcement, this proposal removes the language which limits controls and exterior lighting power. Approval of this proposal would support that all exterior lighting, regardless of electrical service location, would now comply and be as efficient as required for any building site.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

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

Public Hearing Results

Committee Action **As Modified**

Committee Reason: this improves the language of the section by addressing situations where third party lighting is installed. It also addresses lighting at the building site that is controlled by the building owner.

Final Hearing Results

CED1-65-22	AM

CED1-75-22

Original Proposal

IECC: TABLE C405.3.2(2)

Proponents: Glenn Heinmiller, Lam Partners, IALD (glenn@lampartners.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C405.3.2(2) INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

Portions of table not shown remain unchanged.

COMMON SPACE TYPES[a]	LPD (watts/ft²)
Lobby	
For an elevator	0.64
In a facility for the visually impaired (and not used primarily by the staff[b])	1.44
In a hotel	0.48
In a motion picture theater	0.20
In a performing arts theater	1.21
Otherwise	0.80

Reason: The proposed lighting power allowance for Hotel Lobbies is insufficient. Hotel Lobby allowances, before 2018, tracked much more closely to the allowance for Lobby, Otherwise. Eliminating the space type for Hotel Lobbies will mean that designers will use the allowance from the Lobby, Otherwise space type for Hotel Lobbies. Hotel lobbies are no less complex a design than lobbies for corporate buildings or high-rise residential buildings. Often, hotel lobby designs are more complex, to support the hospitality setting.

ASHRAE/IES 90.1	Year				90.1 Add. ba
	2010	2013	2016	2019	2022
Hotel Lobby	0.90	1.06	1.06	0.51	0.48
Lobbies, Otherwise	0.90	0.90	1.00	0.84	0.80

IECC	Year				PC Draft#1
	* 2012	2015	2018	2021	2024
Hotel Lobby	2.10	1.06	1.06	0.51	0.48
Lobbies, Otherwise	1.10	0.90	1.00	0.84	0.80

* No decorative allowance

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This lighting power allowance adjustment does not require the use of more expensive lighting equipment

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This will allow hotel lobbies to match the requirements of other lobbies, as the lighting requirements are similar.

Final Hearing Results	
CED1-75-22	AS

CED1-76-22

Original Proposal

IECC: C405.3.2.2.1

Proponents: Jonathan McHugh, McHugh Energy Consultants Inc., McHugh Energy Consultants Inc. (jon@mchughenergy.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.3.2.2.1 Additional interior lighting power. Where using the Space-by-Space Method, an increase in the interior lighting power allowance is permitted for specific lighting functions. Additional power shall be permitted only where the specified lighting is installed and controlled in accordance with Section C405.2.5. ~~This~~ These additional power allowances shall be used only for the ~~specified~~ luminaires serving the specific lighting function 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 allowance shall be the connected lighting power of the luminaires specifically highlighting merchandise, calculated in accordance with Equation 4-12, or the additional power allowance ~~determined~~ calculated in accordance with Equation 4-13, whichever is less.

$$\text{Additional lighting power allowance} = 750\text{ W} + (\text{Retail Area } 1 \times 0.40\text{ W/ft}^2) + (\text{Retail Area } 2 \times 0.40\text{ W/ft}^2) + (\text{Retail Area } 3 \times 0.70\text{ W/ft}^2) + (\text{Retail Area } 4 \times 1.00\text{ W/ft}^2)$$

For SI units:

$$\text{Additional lighting power allowance} = 750\text{ W} + (\text{Retail Area } 1 \times 4.3\text{ W/m}^2) + (\text{Retail Area } 2 \times 4.3\text{ W/m}^2) + (\text{Retail Area } 3 \times 7.5\text{ W/m}^2) + (\text{Retail Area } 4 \times 10.8\text{ W/m}^2)$$

(Equation 4-13)

where:Retail Area 1 = The floor area for all products not listed in Retail Area 2, 3 or 4Retail 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 allowance for that space shall be ~~not more than~~ the smallest ~~wattage~~ of the following:

   2.1 0.66 W/ft^2 (7.1W/m^2) in lobbies, ~~and~~

   2.2 ~~not more than~~ 0.55 W/ft^2 (5.9 W/m^2) in other spaces.~~.~~ , or

   2,3 the connected lighting power of the luminaires specifically for ~~the purpose of~~ decorative appearance or for highlighting art or exhibits, calculated according to Equation 4-12.

Reason: The purpose of this proposal is to clarify what is the lighting power allowance associated with additional lighting allowed for retail display lighting and decorative lighting. The maximum possible additional lighting allowances are very large; they are equivalent in magnitude to the general lighting allowances and approximately allow for doubling the installed lighting power when these additional allowances are fully utilized.
The current wording has this phrase: "This additional power shall be used only for the specified luminaires and shall not be used for any other purpose." This means that one cannot install additional general lighting above what is allowed by the general lighting LPD and use the additional lighting power allowance.
The definition of what is the maximum allowed total lighting power allowance has become controversial with the lighting control credit for installing reduced lighting power below the allowed lighting power [see Section C406.2.5.6 L06 Reduced Lighting Power]. One can receive credits for up to a 20% in the base allowance. Common practice is to not install decorative lighting in many spaces. If it is not clear that decorative lighting is not able to claim the difference between the maximum allowed and what is installed, one could have a 50% reduction in LPD without actually changing common practice for many interior lighting designs. This is not the intent of the reduced lighting power credit.
The current draft of Section C406.2.5.6 L06 Reduced Lighting Power only compares the net lighting power and the net allowances not including the additional lighting power. In this situation the clarification is not very important. However there has been an interest in reverting the reduced lighting power credit to the format in the 2021 IECC Section C406.3. In the 2021 version of the IECC, the total lighting power is compared to the total lighting power allowances including the additional lighting power allowances.
The aim of this proposal is to make clear that the additional lighting power allowances is the lesser of what additional lighting is installed and the allowances which are a product of a lighting power density and the area for the allowance. As a result there is no reduction associated with using less additional lighting power only reductions allocated to installing less general lighting power than the general lighting power allowances.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal has no impact on the cost of the standard; it is only clarifying what is already intended for the calculation of additional lighting power allowances.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal clarifies the existing requirements of the section. This has no impact on cost.

Final Hearing Results

CED1-76-22 AM

CED1-77-22

Original Proposal

IECC: C405.8, NEMA Chapter 06

Proponents: Bryan P. Holland, National Electrical Manufacturers Association (NEMA), National Electrical Manufacturers Association (NEMA) (bryan.holland@nema.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.8 Electric motors. Electric motors shall meet the minimum efficiency requirements of Tables C405.8(1) through C405.8(4) when tested and rated in accordance with the DOE 10 CFR 431. The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the motor manufacturer.

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

1. Air-over electric motors.
2. Component sets of an electric motor.
3. Liquid-cooled electric motors.
4. Submersible electric motors.
5. Inverter-only electric motors.
6. Definite purpose machines within the scope of ANSI/NEMA MG 1-2021, Part 18.

NEMA

National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, VA 22209

MG1~~-2016~~ 2021: Motors and Generators

Reason: The coverage of motors in this section as written is still too broad. In accordance with the DoE Small Motor Rule, efficiency regulations apply only to open drip-proof single- and three-phase general purpose motors and exclude definite purpose motors such as jet pump, belted fan, submersible, sump pump motors, etc. The full complement of definite purpose machines can be found in ANSI/NEMA MG 1-2021, Part 18.

Bibliography: I. ANSI/NEMA MG 1-2021

II. 10 CFR Part 431

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

The current requirements would potentially increase the cost of manufacturing of definite purpose machines to make them more efficient than what Federal regulations presently require, thus increasing the cost of construction. This new exception will prevent this increased cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This change ensures that the code is consistent with federal energy efficiency requirements and exceptions for motors.

Final Hearing Results

	CED1-77-22	AM

CED1-78-22

Original Proposal

IECC: C405.9 (New), C405.9.2 (New), ANSI Chapter 06 (New)

Proponents: Nicholas O'Neil, Energy 350, NEEA (noneil@energy350.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C405.9.~~1~~ Data Centers and Computer Rooms ~~Systems~~. ~~Transformers, uninterruptable power supplies, motors and electrical power processing equipment in data center systems shall comply with Section 8 of ASHRAE 90.4 in addition to this code.~~Electrical equipment in data centers and computer rooms shall comply with this section.

Add new text as follows:

C405.9.1 Data centers. Transformers, uninterruptable power supplies, motors and electrical power processing equipment in*data centers* shall comply with Section 8 of ASHRAE 90.4 in addition to this code.

C405.9.2 Computer Rooms. Uninterruptable power supplies in *computer rooms* shall comply with the requirements in Tables 8.5 and 8.6 of ASHRAE 90.4 in addition to this code.Exception: AC-output UPS that utilizes standardized NEMA 1-15P or NEMA 5-15P input plug, as specified in ANSI/NEMA WD-6-2016.

Add new standard(s) as follows:

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

WD-6-2016	Wiring Devices - Dimensional Specifications Section C405.9.2

Reason: There are no standards for Uninterruptible Power Supply (UPS) systems in computer rooms like there are for Data Centers. This code proposal introduces minimum UPS efficiency aligned with efficient levels in ASHRAE 90.4. Therefore, the UPS requirements for computer rooms and data centers are equivalent. A UPS with a NEMA 1-15P or NEMA 5-15P plug are exempt from this requirement because minimum standards for these devices are already covered by DOE.

A similar code provision was adopted in both the 2022 Title 24 updates as well as the 2021 Washington State Energy Code (WSEC) and was found to be a cost-effective approach even though the proposal targeted ENERGY STAR efficiency thresholds.

Bibliography: ENERGY STAR Program Requirements for Uninterruptible Power Supplies (UPSs) Test Method - Rev. Dec-2017

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

This proposal is a compromise from an earlier proposal that required alignment with ENERGY STAR specifications. The cost data from that proposal can be used here as it was found to be a cost-effective approach.

Incremental costs were found to be $112/kW for high efficiency UPS systems, and were converted to $/sqft based on a 500sqft room (the threshold for which a computer room does not qualify as a data center). Costs were found to be estimated at $0.22/sqft and detailed cost information obtained through Final CASE report for 2022 Title 24 attached to this proposal and accessed publicly here:
https://title24stakeholders.com/wpcontent/uploads/2021/03/NR-Computer-Room-Efficiency-Final-CASE-Report_Statewide-CASETeam_updated.pdf

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This code change proposal aligns the efficiency requirements for UPS installed in computer rooms with the efficiency requirements for this same equipment installed in data centers. This will reduce the energy consumption of UPS in computer rooms while improving the overall energy efficiency of the occupancy.

Final Hearing Results

CED1-78-22	AM

CED1-81-22

Original Proposal

IECC: C406.2.5

Proponents: Glenn Heinmiller, Lam Partners, IALD (glenn@lampartners.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C406.2.5 Energy Savings in Lighting Systems. Projects are permitted to achieve energy credits for increased lighting system performance by meeting the requirements of either:

1. C406.2.5.2 L02
2. C406.2.5.3 L03
3. C406.2.5.4 L04
4. C406.2.5.5 L05
5. C406.2.5.6 L06
6. Any combination of L03, L04, L05 and L06
7. Any combination of L02, L03 and L04

~~Where lighting energy credit measures include reductions in lighting power, the lighting shall achieve ANSI/IES recommended practice for minimum illuminance levels as referenced at "The Interactive Illuminance Selector," which includes minimum recommended illuminance levels from various ANSI/IESRP-## standards.~~

Reason: The purpose of this requirement was to prevent low-quality lighting design solutions that might be incentivized by reduced lighting power density. Although well-intentioned, this requirement must be deleted because:

· Lighting designers must have the flexibility to design to whatever light levels are appropriate to provide quality lighting with minimal energy use. Sometimes this might mean illuminance levels that are below IES recommendations. In this case, the requirement would force the use of more energy than necessary.

· The purpose of the code is to regulate building energy use, not design quality. The IECC is not a design guide.

· This requirement would add a massive compliance and enforcement burden, for no energy savings benefit.

· C405.2.5.6 L06 provides no incentive for lighting power density lower than 80% of allowed lighting power. There is no incentive to have exceptionally low lighting power density that *might* lead to poor lighting quality.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Removing this requirement will have no effect on the cost of equipment used

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Current language does not provide energy savings and is unnecessary. The language is not enforceable.

Final Hearing Results

CED1-81-22	AS

CED1-84-22

Original Proposal

IECC: C408.3, C408.3.1, C408.3.1.1, C408.3.1.2

Proponents: Michael Jouaneh, Lutron Electronics Co., Inc., Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C408.3 Functional testing of lighting and receptacle controls. Automatic lighting and receptacle controls required by this code shall comply with this section.

C408.3.1 Functional testing. Prior to passing final inspection, the *registered design professional* or *approved agency* shall provide evidence that the lighting and receptacle control systems have been tested to ensure that control hardware and software are calibrated, adjusted, programmed and in proper working condition in accordance with the *construction documents* and manufacturer's instructions. Functional testing shall be in accordance with Sections C408.3.1.1 through C408.3.1.3 for the applicable control type.

C408.3.1.1 Occupant sensor controls. Where *occupant sensor controls* are provided, the following procedures shall be performed:

1. Certify that the *occupant sensor* has been located and aimed in accordance with manufacturer recommendations.
2. For projects with seven or fewer *occupant sensors*, each sensor shall be tested.
3. For projects with more than seven *occupant sensors,* testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each unique combination of sensor type and space geometry are provided, not less than 10 percent and in no case fewer than one, of each combination shall be tested unless the *code official* or design professional requires a higher percentage to be tested. Where 30 percent or more of the tested controls fail, all remaining identical combinations shall be tested.For *occupant sensor controls* to be tested, verify the following:
   3.1. Where *occupant sensor controls* include status indicators, verify correct operation.
   3.2. The controlled lights and receptacles controlled by *occupant sensor controls* turn off or down to the permitted level within the required time upon vacancy of the space.
   3.3. For auto-on *occupant sensor controls*, the controlled lights and receptacles controlled by *occupant sensor controls* turn on when an occupant enters the space.
   3.4. For manual-on *occupant sensor controls*, the controlled lights and receptacles controlled by *occupant sensor controls* turn on only when manually activated.
   3.5. The lights are not incorrectly turned on by movement in adjacent areas or by HVAC operation.

C408.3.1.2 Time-switch controls. Where *time-switch controls* are provided~~, the following procedures shall be performed~~:items 1 through 5 shall be performed for all time-switch controls. For projects with more than seven spaces where lighting or receptacles are controlled by *time-switch controls*, not less than 10 percent of spaces and in no case fewer than one, shall be tested according to items 6 and 7 unless the code official or design professional requires a higher percentage to be tested. Where 30 percent or more of the tested spaces fail any of the requirements in items 6 and 7, all remaining spaces shall be tested.

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.
   <u>6.3 Receptacles in the space controlled by the time-switch controls turn on.</u>
7. Simulate unoccupied condition. Verify and document the following:
   7.1. Nonexempt lighting turns off.
   7.2. Manual override switch allows only the lights<u>and receptacles controlled by the *time-switch controls*</u> in the enclosed space where the override switch is located to turn on <u>controlled lighting and receptacles for no more than 2 hours</u> ~~or remain on until the next scheduled shutoff occurs~~.
   <u>7.3 Receptacles controlled by the *time-switch controls* turn off.</u>
8. Additional testing as specified by the *registered design professional.*

Reason: The new requirement for hotel guestroom is for <u>all</u> lighting and switched receptacles to be off when room is vacant. This provision will help ensure that the code captures control of <u>all</u> lighting (permanent hardwired lighting as well as plugged-in lighting) by requiring verification that any switched or automatically controlled receptacles are also off when the room is vacant for more than 20 minutes. This provision also ensures energy savings from controlled receptacles by requiring the controlled receptacles are functioning as intended as well as the lighting.

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

Potential slight increase in cost. Functional testing of lighting controls is already required. This provision simply adds verification that the controlled receptacles are also working as intended.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Verifying efficiency through functional testing of controlled receptacles.

Final Hearing Results

CED1-84-22 AM

CED1-87-22

Original Proposal

IECC: C105.2.2

Proponents: Jay Crandell, P.E., ABTG / ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C105.2.2 Building ~~T~~thermal envelope. Inspections shall verify the correct type of insulation, *R*-values, location of insulation, thermal bridge mitigation, fenestration, *U*-factor, SHGC and VT, and that air leakage controls are properly installed, as required by the code, *approved* plans and specifications.

Reason: Thermal bridging requirements were added in Section C402.7 of the draft standard. They should be included in the building thermal envelope items listed for inspection in Section C105.2.2. Thermal bridging details can be as important to building thermal envelope performance as the other items currently mentioned in C105.2.2 and, if not compliant, can severely impact performance. The proposal also uses the defined term "building thermal envelope" for the section title.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal just coordinates building thermal envelope inspections with provisions added to the IECC standard draft for thermal bridges.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: This proposal clarifies the inspection of thermal bridges, and also corrects a section title.

Final Hearing Results

CED1-87-22	AS

CED1-90-22

Original Proposal

IECC: C303.1.3

Proponents: Helen Sanders, Technoform North America, Facade Tectonics Institute (helen.sanders@technoform.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C303.1.3 Fenestration product rating. *U*-factors, *solar heat gain coefficient* (SHGC), and *visible transmittance* (VT) of fenestration products shall be determined as follows:

1. For windows, doors and skylights, *U*-factor, SHGC and VT ratings shall be determined in accordance with NFRC 100 and NFRC 200.
2. Where required for garage doors and rolling doors, *U*-factor ratings shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

U-factors, SHGC, and VT shall be determined by an accredited, independent laboratory, and *labeled* and certified by the manufacturer by a label affixed to the product or a label certificate specific to the products in the project. Products lacking such a *labeled U*-factor shall be assigned a default *U*-factor from Table C303.1.3(1) or Table C303.1.3(2). ~~The *solar heat gain coefficient* (SHGC) and *visible transmittance* (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and *labeled* and certified by the manufacturer~~. Products lacking such a *labeled* SHGC or VT shall be assigned a default SHGC or VT from Table C303.1.3(3). For Tubular Daylighting Devices, VT_{annual} shall be measured and rated in accordance with NFRC 203.

Reason: On larger projects using the performance path, where rigor is warranted, project-specific size and configuration yields more-accurate values for U-factor, SHGC and VT than NFRC 100 standard sizes. This helps ensure that HVAC equipment capacity sizing, energy consumption modeling and product comparisons are based on accurate values. This increased level of accuracy is becoming more important in order to meet energy efficiency targets and to ensure occupant comfort. The NFRC 100 and 200 standard size U-factor and SHGC values provide a simplified approach when employing the prescriptive path and do not deliver a robust output for HVAC sizing.

The new 2023 version of NFRC 100 and 200, which will be published next year (2023), introduces a new, easier to use, methodology (the Commercial Trendline Approach) for calculating commercial fenestration performance, and the accompanying NFRC certification process provides a project-size and configuration specific path for certifying commercial fenestration performance. The project specific size calculation methodology for U-factor (aspect ratio calculation) is described in Appendix A4 of NFRC 100-2023 which ensures consistency in size-specific calculation methodology. A pre-publication version of NFRC 100-2023 has been provided by NFRC for the purpose of supporting documentation for this proposal and is uploaded with this proposal. This standard has already been approved by the NFRC board and membership, and will be published once the new web tools and certification program are rolled out to accompany it in 2023. For ease of reference, the commercial trendline approach is detailed in section 5.12, starting on P121, and the size-specific U-factor determination is detailed in Appendix A4, page 135. In addition, the proposed language will help clarify the confusion among design teams on whether to consider NFRC sizes, or the project specific size and configurations, streamlining the design process. It also clarifies that the project size U-factor, SHGC and VT, shall be calculated according to the NFRC 100 and 200 standards and does not require separate physical testing.

The proposal does not change the fact that the NFRC 100 and 200 remains the standard by which performance is determined, and prescriptive U-factors and SHGC for fenestration remain based on the standard NFRC size.

Clause C402.4.3.4 Area-weighted U-factor listed below would still allow for using an area-weighted average of the different project size.

We have suggested this section of the code for this clarification to be inserted, but the committee may find a more appropriate place for it.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal aims to clarify and improve the way U-factor is defined in the total energy compliance path. There should be no impact in the cost of construction. Some project teams already simulate and submit both project size and NFRC size because of lack of clarity, so clarifying this point could actually reduce the cost of the design process.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: As modified, this proposal clarifies that either a label affixed to the product or a label certificate for the project in compliance with NFRC 100 and 200 may be provided for fenestration. This is also consistent with how ASHRAE 90.1 handles fenestration labeling.

Final Hearing Results

CED1-90-22	AM

CED1-91-22

Original Proposal

IECC: TABLE C303.1.3(1)

Proponents: Brian Trimble, International Masonry Institute, International Masonry Institute (btrimble@imiweb.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

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

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

Reason: The proper term is glass block which is translucent. Glazed block is a different product. Glass Unit Masonry is more appropriate than Glass Block, but most designers know it as glass block.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The correct terminology is glass block. Glazed block has a different meaning.

Final Hearing Results

CED1-91-22 AS

CED1-92-22

Original Proposal

IECC: C105.2.2, SECTION 202, C401.3, SECTION C402, C402.1, C402.1.1.2, TABLE C402.1.1.2, TABLE C402.1.2, C402.1.2.2, TABLE C402.1.3, C402.1.4, TABLE C402.5, C402.6, C402.6.1.1, C402.6.2.3, C402.6.5, C403.4.1, C403.13.1, C403.14, C406.1.3, C406.2.1, C406.2.1.1, C406.3.8, TABLE C407.2(1), C409.6.1.4, C503.1, C503.2, C503.6, C504.2, C505.2, C505.2.1

Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C105.2.2 Building ~~Thermal~~ thermal envelope. Inspections shall verify the correct type of insulation, *R*-values, location of insulation, fenestration, *U*-factor, SHGC and VT, and that air leakage controls are properly installed, as required by the code,*approved* plans and specifications.

CONTINUOUS INSULATION (ci). Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the *building thermal envelope*~~building envelope~~.

C401.3 Building ~~Thermal~~ thermal envelope certificate. A permanent *building thermal envelope*~~thermal envelope~~ certificate shall be completed by an *approved* party. Such certificate shall be posted on a wall in the space where the space conditioning equipment is located, a utility room or other *approved* location. If located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. A copy of the certificate shall also be included in the construction files for the project. The certificate shall include the following:

1. *R*-values of insulation installed in or on ceilings, roofs, walls, foundations and slabs,*basement walls*, crawl space walls and floors and ducts outside *conditioned spaces*.
2. *U*-factors and *solar heat gain coefficients* (SHGC) of fenestrations.
3. Results from any *building* *thermal envelope* ~~envelope~~ air leakage testing performed on the *building*.

Where there is more than one value for any component of the *building thermal envelope*~~building envelope~~, the certificate shall indicate the area-weighted average value where available. If the area-weighted average is not available, the certificate shall list each value that applies to 10 percent or more of the total component area.

SECTION C402
BUILDING THERMAL ENVELOPE REQUIREMENTS

C402.1 General. *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 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the U-, C- and F-factor based method of Section C402.1.2; the R-value based method of C402.1.3; or the component performance alternative of Section C402.1.4. Where the total area of the through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above-grade wall area, the building thermal envelope shall comply with Section C402.1.2.4.
2. Wall solar reflectance and thermal emittance shall comply with Section C402.3.
3. Roof solar reflectance and thermal emittance shall comply with Section C402.4.

4. Fenestration in *building thermal envelope* ~~building envelope~~ assemblies shall comply with Section C402.5.
5. Air leakage of the building thermal envelope shall comply with Section C402.6.
6. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.12.
7. *Thermal bridges* in *above-grade walls* shall comply with Section C402.7.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.5, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1 or Section C401.2.2.

C402.1.1.2 Greenhouses. Greenhouse structures or areas that are mechanically heated or cooled and that comply with all of the following shall be exempt from the *building thermal envelope*~~building envelope~~ requirements of this code:

1. Exterior opaque envelope assemblies comply with Sections C402.2 and C402.5.5.

   Exception: Low energy greenhouses that comply with Section C402.1.1.

2. Interior partition *building thermal envelope* assemblies that separate the greenhouse from *conditioned space* comply with Sections C402.2, C402.5.3 and C402.5.5.
3. Fenestration assemblies that comply with the *building thermal envelope* ~~thermal envelope~~ requirements in Table C402.1.1.2. The *U*-factor for a roof shall be for the roof assembly or a roof that includes the assembly and an *internal curtain system*.

   Exception: Unconditioned greenhouses.

TABLE C402.1.1.2 FENESTRATION BUILDING THERMAL ENVELOPE MAXIMUM REQUIREMENTS

COMPONENT	*U*-FACTOR (BTU/h × ft^2 × °F)
Skylight	0.5
Vertical fenestration	0.7

TABLE C402.1.2 OPAQUE BUILDING 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-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.029	U-0.029	U-0.029	U-0.026	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-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.017	U-0.017	U-0.017	U-0.017
Walls, above grade																
Mass[f]	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071	U-0.037	U-0.037
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.050	U-0.050	U-0.050	U-0.050	U-0.050	U-0.044	U-0.039	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-0.055	U-0.055	U-0.049	U-0.049	U-0.049	U-0.042	U-0.037	U-0.037
Wood framed and other[c]	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.032	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-0.092	C-0.119	C-0.092	C-0.092	C-0.063	C-0.063	C-0.063	C-0.063	C-0.063
Floors																
Mass[d]	U-0.322[e]	U-0.322[e]	U-0.107	U-0.087	U-0.074	U-0.074	U-0.057	U-0.051	U-0.057	U-0.051	U-0.051	U-0.051	U-0.042	U-0.042	U-0.038	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-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027
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-0.54	F-0.52	F-0.52	F-0.52	F-0.51	F-0.51	F-0.434	F-0.51	F-0.434	F-0.434	F-0.424
Heated slabs	F-0.69	F-0.69	F-0.69	F-0.69	F-0.66	F-0.66	F-0.62	F-0.62	F-0.62	F-0.62	F-0.62	F-0.602	F-0.602	F-0.602	F-0.602	F-0.602
Opaque doors																
Nonswinging door	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31
Swinging door[g]	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	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[h]	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	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. Where assembly *U*-factors, *C*-factors and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.

c. Where heated slabs are below grade, below-grade walls shall comply with the*U*-factor requirements for above-grade mass walls.

d. “Mass floors” shall be in accordance with Section C402.2.3.

e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.

f. “Mass walls” shall be in accordance with Section C402.2.2.

g. Swinging door *U*-factors shall be determined in accordance with NFRC-100.

h. Garage doors having a single row of fenestration shall have an assembly*U*-factor less than or equal to 0.44 in Climate Zones 0 through 6 and less than or equal to 0.36 in Climate Zones 7 and 8, provided that the fenestration area is not less than 14 percent and not more than 25 percent of the total door area.

C402.1.2.2 U-factor thermal resistance of cold-formed steel assemblies. *U*-factors for <u>*building thermal envelopes*</u> ~~building envelopes~~ containing cold-formed steel framed ceilings and walls shall be permitted to be determined in accordance with~~with~~ AISI S250 as modified herein.

1. Where the steel-framed wall contains no cavity insulation, and uses continuous insulation to satisfy the U-factor maximum, the steel-framed wall member spacing is permitted to be installed at any on-center spacing.
2. Where the steel-framed wall contains framing at 24 inches (610 mm) on center with a 23 percent framing factor or framing at 16 inches (400 mm) on-center with a 25 percent framing factor, the next lower framing member spacing input values shall be used when calculating using AISI S250.
3. Where the steel-framed wall contains less than 23 percent framing factors the AISI S250 shall be used without any modifications.
4. Where the steel-framed wall contains other than standard C-shape framing members the AISI S250 calculation option for other than standard C-shape framing is permitted to be used.

TABLE C402.1.3 OPAQUE <u>BUILDING</u> THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE ALTERNATIVES [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 buildings[b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-25 + R-11 + 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-49	R-49	R-49	R-49	R-49	R-49	R-60	R-60	R-60	R-60
Walls, above grade																

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
Mass[f]	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-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-17ci	R-13 + R-19.5ci	R-13 + R-19.5ci	R-13 + R-19.5ci
Metal framed[h]	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-15.2ci or R-13 + R-10ci or R-20 + R-9ci	R-0 + R-15.2ci or R-13 + R-10ci or R-20 + R-9ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-21ci or R-13 + R-15.6ci or R-20 + R-14.3ci	R-0 + R-24ci or R-13 + R-18.8ci or R-20 + R-17.5ci	R-0 + R-24ci or R-13 + R-18.8ci or R-20 + R-17.5ci
Wood framed and other[h]	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 +R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 + R-27.5ci or R-13 + R-18.8ci or R-20 + R-14ci	R-0 + R-27.5ci or R-13 + R-18.8ci or R-20 + R-14ci
Walls, below grade																
Below-grade wall[d]	NR	NR	NR	NR	NR	NR	R-7.5ci	R-10ci	R-7.5ci	R-10ci	R-10ci	R-15ci	R-15ci	R-15ci	R-15ci	R-15ci
Floors																
Mass[e]	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-14.6ci	R-16.7ci	R-14.6ci	R-16.7ci	R-16.7ci	R-16.7ci	R-20.9ci	R-20.9ci	R-23ci	R-23ci
Joist/framing	R-13	R-13	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-38	R-38	R-38	R-38	R-38	R-38
Slab-on-grade floors																
Unheated slabs	NR	NR	NR	NR	NR	R-10 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-20 for 24″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 48″ below	R-25 for 48″ 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

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 90.1 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 C402.1.2.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted not less than 32 inches or less on center vertically and not less than 48 inches 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 R-value requirements for above-grade mass walls .

e. “Mass floors” shall be in accordance with Section C402.2.3.

f. “Mass walls” shall be in accordance with Section C402.2.2.

g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation and full-slab insulation components shall be installed in accordance with Section C402.2.4.1 .

h. The first value is *cavity insulation*; the second value is *continuous insulation*. Therefore, “R-0+R-12ci” means R-12 *continuous insulation* and no *cavity insulation*; “R-13+R-3.8ci” means R-13 *cavity insulation* and R-3.8 *continuous insulation*; “R-20” means R-20 *cavity insulation* and no *continuous insulation*. R-13, R-20, and R-27 *cavity insulation* as used in this table apply to a nominal 4-inch (101 mm), 6-inch (152 mm), and 8-inch (203 mm) deep wood or cold-formed steel stud cavities, respectively.

C402.1.4 Component performance alternative. *Building thermal envelope*~~Building envelope~~ values and fenestration areas determined in accordance with Equation 4-1 shall be an alternative to compliance with the *U*-, *F*-, psi-, chi-, and*C*-factors in Tables C402.1.2, C402.1.5, and C402.5 and the maximum allowable fenestration areas in Section C402.5.1. *Fenestration* shall meet the applicable SHGC requirements of Section C402.5.3.

$$\underline{A_P + B_P + C_P + T_P \leq A_T + B_T + C_T + T_T - V_F - V_S} \qquad \textbf{(Equation 4-1)}$$

A_P = Sum of the (area x U-factor) for each proposed building thermal envelope assembly, other than slab-on-grade or below-grade wall assemblies
B_P = Sum of the (length x F-factor) for each proposed slab-on-grade edge condition
C_P = Sum of the (area x C-factor) for each proposed below-grade wall assembly
T_P = Sum of the (ψL_P) and (χN_p) values for each type of thermal bridge condition of the building thermal envelope as identified in Section C402.6 in the proposed building. For the purposes of this section, the (ψL_P) and (χN_P) values for thermal bridges caused by materials with a thermal conductivity less than or equal to 3.0 Btu-in/h-ft^2-F shall be assigned as zero. For buildings or structures located in Climate Zones 0 through 3, the value of T_P shall be assigned as zero.
ψL_P= psi-factor × length of the thermal bridge elements in the proposed building thermal envelope.
χN_P = chi-factor x number of the thermal bridge point elements other than fasteners, ties, or brackets in the proposed building thermal envelope.
A_T = Sum of the (area x U-factor permitted by Tables C402.1.2 and C402.5) for each proposed building thermal envelope assembly, other than slab-on-grade or below-grade wall assemblies
B_T = Sum of the (length x F-factor permitted by Table C402.1.2 for each proposed slab-on-grade edge condition
C_T = Sum of the (area x C-factor permitted by Table C402.1.2) for each proposed below-grade wall assembly
T_T = Sum of the (ψL_T) and (χN_T) values for each type of thermal bridge condition in the proposed building thermal envelope as identified in Section C402.6 with values specified as "compliant" in Table C402.1.4. For the purposes of this section, the (ψL_T) and (χNT) values for thermal bridges caused by materials with a thermal conductivity less than or equal to 3.0 Btu-in/h-ft^2-F shall be assigned as zero. For buildings or structures located in Climate Zones 0 through 3, the value of T_T shall be assigned as zero.
ψL_T= (psi-factor specified as "compliant" in Table C402.1.5) × length of the thermal bridge elements in the proposed building thermal envelope.
χN_T = (chi-factor specified as "compliant" in Table C402.1.5) x number of the thermal bridge point elements other than fasteners, ties, or brackets in the proposed building thermal envelope.
P_F = Maximum vertical fenestration area allowable by Section C402.5.1, C402.5.1.1, or C402.5.1.2
Q_F = Proposed vertical fenestration area
R_F = Q_F - P_F, but not less than zero (excess vertical fenestration area)
S_F = Area-weighted average U-factor permitted by Table C402.5 of all vertical fenestration assemblies
T_F = Area-weighted average U-factor permitted by Table C402.1.2 of all exterior opaque wall assemblies
U_F = S_F – T_F (excess U-factor for excess vertical fenestration area)
V_F = R_F x U_F (excess UxA due to excess vertical fenestration area)
P_S = Maximum skylight area allowable by Section C402.1.2
Q_S = Actual skylight area
R_S = Q_S - P_S, but not less than zero (excess skylight area)
S_S = Area-weighted average U-factor permitted by Table C402.5 of all skylights
T_S = Area-weighted average U-factor permitted by Table C402.1.2 of all opaque roof assemblies
U_S = S_S – T_S (excess U-factor for excess skylight area)
V_S = R_S x U_S (excess UxA due to excess skylight area)
A proposed psi- or chi-factor for each thermal bridge shall comply with one of the following as applicable:

1. Where the proposed mitigation of a thermal bridge is compliant with the requirements of Section C402.6, the "compliant" values in Table C402.1.4 shall be used for the proposed psi- or chi-factors.
2. Where a thermal bridge is not mitigated in a manner at least equivalent to Section C402.6, the "non-compliant" values in Table C402.1.4 shall be used for the proposed psi- or chi-factors.
3. Where the proposed mitigation of a thermal bridge provides a psi- or chi-factor less than the "compliant" values in Table C402.1.4, the proposed psi- or chi-factor shall be determined by thermal analysis, testing, or other approved sources.

Staff note existing items removed

TABLE C402.5 BUILDING <u>THERMAL</u> 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		0.45		0.42		0.36		0.36		0.34		0.29		0.26	
Operable fenestration	0.62		0.60		0.54		0.45		0.45		0.42		0.36		0.32	
Entrance doors	0.83		0.77		0.68		0.63		0.63		0.63		0.63		0.63	
SHGC																
Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	
PF < 0.2	0.23	0.21	0.25	0.23	0.25	0.23	0.36	0.33	0.38	0.33	0.38	0.34	0.40	0.36	0.40	0.36
0.2 ≤ PF < 0.5	0.28	0.25	0.30	0.28	0.30	0.28	0.43	0.40	0.46	0.40	0.46	0.41	0.48	0.43	0.48	0.43
PF ≥ 0.5	0.37	0.34	0.40	0.37	0.40	0.37	0.58	0.53	0.61	0.53	0.61	0.54	0.64	0.58	0.64	0.58
Skylights																
U-factor	0.70		0.65		0.55		0.50		0.50		0.50		0.44		0.41	
SHGC	0.30		0.30		0.30		0.40		0.40		0.40		NR		NR	

NR = No Requirement, PF = Projection Factor.

C402.6 Air leakage—<u>building</u> thermal envelope. The *building thermal envelope* shall comply with Sections C402.6.1 through C402.6.8.1.

C402.6.1.1 Air barrier design and documentation requirements . Design of the continuous air barrier shall be documented in the following manner:

1. Components comprising the continuous air barrier and their position within each*<u>building thermal envelope</u>* ~~building thermal envelope~~ assembly shall be identified.
2. Joints, interconnections, and penetrations of the continuous air barrier components shall be detailed.
3. The continuity of the air barrier building element assemblies that enclose conditioned space or provide a boundary between conditioned space and unconditioned space shall be identified.
4. Documentation of the continuous air barrier shall detail methods of sealing the air barrier such as wrapping, caulking, gasketing, taping or other approved methods at the following locations:
   4.1 Joints around fenestration and door frames.

   4.2 Joints between walls and floors, between walls at building corners, between walls and roofs including parapets and copings, where above-grade walls meet foundations, and similar intersections.

   4.3 Penetrations or attachments through the continuous air barrier in*<u>building thermal envelope</u>*~~building envelope~~ roofs, walls, and floors.

   4.4 Building assemblies used as ducts or plenums.

   4.5 Changes in continuous air barrier materials and assemblies.

5. Identify where testing will or will not be performed in accordance with Section C402.5.2 Where testing will not be performed, a plan for field inspections required by C402.5.2.3 shall be provided that includes the following:
   5.1 Schedule for periodic inspection,

   5.2 Continuous air barrier scope of work,

   5.3 List of critical inspection items,

   5.4 Inspection documentation requirements, and

   5.5 Provisions for corrective actions where needed.

C402.6.2.3 Building <u>thermal</u> envelope design and construction verification criteria. Where Section C402.6.2.1 and C402.6.2.2 are not appliable the installation of the continuous air barrier shall be verified by the *code official*, a *registered design professional* or *approved* agency in accordance with the following:

1. A review of the construction documents and other supporting data shall be conducted to assess compliance with the requirements in Section C402.6.1.
2. Inspection of continuous air barrier components and assemblies shall be conducted during construction to verify compliance with the requirements ofC402.6.2.3.1 or C502.6.2.3.2. The air barrier shall remain accessible for inspection and repair.
3. A final inspection report shall be provided for inspections completed by the*registered design professional* or *approved* agency. The inspection report shall be provided to the building owner or owner's authorized agent and the *code official*. The report shall identify deficiencies found during inspection and details of corrective measures taken.

C402.6.5 Air intakes, exhaust openings, stairways and shafts. Stairway enclosures, elevator shaft vents and other outdoor air intakes and exhaust openings integral to the *building thermal envelope*~~building envelope~~ shall be provided with dampers in accordance with Section C403.7.7.

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

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

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

C403.13.1 Duct and plenum insulation and sealing. Supply and return air ducts and plenums shall be insulated with not less than R-6 insulation where located in unconditioned spaces and where located outside the building with not less than R-8 insulation in *Climate Zones* 0 through 4 and not less than R-12 insulation in *Climate Zones* 5 through 8. Ducts located underground beneath buildings shall be insulated as required in this section or have an equivalent thermal distribution efficiency. Underground ducts utilizing the thermal distribution efficiency method shall be *listed* and *labeled* to indicate the *R*-value equivalency. Where located within a *building thermal envelope*~~building envelope~~ assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by not less than R-8 insulation in *Climate Zones* 0 through 4 and not less than R-12 insulation in*Climate Zones* 5 through 8.

Exceptions:

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

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

C403.14 Mechanical systems located outside of the building thermal envelope. Mechanical systems providing heat outside of the *building thermal envelope*~~thermal envelope of a building~~ shall comply with Sections C403.14.1 through C403.14.4.

C406.1.3 Substantial Alterations to Existing Buildings. The *building thermal envelope*, *equipment*, and *systems* in *alterations* to *buildings* exceeding 5000 square feet (46.5 m^2) of *gross conditioned floor area* shall comply with the requirements of Section C406.1.1 and C406.1.2 where the alteration includes replacementof two or more of the following:

1. HVAC unitary systems or HVAC central heating or cooling equipment serving the alteration area, not including ductwork or*piping*.
2. 80% or more of the lighting fixtures in the *alteration* area.
3. *Building thermal envelope* ~~Building envelope~~ components in the *alteration* area including new exterior cladding, fenestration, or insulation.

C406.2.1 More Efficient Building Thermal Envelope. A project shall achieve credits for improved envelope performance by complying with one of the following measures:

1. Section C406.2.1.1: E01
2. Section C406.2.1.2: E02
3. Section C406.2.1.3: E03
4. Both E02 and E03
5. Any combination of:
    - 5.1. Section C406.2.1.3: E03
    - 5.2. Section C406.2.1.4: E04
    - 5.3. Section C406.2.1.5: E05
    - 5.4. Section C406.2.1.6: E06

C406.2.1.1 EO1 Improved envelope performance 901 Appendix C. *Building thermal envelope*~~envelope~~ measures shall be installed to improve the energy performance ofthe project. The achieved energy credits shall be determined using Equation 4-15.

(Equation 4-15)

$$EC_{ENV} = 1000 \times (EPF_B - EPF_P)/EPF_B$$

EC_{ENV}= E01 measure energy credits
EPFB= base envelope performance factor calculated in accordance with ASHRAE 90.1-2019-Appendix C.
EPF_P= proposed envelope performance factor calculated in accordance with ASHRAE 90.1-2019-Appendix C.

C406.3.8 G07 Building Thermal Mass. The project shall have additional passive interior mass and a night flush control of the HVAC system. The credit is available to projects that have at least 80 percent of gross floor area unoccupied between midnight and 6:00 a.m. The project shall meet the following requirements:

1. Interior to the *building thermal envelope* insulation, provide 10 lb/ft(50 kg/m) of project conditioned floor area of passive thermal mass in the *building interior wall*, the inside of the *exterior wall*, or interior floor construction. Mass *construction* shall have mass surfaces directly contacting the air in *conditioned spaces* with directly attached gypsum panels allowed. Mass with carpet or furred gypsum panels or *exterior wall* mass that is on the exterior of the insulation layer (e.g., the portion of CMU block on the exterior of insulation filled cell cavities) shall not be included toward the *building* mass required.
2. HVAC units for 80 percent or more of the supply airflow in the project shall be equipped with outdoor air economizers and fans that have variable or low speed capable of operating at 66 percent or lower airflow and be included in the night flush *control* sequence.

3. Night flush controls shall be configured with the following sequence or another night flush strategy shall be permitted where demonstrated to be effective, avoids added morning heating, and is approved by the *authority having jurisdiction*.
    3.1. Summer mode shall be activated when outdoor air temperature exceeds 70ºF (21ºC) and shall continue uninterrupted until deactivated when outdoor air temperature falls below 45ºF (7ºC). During summer mode, the occupied cooling *set point* shall be set 1ºF (0.6ºC) higher than normal and the occupied heating *set point* shall be reset 2ºF (1.1ºC) lower than normal.
    3.2. When all the following conditions exist, night flush shall be activated:
        3.2.1. Summer mode is active in accordance with item 3.1.
        3.2.2. Outdoor air temperature is 5ºF (2.8ºC) or more below indoor average zone temperature.
        3.2.3. Indoor average zone temperature is greater than morning occupied heating*set point*.
        3.2.4. In climate zones 0A through 3A, outdoor dewpoint is below 50ºF (10ºC) or outdoor air enthalpy is less than indoor air enthalpy.
        3.2.5. Local time is between 10:00 pm and 6:00 am.
    3.3. When night flush is active,*automatic* night flush controls shall operate outdoor air *economizers* at low fan speed not exceeding 66 percent during the unoccupied period with *mechanical cooling* and heating locked out.

TABLE C407.2(1) REQUIREMENTS FOR TOTAL SIMULATED BUILDING PERFORMANCE

SECTION [a]	TITLE
Envelope	
C401.3	*Building thermal envelope* Thermal envelope certificate
C402.2.1.1	Joints staggered
C402.2.1.2	Skylight curbs
C402.2.6	Insulation of radiant heating system
C402.6	Air leakage—*building thermal envelope* thermal envelope
Mechanical	
C403.1.1	Calculation of heating and cooling loads
C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies
C403.4	Thermostatic controls
C403.4.2	Off-hour controls
C403.4.7	HVAC system controls for operable openings to the outdoors
C403.5.5	Economizer fault detection and diagnostics
C403.7, except C403.7.4.1	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.12, except C403.12.3	Refrigeration equipment performance
C403.13	Construction of HVAC system elements
C403.14	Mechanical systems located outside of the building thermal envelope

C404	Service water heating
C405, except C405.3	Electrical power and lighting systems
C406.1.2	Additional renewable and load management credit requirements
C408	Maintenance information and system commisioning

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

C409.6.1.4 Building Thermal Envelope Components. *Building thermal envelope*~~Building envelope~~ components modeled in the standard reference design and the proposed design shall comply with the requirements of this Section.

C503.1 General. *Alterations* to any *building* or structure shall comply with the requirements of Section C503. *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.

Exception: The following *alterations* need not comply with the requirements for new construction, provided that the energy use of the building is not increased:

1. Storm windows installed over existing *fenestration*.
2. Surface-applied window film installed on existing single-pane *fenestration* assemblies reducing solar heat gain, provided that the code does not require the glazing or *fenestration* to be replaced.
3. *Roof recover*.
4. Roof replacement where roof assembly insulation is integral to or located below the structural roof deck.
5. *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 thermal envelope* ~~building envelope~~.
6. An existing building undergoing alterations that complies with Section C407.

C503.2 Building thermal envelope. Alterations of existing *building thermal envelope* assemblies shall comply with this section. New *building thermal envelope*~~building envelope~~ assemblies that are part of the *alteration* shall comply with Section C402 . An area-weighted average *U*-factor for new and altered portions of the *building thermal envelope* shall be permitted to satisfy the *U*-factor requirements in Table C402.1.4. The existing *R*-value of insulation shall not be reduced or the *U*-factor of a *building thermal envelope* assembly be increased as part of a *building thermal envelope* alteration except where complying with Section C407.

Exception: Where the existing building exceeds the fenestration area limitations of Section C402.5.1 prior to alteration, the building is exempt from Section C402.5.1 provided that there is no increase in fenestration area.

C503.6 Additional energy efficiency credits. *Alterations* shall comply with measures from Sections C406.2 and C406.3 to achieve not less than 10 percent the number of required efficiency credits from Table C406.1.1 based on building occupancy group and *climate zone*. Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of this section.

Exceptions:

1. *Alterations* that include replacement of no more than one of the following:
   1.1 HVAC unitary systems or HVAC central heating or cooling equipment serving the *work area* of the *alteration*.

   1.2 Water heating equipment serving the *work area* of the alteration.

   1.3 50 percent or more of the lighting fixtures in the *work area* of the alteration.

   1.4 50 percent or more of the area of interior surfaces of the *building thermal envelope* ~~thermal envelope~~ in the *work area* of the alteration.

   1.5 50 percent or more of the building's *exterior wall envelope*, including fenestration.

2. *Alterations* to *buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, High-Hazard Group H.
3. *Alterations* that do not contain conditioned space.
4. Portions of *buildings* devoted to manufacturing or industrial use.
5. *Buildings* in Climate Zone 0A.
6. *Alterations* that are permitted with an *addition* complying with Section C502.3.7.
7. *Alterations* that comply with Section C407.

C504.2 Application. For the purposes of this code, the following shall be considered to be repairs:

1. Glass-only replacements in an existing sash and frame.
2. *Roof repairs*.
3. Air barriers shall not be required for *roof repair* where the repairs to the building do not include *alterations*, renovations or *repairs* to the remainder of the *building thermal envelope*~~building envelope~~.
4. Replacement of existing doors that separate conditioned space from the exterior shall not require the installation of a vestibule or revolving door, provided that an existing vestibule that separates a conditioned space from the exterior shall not be removed.
5. *Repairs* where only the bulb, the ballast or both within the existing luminaires in a space are replaced, provided that the replacement does not increase the installed interior lighting power.

C505.2 Energy use intensities. *Building thermal envelope*~~Building envelope~~, space heating, cooling, ventilation, lighting and service water heating shall comply with Sec-tions C505.2.1 through C505.2.4.

Exceptions:

1. Where it is demonstrated by analysis approved by the *code official* that the change will not increase energy use intensity.
2. Where the occupancy or use change is less than 5,000 square feet (464 m^2) in area.

C505.2.1 Building thermal envelope. Where a *change of occupancy* or use is made to a whole building that the results in fenestration area greater than the maximum fenestration area allowed by Section C402.4.1, the *building* shall comply with Section C402.1.5, with a proposed UA that shall not be greater than 110 percent of the target UA.

Exception: Where the *change of occupancy* or use is made to a portion of the *building*, the new occupancy is exempt from Section C402.4.1 provided that there is not an increase in fenestration area.

Reason: "Building thermal envelope" is a defined term in the IECC, but "building envelope" and "thermal envelope" are not defined. This proposal attempts to standardize terminology throughout the commercial provisions by replacing all instances of "building envelope" and "thermal envelope" with the defined term "building thermal envelope." Within the commercial provisions of the First Public Comment Draft there are twenty-five uses of "building envelope" and twelve uses of "thermal envelope" that have been changed. If there are technically valid reasons to retain existing terminology in specific situations, please consider amending this proposal for those sections, as necessary.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal modifies terminology without intending to make technical changes. Therefore, there will be no impact on cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Consistent use of “building thermal envelope” terminology.

Final Hearing Results

CED1-92-22	AS

CED1-94-22

Original Proposal

IECC: C402.1, C402.1.2, C402.1.3, TABLE C402.1.3, C402.1.4

Proponents: Jay Crandell, P.E., ABTG / ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.1 General. *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 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either ~~the U-, C- and F-factor based method of~~ Section C402.1.2; ~~the R-value based method of~~ Section C402.1.3; or ~~the component performance method alternative of~~ Section C402.1.4. Where the total area of the through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above-grade wall area, the building thermal envelope shall comply with Section C402.1.2.4.
2. Wall solar reflectance and thermal emittance shall comply with Section C402.3.
3. Roof solar reflectance and thermal emittance shall comply with Section C402.4.
4. Fenestration in building envelope assemblies shall comply with Section C402.5.
5. Air leakage of the building thermal envelope shall comply with C402.6.
6. 7. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.12.
7. 6. *Thermal bridges* in *above-grade walls* shall comply with Section C402.7.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.5, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1 or Section C401.2.2.

C402.1.2 Assembly U-factor, C-factor or F-factor~~-based~~ method. *Building thermal envelope* opaque assemblies shall have a *U*-, *C*- or *F*-factor not greater than that specified in Table C402.1.2. 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 C402.1.2. 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 C402.1.2

C402.1.3 Insulation component R-value method ~~alternatives~~. For opaque portions of the *building thermal envelope* using this section as an alternative to Section C402.1.2, the *R*-values for cavity insulation and continuous 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.

TABLE C402.1.3 OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD ~~ALTERNATIVES~~ [a]

Portions of table not shown remain unchanged.

C402.1.4 Component performance method ~~alternative~~. Building envelope values and fenestration areas determined in accordance with Equation 4-1 shall be an alternative to compliance with the *U*-, *F*-, psi-, chi-, and *C*-factors in Tables C402.1.2, C402.1.5, and C402.5 and the maximum allowable fenestration areas in Section C402.5.1. *Fenestration* shall meet the applicable SHGC requirements of Section C402.5.3.*(remainder of section unchanged)*

Reason: This proposal is a clean-up so that the U-factor, R-value, and component performance methods are all titled the same and referenced the same in Section C402.1. These editorial changes also make the section titles consistent with the titles of Tables C402.1.2 and C402.1.3. Also, two items listed in Section C402.1 are re-ordered to align with the sequence of requirements and sections in C402.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is editorial in making section and table titles consistent. There are no changes in requirements.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Editorial clean-up of section references and titles for prescriptive U-factor, R-value, and component performance methods.

Final Hearing Results

CED1-94-22	AM

CED1-95-22

Original Proposal

IECC: C402.1

Proponents: Jay Crandell, P.E., ABTG / ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.1 General. *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 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the U-, C- and F-factor based method of Section C402.1.2; the R-value based method of C402.1.3; or the component performance alternative of Section C402.1.4. Where the total area of the through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above-grade wall area, the building thermal envelope shall comply with Section C402.1.2.4.
2. Wall solar reflectance and thermal emittance shall comply with Section C402.3.
3. Roof solar reflectance and thermal emittance shall comply with Section C402.4.
4. Fenestration in building envelope assemblies shall comply with Section C402.5.<u>Where buildings have a vertical fenestration area or skylight area greater than allowed in Section C402.5, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1, Section C401.2.2, or Section C402.1.4.</u>
5. Air leakage of the building thermal envelope shall comply with C402.6.
6. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.12.
7. *Thermal bridges* in *above-grade walls* shall comply with Section C402.7.

~~Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.5, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1 or Section C401.2.2~~.

Reason: This proposal is editorial clean-up and merely moves a "dangling" allowance for fenestration into item 5 of the list where fenestration is specifically addressed.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal makes no technical change and moves existing text to a more appropriate location.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clean-up and move requirements related to fenestration into one place (Item 4 of list) and add one missing section reference.

Final Hearing Results

CED1-95-22 AM

CED1-99-22

Original Proposal

IECC: C402.1.1.3

Proponents: Sumit Sunthankar, Custom Instrumentation Services Corporation, Custom Instrumentation Services Corporation (ssunthankar@ciscocems.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.1.1.3 Equipment Building. 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 1,200 square feet (110 m^2).
2. Are intended to house electric 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)~~ <u>(20,000 Btu/hr) (6kW)</u> and a heating thermostat setpoint that is restricted to not more than 50°F (10°C).
4. Have an average wall and roof *U*-factor less than 0.200 in *Climate Zones* 1 through 5 and less than 0.120 in *Climate Zones* 6 through 8.
5. Comply with the roof solar reflectance and thermal emittance provisions for *Climate Zone* 1.

Reason: Our company, Custom Instrumentation Services Corporation which is located in Denver, Colorado, manufactures small, steel commercial equipment shelters for shipment all around the country. These shelters, generally anywhere from an 8'x8' size to a 12'x20' size, house sensitive analyzer equipment that monitors the chemical emissions of power plants and other sources for environmental purposes, as well as other electronic components. The analyzer equipment, which monitor these emissions, are working continuously and they generate a lot of heat when monitoring therefore, because our shelters are small, the shelters are naturally heated by this equipment. We install an HVAC unit on the shelter keep the shelter cool to the appropriate set temperature and occasionally, due to customer requests, we install 2 HVAC units on the shelter where one is a redundant or backup unit in case of failure. These HVAC units are rarely used to heat the shelters, perhaps only in extreme cold conditions outside or when the analyzers are down due to failure or maintenance. Also, our shelters are unmanned/unoccupied so they generally fall under a U occupancy code. With the current IECC code standards for thermal envelope, if the criteria under section C402.1.2 for equipment buildings are not met, we are required to install anywhere from 3-6 inches of insulation inside and around our shelters between the interior and exterior panels. Because the shelter is already generating heat from the analyzers, this extra insulation requires us to install larger HVAC units than needed on the shelter in order to keep them cool which is counter-intuitive and an inefficient use of energy. During the winter months when the temperature is colder, if additional insulation is added, the HVAC will be producing more cooling energy which is counterintuitive to what we need since the shelters should be cooling naturally from the outside air. The attached HVAC calculation files provides the details on this. From our calculations and based on a temperature at 0 degrees Fahrenheit and 75 degree shelter temperature, if more insulation is added on our calculations for the HVAC unit, then the cooling BTU energy increases. Generally, another 1000 Btu/hr or so of cooling is generated by the HVAC for every inch of insulation that is added to the shelter walls, floor, and ceiling. The proposed revision to add exception item #6 under the C402.1.1.3 code is an exemption for small equipment buildings that house electronic components generating heat. Back in 2018, the State of Colorado voted to add the same statement in their Administrative Rules for Building Codes and Standards. If the exemption above cannot be received, then we have another proposal in regard to section C402.1.2 item 3 for the heating system capacity criteria of 17,000 Btu/hr (5kW). This capacity is insufficient and low for our shelters so we would like to propose increasing the heating system capacity to 20,000 Btu/hr (6kW). We cannot purchase an HVAC unit from our vendors that are lower than this capacity to meet the cooling requirements for the analyzer equipment in our shelters. Since our shelters require a 480V 3-phase electrical system and an HVAC unit with a large cooling capacity, generally between 20-30 kBTU/hr, the minimum that we can purchase is a unit with a 6 kW heating capacity.

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

This change should decrease the cost of construction since less insulation material will be needed if the exemption is provided. This also means that there will be less HVAC energy usage since the equipment will provide the heating in the shelter. We may be able to save on HVAC unit costs if the full exemption is provided for equipment buildings.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal as modified addresses the types of heating systems available for these types of buildings.

Final Hearing Results

CED1-99-22	AM

CED1-100-22

Original Proposal

IECC: TABLE C402.1.2, C402.1.2.1.4, TABLE C402.1.3, C402.1.3.6

Proponents: Martha VanGeem, Martha G VanGeem, Masonry Alliance for Codes and Standards; Emily Lorenz, consulting engineer, self (emilyblorenz@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C402.1.2 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-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.029	U-0.029	U-0.029	U-0.026	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-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.017	U-0.017	U-0.017	U-0.017
Walls, above grade																
Mass[f]	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071	U-0.037	U-0.037
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.050	U-0.050	U-0.050	U-0.050	U-0.050	U-0.044	U-0.039	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-0.055	U-0.055	U-0.049	U-0.049	U-0.049	U-0.042	U-0.037	U-0.037
Wood framed and other[c]	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.032	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-0.092	C-0.119	C-0.092	C-0.092	C-0.063	C-0.063	C-0.063	C-0.063	C-0.063
Floors																
Mass[d]	U-0.322[e]	U-0.322[e]	U-0.107	U-0.087	U-0.074	U-0.074	U-0.057	U-0.051	U-0.057	U-0.051	U-0.051	U-0.051	U-0.042	U-0.042	U-0.038	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-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027
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-0.54	F-0.52	F-0.52	F-0.52	F-0.51	F-0.51	F-0.434	F-0.51	F-0.434	F-0.434	F-0.424
Heated slabs	F-0.69	F-0.69	F-0.69	F-0.69	F-0.66	F-0.66	F-0.62	F-0.62	F-0.62	F-0.62	F-0.62	F-0.602	F-0.602	F-0.602	F-0.602	F-0.602
Opaque doors																
Nonswinging door	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31
Swinging door[g]	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	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[h]	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	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. Where assembly *U*-factors, *C*-factors and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.

c. Where heated slabs are below grade, below-grade walls shall comply with the*U*-factor requirements for above-grade mass walls.

d. “Mass floors” shall be in accordance with SectionC402.1.3.6 ~~C402.2.3~~.

e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.

f. “Mass walls” shall be in accordance with SectionC402.1.3.6 ~~C402.2.2~~.

g. Swinging door *U*-factors shall be determined in accordance with NFRC-100.

h. Garage doors having a single row of fenestration shall have an assembly *U*-factor less than or equal to 0.44 in Climate Zones 0 through 6 and less than or equal to 0.36 in Climate Zones 7 and 8, provided that the fenestration area is not less than 14 percent and not more than 25 percent of the total door area.

C402.1.2.1.4 Mass walls and floors. Compliance with required maximum U-factors for mass walls and mass floors in accordance with Table C402.1.2 shall be permitted for assemblies complying with Section C402.1.3.~~3~~6.

TABLE C402.1.3 OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE ALTERNATIVES [a]

Portions of table not shown remain unchanged.

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 buildings[b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-25 + R-11 + 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-49	R-49	R-49	R-49	R-49	R-49	R-60	R-60	R-60	R-60
Walls, above grade																
Mass[f]	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-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-17ci	R-13 + R-19.5ci	R-13 + R-19.5ci	R-13 + R-19.5ci
Metal framed[h]	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-15.2ci or R-13 + R-10ci or R-20 + R-9ci	R-0 + R-15.2ci or R-13 + R-10ci or R-20 + R-9ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-21ci or R-13 + R-15.6ci or R-20 + R-14.3ci	R-0 + R-24ci or R-13 + R-18.8ci or R-20 + R-17.5ci	R-0 + R-24ci or R-13 + R-18.8ci or R-20 + R-17.5ci
Wood framed and other[n]	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 +R-12ci or R-13 + R-3.8ci orR-20	R-0 + R-12ci or R-13 + R-3.8ci orR-20	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 + R-27.5ci or R-13 + R-18.8ci or R-20 + R-14ci	R-0 + R-27.5ci or R-13 + R-18.8ci or R-20 + R-14ci
Walls, below grade																
Below-grade wall[d]	NR	NR	NR	NR	NR	NR	R-7.5ci	R-10ci	R-7.5ci	R-10ci	R-10ci	R-15ci	R-15ci	R-15ci	R-15ci	R-15ci
Floors																
Mass[e]	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-14.6ci	R-16.7ci	R-14.6ci	R-16.7ci	R-16.7ci	R-16.7ci	R-20.9ci	R-20.9ci	R-23ci	R-23ci
Joist/framing	R-13	R-13	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-38	R-38	R-38	R-38	R-38	R-38
Slab-on-grade floors																
Unheated slabs	NR	NR	NR	NR	NR	R-10 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-15 for 24″ below	R-20 for 24″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 24″ below	R-20 for 48″ below	R-20 for 48″ below	R-25 for 48″ 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

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 90.1 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 C402.1.2.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted not less than 32 inches or less on center vertically and not less than 48 inches 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 R-value requirements for above-grade mass walls .

e. “Mass floors” shall be in accordance with Section C402.1.3.6 ~~2.3~~.

f. “Mass walls” shall be in accordance with Section C402.1.3.6 ~~2.2~~.

g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation and full-slab insulation components shall be installed in accordance with Section C402.2.4.1 .

h. The first value is *cavity insulation*; the second value is *continuous insulation*. Therefore, “R-0+R-12ci” means R-12 *continuous insulation* and no *cavity insulation*; “R-13+R-3.8ci” means R-13 *cavity insulation* and R-3.8 *continuous insulation*; “R-20” means R-20 *cavity insulation* and no *continuous insulation*. R-13, R-20, and R-27 *cavity insulation* as used in this table apply to a nominal 4-inch (101 mm), 6-inch (152 mm), and 8-inch (203 mm) deep wood or cold-formed steel stud cavities, respectively.

C402.1.3.6 Mass walls and mass floors. Compliance with required maximum U-factors for mass walls and mass floors in accordance with Table C402.1.2 and minimum R-values for insulation components applied to mass walls and mass floors in accordance with Table C402.1.3 shall be permitted for assemblies complying with the following:

1. Where used as a component of the building thermal envelope, mass walls shall comply with one of the following:
   1.1 Weigh not less that 35 pounds per square foot (171 kg/m^2) of wall surface area.
   1.2 Weigh not less than 25 pounds per square foot (122 kg/m^2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m^3).
   1.3 Have a heat capacity exceeding 7 Btu/ft^2 × ºF (144 kJ/m^2 × K).
   1.4 Have a heat capacity exceeding 5 Btu/ft^2 × ºF (103 kJ/m^2 × K) where the material weight is not more than 120 pcf (1900 kg/m^3).

2. Where used as a component of the building thermal envelope of a building, the minimum weight of mass floors shall comply with provide one of the following:
   2.1 35 pounds per square foot (171 kg/m^2)of floor surface area.
   2.2 25 pounds per square foot (122 kg/m^2) of floor surface area where the material weight is not more than 120 pcf (1900 kg/m^3).

Reason: This proposal fixes Section C402.1.3.6, on mass walls and mass floors, to clarify the definition of mass walls and mass floors for U-factor compliance. It also fixes several errata of several section numbers.

First, although the pointers from the U-factor table, footnotes d and f, when corrected for errata, point to Section C402.1.3.6., this section says that mass walls and mass floors are used for the R-value table, Table C402.1.3. This new text clarifies that these definitions for mass walls and mass floors in Section C402.1.3.6 also apply to the U-factor table, C402.1.2.

The word "mass" has been added before "floors" in the section header of C402.1.3.6 so that users searching for "mass floors" clearly land in this section.

Errata:

C402.1.2.1.4 should point to Section C402.1.3.6.

Footnotes e and f in Table C402.1.3 should point to C402.1.3.6.

Footnotes d and f in Table C402.1.2 should point to C402.1.3.6.

Corrected superscripts and various degree and multiplication symbols in C402.1.3.6

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal clarifies text and fixes errata, so it does not affect the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This clarifies the text and section numbers for mass walls and floors systems available for these types of buildings.

Final Hearing Results

CED1-100-22	AM

CED1-103-22

Original Proposal

IECC: C402.1.2.1.2 (New), C402.1.3.3 (New)

Proponents: Jay Crandell, P.E., ABTG / ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Add new text as follows:

C402.1.2.1.2 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof-ceiling construction.

C402.1.3.3 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the thermal resistance (R-value) of roof insulation in roof-ceiling construction.

Reason: This proposal restores the suspended ceiling provision that was inadvertently deleted entirely from the code by conflicted actions on CEPI-27 (as modified/replaced) and CEPI-41, both of which did not intend to entirely delete this provision. This proposal adds the suspended ceiling under the U-factor determination requirements and also the R-value compliance provisions since it applies to both.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not impact cost because it is restoring a provision that was not intended to be deleted during the public input phase of developing the draft IECC standard.

Public Hearing Results

Committee Action	As Modified

Committee Reason: Proposal corrects omission of provisions for addressing U-factor and R-value limits for suspended ceilings.

Final Hearing Results

CED1-103-22	AM

CED1-106-22

Original Proposal

IECC: SECTION 202, C402.1.2.4

Proponents: Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov); Michael Rosenberg, Pacific Northwest National Laboratory, Pacific Northwest National Laboratory (michael.rosenberg@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

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

C402.1.2.4 Thermal Resistance of mechanical equipment penetrations. Where the total area of through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above grade wall area, such area shall be calculated as a separate wall assembly, in accordance with either Section C402.1.2.1.5 or Section C402.1.4, ~~with~~using a published and approved U-factor for that equipment or a default U-factor of 0.5.

Reason: This proposal is editorial and adds language to clarify that above grade wall compliance with U-factor requirements can be based on the area weighted average of different above grade wall components having different U-factors. Without this language it is unclear whether a building meeting the threshold required to account for mechanical equipment penetrations can use the prescriptive U-factor method for demonstrating above grade wall U-factor compliance.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is editorial and does not impact the cost effectiveness of the IECC 2024.

Public Hearing Results

Committee Action	**As Modified**

Committee Reason: This proposal is editorial. Without this language it is unclear whether a building meeting the threshold required to account for mechanical equipment penetrations can use the prescriptive U-factor method for demonstrating above grade wall U-factor compliance.

Final Hearing Results

CED1-106-22	AM

CED1-107-22

Original Proposal

IECC: C402.1.2.1.5 (New), C402.7.1

Proponents: Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov); Michael Rosenberg, Pacific Northwest National Laboratory, Pacific Northwest National Laboratory (michael.rosenberg@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Add new text as follows:

C402.1.2.1.5 Area-weighted Averaging of Above-Grade Wall U-factors. For Where *above-grade walls* which include more than one assembly component type or a penetration of the opaque wall area, the area weighted U-factor of the entire *above-grade wall* may is permitted to be determined by an approved method accepted engineering practice.

Revise as follows:

C402.7.1 Balconies and floor decks. Balconies and concrete floor decks shall not penetrate the building thermal envelope. Such assemblies shall be separately sup-ported or shall be supported by structural attachments or elements that minimize thermal bridging through the building thermal envelope.

Exceptions: Balconies and concrete floor decks shall be permitted to penetrate the *building thermal envelope* where:

1. an area-weighted *U*-factor is used for *above-grade wall* compliance that ~~which~~ includes a *U*-factor of 0.8 Btu/h-°F-ft^2 for the area of the *above-grade wall* penetrated by the concrete floor deck in accordance with Section C402.1.2.1.5, or
2. an approved thermal break device of not less than R-10 is installed in accordance with the manufacturer's instructions, or ~~.~~
3. An *approved* design where the *above-grade wall U*-factor used for compliance accounts for all balcony and concrete floor deck *thermal bridges*.

Reason: This proposal is editorial and proposes language to clarify how to account for thermal bridges associated with floors that penetrate the wall plane. New language clarifying that above grade wall U-factors can be area weighted supports compliance Option 1. A new compliance requirement is proposed that aligns with language for the other thermal bridges and would allow a design to use either the Component Alternative Compliance approach or a Performance Compliance path.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not impact cost effectiveness.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposed change clarifies the intent of Section C402.7.1 and adds new language that aligns with the requirements for other types of thermal bridges. It also corrects the units for chi factor.

Final Hearing Results

CED1-107-22	AM

CED1-108-22

Original Proposal

IECC: C402.1.2.2, C402.1.2.3, C402.1.2.4

Proponents: Jay Crandell, P.E., ABTG / ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.1.2.1.4 ~~**C402.1.2.2 U-factor thermal resistance of c**~~**Cold-formed steel assemblies.** *U*-factors for building envelopes containing cold-formed steel framed ceilings and walls shall be permitted to be determined in accordance withwith AISI S250 as modified herein.

1. Where the steel-framed wall contains no cavity insulation, and uses continuous insulation to satisfy the U-factor maximum, the steel-framed wall member spacing is permitted to be installed at any on-center spacing.
2. Where the steel-framed wall contains framing at 24 inches (610 mm) on center with a 23 percent framing factor or framing at 16 inches (400 mm) on-center with a 25 percent framing factor, the next lower framing member spacing input values shall be used when calculating using AISI S250.
3. Where the steel-framed wall contains less than 23 percent framing factors the AISI S250 shall be used without any modifications.
4. Where the steel-framed wall contains other than standard C-shape framing members the AISI S250 calculation option for other than standard C-shape framing is permitted to be used.

C402.1.2.1.5 ~~**C402.1.2.3 Thermal Resistance of**~~ **Spandrel Panels.** U-factors of opaque assemblies within fenestration framing systems shall be determined in accordance with the default values in Table C402.1.2.3, ASTM C1363, or ANSI/NFRC 100.

C402.1.2.1.6 ~~**C402.1.2.4 Thermal Resistance of m**~~**Mechanical equipment penetrations.** Where the total area of through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above grade wall area, such area shall be calculated as a separate wall assembly with a published and approved U-factor for that equipment or a default U-factor of 0.5.

Reason: This proposal is editorial and moves sections that address how to determine U-factors and places them as subsections under Section C402.1.2.1 which is where methods and requirements for determining U-factors are located. In addition the subsection titles are revised to remove reference to "thermal resistance" since the provision is addressing U-factors, not R-values.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal is editorial and does not change requirements. It just places them in the proper location within the intended framework of Section C402.1.2.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: move sections related to U-factor determination under section for U-factor determination and change title to remove reference to thermal resistance to be consistent focus on U-factors.

Final Hearing Results

CED1-108-22	AM

CED1-110-22

Original Proposal

IECC: TABLE C402.1.2.3, C402.5.5, C402.7.4, C406.2.1.1, C505.2.1

Proponents: Thomas Culp, Birch Point Consulting LLC, Glazing Industry Code Committee and Aluminum Extruders Council (culp@birchpointconsulting.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C402.1.2.3 EFFECTIVE U-FACTORS FOR SPANDREL PANELS[a]

Portions of table not shown remain unchanged.

c. This frame type chall be used for systems where a ~~urethan or~~ non-metallic element separates the metal exposed to the exterior from the metal that is exposed to the interior condition.

C402.5.5 Doors. Opaque swinging doors shall comply with Table C402.1.2. Opaque nonswinging doors shall comply with Table C402.1.2. Opaque doors shall be considered as part of the gross area of above-grade walls that are part of the *building thermal envelope*. Opaque doors shall comply with Section C402.5.5.1 or C402.5.5.2. Other doors shall comply with the provisions of Section ~~C402.4.3~~ C402.5.3 for vertical fenestration.

C402.7.4 Vertical fenestration. Vertical fenestration intersections with above grade walls shall comply with one or more of the following:

1. Where above-grade walls include continuous insulation, the plane of the exterior glazing layer or, for metal frame fenestration, a non-metal thermal break in the frame shall be positioned within 2 inches (610 mm) of the interior or exterior surface of the continuous insulation.
2. An approved design where the above-grade wall U-factor used to demonstrate compliance accounts for the beam or column thermal bridge.
3. The surface of the rough opening, not covered by the fenestration frame, shall be insulated with insulation of not less than R-3 material or covered with a wood buck that is not less than 1.5 inches (457 mm) thick.
4. For the intersection between vertical fenestration and opaque spandrel in a shared framing system, manufacturer's data for the spandrel *U*-factor shall account for *thermal bridges*.

Exceptions:

1. Where an approved design for the above-grade wall *U*-factor used for compliance accounts for *thermal bridges* at the intersection with the vertical fenestration.
2. Doors

C406.2.1.1 EO1 Improved envelope performance 901 Appendix C. *Building* envelope measures shall be installed to improve the energy performance ofthe project. The achieved energy credits shall be determined using Equation 4-15.

(Equation 4-15)

$$\underline{EC_{ENV} = 1000 \text{ X } (EPF_B - EPF_P)/EPF_B}$$

EC_{ENV}= E01 measure energy credits
EPFB= base envelope performance factor calculated in accordance with ASHRAE 90.1~~-2019~~-Appendix C.

EPF_P= proposed envelope performance factor calculated in accordance with ASHRAE 90.1~~-2019-~~Appendix C.

C505.2.1 Building envelope. Where a *change of occupancy* or use is made to a whole building that the results in fenestration area greater than the maximum fenestration area allowed by Section ~~C402.4.1~~C402.5.1, the *building* shall comply with Section C402.1.5, with a proposed UA that shall not be greater than 110 percent of the target UA.

Exception: Where the *change of occupancy* or use is made to a portion of the *building*, the new occupancy is exempt from Section ~~C402.4.1~~ C402.5.1 provided that there is not an increase in fenestration area.

Reason: Various errata / corrections:

- In footnote c of Table C402.1.2.3, remove "urethan or" so it is not material specific and parallels footnote b. Or at a minimum, correct the spelling of "urethane."
- In item 3 of C402.7.4, “coved” should be “covered”
- In C402.5.5 Doors, the reference to C402.4.3 should be changed to C402.5.3 due to section renumbering.
- In C406.2.1.1, it should refer just to ASHRAE 90.1 Appendix C, not ASHRAE 90.1-2019 Appendix C. The proper year will be in Chapter 6 Reference Standards, and will be 2022, not 2019.
- In C505.2.1, the reference to sections C402.4.1 should be changed to C402.5.1 due to section renumbering in chapter 4.
- Also, in the pdf version, the titles for C402.5.1.1 and C402.5.1.2 are repeated twice. Remove first one. But this is not showing up in cdpAccess, so maybe fixed already?

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial fixes. No cost impact.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Corrects various errata per proponents reason statement.

Final Hearing Results

CED1-110-22 AS

CED1-111-22

Original Proposal

IECC: TABLE C402.1.3

Proponents: Jay Crandell, P.E., ABTG / ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C402.1.3 OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE ALTERNATIVES [a]

Portions of table not shown remain unchanged.

Walls, above grade																
Mass[f]																
Metal building																
Metal framed [h, i]																
Wood framed and other [h, i]																

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 90.1 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 C402.1.2.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted not less than 32 inches or less on center vertically and not less than 48 inches 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 R-value requirements for above-grade mass walls .

e. “Mass floors” shall be in accordance with Section C402.2.3.

f. “Mass walls” shall be in accordance with Section C402.2.2.

g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation and full-slab insulation components shall be installed in accordance with Section C402.2.4.1 .

h. The first value is *cavity insulation*; the second value is *continuous insulation*. Therefore, “R-0+R-12ci” means R-12 *continuous insulation* and no *cavity insulation*; “R-13+R-3.8ci” means R-13 *cavity insulation* and R-3.8 *continuous insulation*; “R-20” means R-20 *cavity insulation* and no *continuous insulation*. R-13, R-20, and R-27 *cavity insulation* as used in this table apply to a nominal 4-inch (101 mm), 6-inch (152 mm), and 8-inch (203 mm) deep wood or cold-formed steel stud cavities, respectively.

i. <u>Where the required R-value in Table C402.1.3 is met by using continuous insulation such that cavity insulation is not required, the wall assembly framing is permitted to be spaced at any spacing.</u>

Reason: Footnote 'i' was included as part of the modified CEPI-38 proposal but was inadvertently left out of the public review draft. This proposal includes footnote 'i' to address the omission. As stated in the reason for the modification to CEPI-38: "For R-value options where there is no cavity insulation and only continuous insulation providing the necessary minimum R-value for the wall assembly, the framing spacing (i.e. Framing Factor) becomes not relevant."

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There is no cost impact as this proposal is corrective to align with the approved modification to CEPI-38 in the public input phase. The footnote does provide added flexibility and ease of compliance which may have a small indirect cost reduction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: addresses errata of footnote omitted but previously approved as part of CEPI-38; additional revisions were made for clarity of application.

Final Hearing Results

CED1-111-22	AM

CED1-112-22

Original Proposal

IECC: C402.1.3

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.1.3 Insulation component R-value alternatives. For opaque portions of the *building thermal envelope* using this section as an alternative to Section C402.1.2, the *R*-values for cavity insulation and continuous insulation shall be not less than that specified in Table C402.1.3. ~~Commercial~~*Group R* occupancy 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.

Reason: Conflicting language is corrected. As written the code requires all buildings to comply with Group R requirements

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

Eliminating conflicting language in the code always saves $.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Conflicting language is corrected. As written the code requires all buildings to comply with Group R requirements.

Final Hearing Results

CED1-112-22	AS

CED1-115-22

Original Proposal

IECC: C402.1.3.3, C402.1.3.4, C402.1.3.5

Proponents: Jay Crandell, P.E., ABTG / ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Delete without substitution:

~~**C402.1.3.3 Building materials and air spaces.** Building materials that are not insulation components complying with Chapter 3 shall be excluded from demonstrating compliance with the R-values of Table C402.1.3. Air spaces used to demonstrate compliance with Table C402.1.3 shall comply with Section C402.2.7.~~

~~**C402.1.3.4 Assembly construction.** Assembly constructions used for compliance with Table C402.1.3 shall be as described in ANSI/ASHRAE/IES 90.1 Appendix A.~~

~~**C402.1.3.5 Concrete masonry units, integral insulation.** The R-value of integral insulation installed in concrete masonry units shall not be used in determining compliance with Table C402.1.3 except as otherwise noted.~~

Reason: In CEPI-27 (as modified/replaced) three subsections were deleted from the original proposal. However, in the public review draft, these sections were not shown as deleted. This proposal makes those deletions as a procedural "correction" to the draft. I would prefer that these sections be retained (not deleted), but this would not be consistent with compromises made during the public input phase in gaining broad support for CEPI-27.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Deletion of these sub-sections do not change requirements that are found elsewhere in the code (e.g., table footnotes, other sections, etc.).

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: These deletions were previously agreed on. In CEPI-27 (as modified/replaced) three subsections were deleted from the original proposal. However, in the public review draft, these sections were not shown as deleted. This proposal makes those deletions as a procedural "correction" to the draft.

Final Hearing Results

CED1-115-22 AS

CED1-118-22

Original Proposal

IECC: C402.2.1, C402.2.1.3 (New)

Proponents: Jay Crandell, P.E., ABTG / ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.2.1 Roof-ceiling construction ~~assembly~~. ~~Roof i~~Insulation materials in the roof-ceiling construction shall be installed between the roof or ceiling framing, continuously below ~~above~~ the ceiling framing, continuously above, below, ~~on~~ or within the roof deck ~~assembly~~ or in any approved combination thereof. Insulation installed above the roof deck shall comply with Sections C402.2.1.1 through C402.2.1.3.

Add new text as follows:

C402.2.1.3 Minimum thickness of tapered insulation. The minimum thickness of tapered above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be not less than 1 inch (25 mm).

Reason: The proposal clarifies the title and wording of Section C402.2.1 and avoids misusing a defined term "roof assembly" in the building codes. Instead, a term roof-ceiling construction is used which more broadly encompasses the overall roof structure and components. In addition, a subsection that was inadvertently deleted from the CEPI-27 proposal approved during the public input phase is restored. This occurred because of competing proposals attempting to move this requirement into different places leaving it absent in the final correlation.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal is a clarification and restores a section that was inadvertently omitted due to proposal correlation issues during the public inpu phase.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies roof-ceiling construction insulation options and restores provision for minimum thickness of tapered insulation.

Final Hearing Results

CED1-118-22	AM

CED1-119-22

Original Proposal

IECC: C402.2.6

Proponents: Jay Crandell, P.E., ABTG / ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.2.6 Insulation of radiant heating ~~systems~~ panels. *Radiant heating system* panels, and their associated components that are installed in interior or exterior assemblies, shall be insulated to an *R*-value of not less than R-3.5 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 C402.1.2.

~~**Exception:** Heated slabs on grade shall be insulated in accordance with Section C402.2.4 and Section C402.1~~.

Reason: This proposal clarifies that Section C402.2.6 is addressing radiant heating system panels. Also, heated slabs on grade are not an exception for heating system panels. It is an assembly that is addressed elsewhere in the code. Thus, the exception is moved to the last sentence and changed to a requirement that references appropriate sections for heated slab provisions.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal clarifies an existing provisions without any changes in requirements.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarify that the provisions are intended to apply to only to radiant heat system panels, not other type of radiant heating systems. The exception for heated slabs is deleted because they are not radiant heating system panels and the thermal requirements are addressed elsewhere.

Final Hearing Results

CED1-119-22	AM

CED1-121-22

Original Proposal

IECC: C402.3, SECTION 202 (New)

Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.3 Above-Grade Wall Solar Reflectance. For Climate Zone 0, above-grade east-oriented, south-oriented, and west-oriented walls shall comply with either of the following:

1. Not less than 75 percent of the **opaque** above-grade wall area shall have an area-weighted initial solar reflectance of not less than 0.30 where tested in accordance with ASTM C1549 with AM1.5GV, output or ASTM E903 with AM1.5GV output, or determined in accordance with an approved source. This above-grade wall area shall have an emittance or emissivity of not less than 0.75 where tested in accordance with ASTM C835, C1371, E408, or determined in accordance with an approved source. For the portion of the above-grade wall that is glass spandrel area, a solar reflectance of not less than 0.29, as determined in accordance with NFRC 300 or ISO 9050, shall be permitted. Area-weighted averaging is permitted only using ***south-, east-, and west-oriented walls*** enclosing the same occupancy classification.
2. Not less than 30 percent of theopaque above-grade wall area shall be shaded by manmade structures, existing buildings, hillsides, permanent building projections, on-site renewable energy systems, or a combination of these. Shade coverage shall be calculated by projecting the shading surface downward on the above-grade wall at an angle of 45 degrees.

Exception: Above-grade walls of low energy buildings complying with Section C402.1.1.1, greenhouses complying with Section C402.1.1.2, and equipment buildings complying with Section C402.1.1.3.

Add new definition as follows:

NORTH-ORIENTED. facing within 67.5 degrees of true north in the northern hemisphere or facing within 67.5 degrees of true south in the southern hemisphere.

SOUTH-ORIENTED. facing within 45 degrees of true south in the northern hemisphere or facing within 45 degrees of true north in the southern hemisphere.

EAST-ORIENTED. facing within 45 degrees of true east to the south and within less than 22.5 degrees of true east to the north in the northern hemisphere or facing within 45 degrees of true east to the north and within less than 22.5 degrees of true east to the south in the southern hemisphere.

WEST-ORIENTED. facing within 45 degrees of true west to the south and within less than 22.5 degrees of true west to the north in the northern hemisphere or facing within 45 degrees of true west to the north and within less than 22.5 degrees of true west to the south in the southern hemisphere.

Reason: We added the word opaque and the definitions of east-, west-, north-, and south-oriented to be consistent with ASHRAE 90.1 and the analysis performed in ASHRAE 90.1.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

An analysis was performed on the entire section that showed this proposal was cost effective in Climate zone 0. For the changes in this proposal there are no cost impacts

Public Hearing Results

Committee Action **As Modified**

Committee Reason: In addition to the original reason statement, approval as modified is editorial corrections of existing language.

Final Hearing Results	
CED1-121-22	AM

CED1-126-22

Original Proposal

IECC: TABLE C402.5

Proponents: Helen Sanders, Technoform North America, The Facade Tectonics Institute (helen.sanders@technoform.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C402.5 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		0.45		0.42 0.38		0.36 0.34		0.36 0.34		0.34		0.29 0.28		0.26 0.25	
Operable fenestration	0.62		0.60		0.54		0.45		0.45		0.42		0.36		0.32	
Entrance doors	0.83		0.77		0.68		0.63		0.63		0.63		0.63		0.63	
SHGC																
Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	
PF < 0.2	0.23	0.21	0.25	0.23	0.25	0.23	0.36	0.33	0.38	0.33	0.38	0.34	0.40	0.36	0.40	0.36
0.2 ≤ PF < 0.5	0.28	0.25	0.30	0.28	0.30	0.28	0.43	0.40	0.46	0.40	0.46	0.41	0.48	0.43	0.48	0.43
PF ≥ 0.5	0.37	0.34	0.40	0.37	0.40	0.37	0.58	0.53	0.61	0.53	0.61	0.54	0.64	0.58	0.64	0.58
Skylights																
U-factor	0.70		0.65		0.55		0.50		0.50		0.50		0.44		0.41	
SHGC	0.30		0.30		0.30		0.40		0.40		0.40		NR		NR	

NR = No Requirement, PF = Projection Factor.

Reason: The Department of Energy identified a “net zero energy” window as having a U-factor of 0.10 BTU^{o}/ F.hr.ft^{2} (Reference [1]) and they identified that fenestration with U-factors of 0.15 BTU/^{o}f.hr.ft^{2} could save 1 Quadrillion BTUs annually over the current (2006) building stock (0.71 Quads from heating and 0.31 Quads from cooling) if implemented in all US buildings. This report also demonstrates the importance of U-factor in cooling climates based on the cooling energy reduction, as does a paper from the Façade Tectonics Institute’s World Congress in 2020, which is included in the bibliography [2]. We recognize that to reach net zero goals by 2030, the IECC needs to ratchet down envelope energy efficiency quickly over the next two or three code revisions to achieve that goal. The fixed fenestration U-factors proposed here are a result of a cost-effectiveness evaluation done by the Façade Tectonics Institute (FTI), whose members include architects, engineers, consultants, general and sub-contractors, and glass, window and curtain wall suppliers.

Updated average costs have been gathered for a range of strategies that can be used to increase fenestration performance. These include, for example, adding argon gas to insulating glass, adding a warm-edge spacer, adding a fourth surface low-e, adding wider thermal barriers to the aluminum frame, move from double to triple pane etc. These updated average component costs have been used to estimate average costs to decrease U-factors in curtainwall from a baseline of 0.50 BTU/^{o}F.hr.ft^{2} (the current climate zone 1 requirement) to achieve a range of U-factors from 0.46 to 0.24 BTU/^{o}f.hr.ft^{2}.These costs to achieve U-factors have then been used to assess cost effectiveness based on 3% and 7% discount rates, with and without including the social cost of carbon (SCC). Energy cost savings brought about by reducing U-factors from the current prescriptive value in each climate zone have been calculated using the regression models for the medium office, medium apartment, and a modified medium office (modified for fuel mix) which was used several years ago to support fenestration performance changes in the ASHRAE 90.1 2016 revision. The cost of energy (electric and gas) has not been updated for recent inflation, nor for expected future energy cost increases, from that 2016 analysis, and is likely to be higher than past historical trends. So, the energy cost savings in this analysis are likely to be underestimated and resulting U-factor change recommendations for products that will be impacting building energy use for decades into the future, will be very conservative. Resources from PNNL were not available to support completion of regression analyses of additional building types during the public comment period, which was why we used the regression equations developed for ASHRAE 90.1-2016.

We also note that the costs we have documented for thermal improvements in 2022 will also drop in the future as a specialty products transition to become standard practice, as higher demand triggers manufacturing investment in more efficient, lower cost manufacturing processes and as new R&D results in lower costs. The fenestration industry has seen these effects in the residential window market where a combination of the above code voluntary EnergyStar program and homeowner tax credits have driven above code EnergyStar windows to ~85% of all U.S. residential window sales. EPA announced this week that the new ENERGY STAR requirements, effective 10/2023, for the northern zone in the U.S. will require a U-factor of 0.22, a significant reduction from its current level of 0.27 which will provide significant market pressure to deliver even better performing products that will perform at these levels. We note that the EnergyStar requirements for residential windows are not directly translatable to commercial fenestration because of the increased structural requirements in commercial construction, but that the residential market has been pulled ahead of commercial fenestration in terms of performance because of this combination of standards and incentives. The drive to triple pane which will likely ensue in residential windows accompanying the new EnergyStar requirements may spill over into the commercial market and support reductions in costs for commercial triple pane units.

The details of the methodology, assumptions and the results of the analysis are shown in the attached documentation and are briefly reviewed by climate zone below. Values are given below in dollars per square foot of fenestration area and are the difference between the upfront cost incurred to improve the fenestration and the 40-year energy savings for the 4 measures: 3% and 7% discount rates with and without including the SCC. Negative numbers indicate the U-factor change is cost-effective based on the input assumptions (energy savings higher than upfront costs) and are highlighted in green:

Climate zone 8:

U=0.26 currently	Medium office building				Medium apartment					Adjusted medium office		
Fenestration U-factor	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sq ft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft
0.25	$ (0.53)	$ (0.34)	$ (0.80)	$ (0.56)	$ (0.04)	$ 0.08	$ (0.37)	$ (0.18)	$ (0.22)	$ (0.07)	$ (0.57)	$ (0.35)
0.24	$ 0.39	$ 0.77	$ (0.15)	$ 0.33	$ 1.38	$ 1.61	$ 0.71	$ 1.09	$ 1.01	$ 1.31	$ 0.30	$ 0.75

A reduction in U-factor from 0.26 to 0.25 is shown to be cost-effective for every building type in all of the 4 measures (except at the worst case 7% discount rate for the apartment). FTI recommends making a change to 0.25 BTU/^{o}F.hr.ft^{2} at a minimum, based on this analysis. U=0.24 is cost-effective based on 3%+SCC for the medium office. A case could be made that 0.24 could be cost-effective in the apartment and without SCC if the energy costs of the analysis were increased to today's or future expected rates.

Climate zone 7:

U=0.29 currently	Medium office building				Medium apartment					Adjusted medium office		
Fenestration U-factor	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sq ft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft
0.26	$ 0.99	$ 1.43	$ 0.36	$ 0.92	$ 2.15	$ 2.41	$ 1.39	$ 1.82	$ 1.70	$ 2.05	$ 0.88	$ 1.40
0.27	$ 0.04	$ 0.34	$ (0.37)	$ 0.00	$ 0.82	$ 1.00	$ 0.31	$ 0.60	$ 0.52	$ 0.75	$ (0.03)	$ 0.32
0.28	$ (0.23)	$ (0.09)	$ (0.44)	$ (0.26)	$ 0.15	$ 0.24	$ (0.10)	$ 0.04	$ 0.00	$ 0.12	$ (0.27)	$ (0.10)

A U-factor of 0.28 is cost-effective for the medium office building in all 4-measures (3%, 7% with and without the SCC) and for the adjusted office except for at the 7% discount rate. U=0.28 is cost-effective for the medium apartment based on the SCC at 3%. FTI recommends making the change from 0.29 to 0.28 in this climate zone. A case could be made to make a change to 0.27 since that is cost-effective based on the social cost of carbon in the medium office, and any increase in energy cost assumptions could make it cost-effective in the office building and in other of the measures. Also, the cost of the strategies to achieve lower U-factors (like triple pane constructions) are currently higher than they could be because they are not currently "business as usual". Triple panes in Europe are business-as-usual and are reported to be substantially less expensive than those sold in North America.

Climate zone 6:

U=0.34 currently	Medium office building				Medium apartment				Adjusted medium office			
Fenestration U-factor	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sq ft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft
0.31	$ 0.70	$ 1.07	$ 0.20	$ 0.65	$ 1.60	$ 1.83	$ 0.95	$ 1.32	$ 1.29	$ 1.57	$ 0.62	$ 1.05
0.32	$ 0.63	$ 0.87	$ 0.29	$ 0.59	$ 1.22	$ 1.37	$ 0.79	$ 1.04	$ 1.02	$ 1.21	$ 0.57	$ 0.85
0.33	$ 0.23	$ 0.35	$ 0.06	$ 0.21	$ 0.52	$ 0.60	$ 0.31	$ 0.43	$ 0.42	$ 0.52	$ 0.20	$ 0.34

None of the U-factors tested below the current value of U=0.34 are shown to be cost-effective using the previous energy costs. Note that the cost-effectiveness situation is not only driven by older energy costs, but also because the strategies to achieve the lower U-factor are not yet “business-as-usual” (triple pane, fourth surface low-e etc.) and are therefore higher priced than they would be if used more regularly. If these strategies were used more, then cost-effectiveness would likely be seen. Based on this current analysis, FTI is not proposing a change to U-factor in this climate zone.

Climate zone 5

U=0.36 currently	Medium office building				Medium apartment				Adjusted medium office			
Fenestration U-factor	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sq ft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft
0.32	$ 0.49	$ 0.83	$ 0.00	$ 0.43	$ 1.44	$ 1.63	$ 0.86	$ 1.18	$ 1.03	$ 1.29	$ 0.39	$ 0.79
0.33	$ (0.10)	$ 0.15	$ (0.47)	$ (0.14)	$ 0.61	$ 0.76	$ 0.18	$ 0.42	$ 0.30	$ 0.50	$ (0.18)	$ 0.12
0.34	$ (0.52)	$ (0.35)	$ (0.76)	$ (0.55)	$ (0.04)	$ 0.05	$ (0.33)	$ (0.17)	$ (0.25)	$ (0.12)	$ (0.57)	$ (0.37)

A change from 0.36 to 0.34 is shown to be cost-effective in all building types evaluated at all four measures (except the most stringent test of 7% discount on energy alone in the medium apartment, where it misses by $0.05c/ft and would probably be cost-effective if higher energy costs were assumed). A larger change to 0.33 is cost-effective on 3 of the 4 measures in the unadjusted medium office. FTI is proposing a 0.34 requirement in this climate zone, based on this data.

Climate zone 4:

U=0.36 currently	Medium office building				Medium apartment				Adjusted medium office			
Fenestration U-factor	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sq ft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft
0.32	$ 1.05	$ 1.28	$ 0.71	$ 1.01	$ 1.73	$ 1.86	$ 1.35	$ 1.56	$ 1.42	$ 1.60	$ 0.98	$ 1.26
0.33	$ 0.32	$ 0.49	$ 0.07	$ 0.29	$ 0.83	$ 0.93	$ 0.55	$ 0.70	$ 0.60	$ 0.73	$ 0.27	$ 0.47
0.34	$ (0.24)	$ (0.12)	$ (0.41)	$ (0.26)	$ 0.10	$ 0.17	$ (0.09)	$ 0.02	$ (0.05)	$ 0.04	$ (0.27)	$ (0.13)

A change from 0.36 to 0.34 has been shown to be cost effective for the medium office building across all 4 measures and in the adjusted office building for 3 of the 4 measures (and close to breakeven with 7% discount rate on energy alone). It is cost effective in the medium apartment for the 3% + SCC measure (and close to breakeven on the three other measures). With higher energy cost assumptions, it is likely that the medium apartment would show cost-effectiveness. The City of Seattle (CZ 4) has already changed its fixed fenestration U-factor from 0.36 to 0.34 on the grounds of cost-effectiveness and ease of availability of products at this performance. For these reasons, FTI is proposing reducing the U-factor in this climate zone to 0.34. This would provide a uniform requirement for fixed fenestration of 0.34 from climate zone 4 to climate zone 6, responding to feedback from the subcommittee to not have a different number for each zone.

Climate zone 3:

U=0.42 currently	Medium office building				Medium apartment				Adjusted medium office			
Fenestration U-factor	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sq ft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	above (below) breakeven @7% discount rate with SCC, $/sq.ft
0.38	$ (0.15)	$ 0.01	$ (0.38)	$ (0.18)	$ 0.32	$ 0.41	$ 0.07	$ 0.21	$ 0.11	$ 0.24	$ (0.20)	$ (0.01)
0.39	$ (0.17)	$ (0.05)	$ (0.26)	$ (0.16)	$ 0.18	$ 0.24	$ (0.03)	$ 0.04	$ (0.01)	$ 0.05	$ (0.17)	$ (0.07)
0.40	$ (0.14)	$ (0.06)	$ (0.35)	$ (0.19)	$ 0.09	$ 0.14	$ (0.01)	$ 0.10	$ 0.02	$ 0.12	$ (0.21)	$ (0.07)

This analysis indicates that a change from U=0.42 to 0.38 is cost-effective for the medium office building on 3 of the 4 measures (and within 1c/sq.ft of breakeven at 7%) and the adjusted medium office building when including the social cost of carbon. U= 0.38 is cost-effective at 3%+SCC in the medium apartment and 4c/sq.ft away from breakeven at 7%+SCC. It likely would be cost-effective if higher energy costs were used instead of the older 90.1-2016 analysis values and there is no fundamental limitation to product/technology availability, as more stringent U-factors have been required in more northern climate zones for several code cycles. On this basis, FTI is recommending a move to 0.38.

Climate zone 2

U=0.45 currently	Medium office building				Medium apartment				Adjusted medium office			
Fenestration U-factor	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft
0.40	$ 0.28	$ 0.33	$ 0.20	$ 0.27	$ 0.49	$ 0.50	$ 0.44	$ 0.47	$ 0.36	$ 0.41	$ 0.26	$ 0.33
0.41	$ 0.29	$ 0.34	$ 0.23	$ 0.29	$ 0.46	$ 0.47	$ 0.43	$ 0.45	$ 0.36	$ 0.40	$ 0.28	$ 0.33
0.42	$ 0.10	$ 0.13	$ 0.05	$ 0.09	$ 0.23	$ 0.24	$ 0.20	$ 0.22	$ 0.15	$ 0.18	$ 0.09	$ 0.13
0.43	$ 0.16	$ 0.18	$ 0.13	$ 0.15	$ 0.24	$ 0.25	$ 0.22	$ 0.23				
0.44	$ 0.12	$ 0.13	$ 0.11	$ 0.12								

The analysis for 5 different U-factor changes (from 0.45 to 0.40, 0.41, 0.42, 0.43, and 0.44) shows that the cost-effectiveness results go through an optimum at 0.42. In going from 0.45 to 0.44, there isn't enough improvement in energy performance to offset the small, but finite, increased upfront fenestration cost (est. $0.18/sq.ft). In going from 0.45 to 0.40, the energy savings are greater, but the higher upfront cost (est. $0.56/sq.ft) doesn't offset it sufficiently. Whereas changing to a U-factor of 0.42 achieves a minimum in the cost-effectiveness calculation (albeit not quite negative) - it delivers enough energy savings to balance an moderate increase in cost (est. $0.27/sq.ft). In this analysis, U=0.42 is not sufficient to get to breakeven using current energy and modeling assumptions.

Part of the challenge in CZ2 (and CZ1) in modeling the impact of U-factor is the modeling assumptions.

Modeling in solar heat gain dominated climates can show that lower U-factors can keep the building insulated, trapping solar heat gain, but typically it doesn't account for the use of night ventilation (free) nor the use of economizers that address these issues. Also, reducing the U-factor reduces the SHGC of the fenestration, but we have not modeled this correlated relationship in this analysis, which would show reduced energy usage. Using higher energy costs as experiencing currently and likely in the future, plus improved modeling that supports the use of night ventilation and use of economizers to dissipate heat at night may show cost-effectiveness at 0.42. A case could be made to reduce the U-factor to 0.42 in climate zone 2, but in the spirit of achieving a consensus proposal, we are suggesting no change.

Climate zone 1:

U=0.50 currently	Medium office building				Medium apartment				Adjusted medium office			
Fenestration U-factor	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft	upfront cost above (below) breakeven @3% discount rate, $/sqft	upfront cost above (below) breakeven @7% discount rate, $/sqft	upfront cost above (below) breakeven @3% discount rate with SCC, $/sqft	upfront cost above (below) breakeven @7% discount rate with SCC, $/sq.ft
0.45	$ 0.28	$ 0.28	$ 0.29	$ 0.29	$ 0.23	$ 0.24	$ 0.22	$ 0.23	$ 0.28	$ 0.28	$ 0.29	$ 0.28
0.46	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ (0.03)	$ (0.03)	$ (0.04)	$ (0.03)	$ 0.01	$ 0.01	$ 0.01	$ 0.01

For curtainwall systems, this analysis suggests that there is no additional cost to go from U=0.50 to U=0.46 because this lower U-factor is typically delivered while meeting the SHGC requirements. U=0.46 is cost-effective in this analysis in the medium apartment across all measures. It is not shown to be cost-effective for the medium office building because of the modeling assumptions, which suggest energy use will rise with lower U-factors. But the modeling does not include the use of free night ventilation nor economizer systems, and as such, the heat gain during the day is not allowed to dissipate as much as could be achieved if the building was designed with those strategies. Also, lower U-factor typically delivers lower SHGC, and the impacts of a correlated reduction in SHGC was not evaluated. For many curtainwall systems, a U=0.46 is already delivered by achieving the prescriptive SHGC, although that may not be the case for storefront systems. Therefore, FTI proposes to maintain the U-factor at 0.50, focusing on making changes in the other climate zones.

Additional discussion

According to Steve Selkowitz from LBNL, the results of several of studies indicate that fenestration U-factors between 0.10 to 0.20 Btu/^{o}f.hr.ft^{2} are likely to be appropriate to get to net zero fenestration performance across even the northern climate zones, with variation also depending on orientation and window area (more area needing lower U-factor) and in some cases with dynamic solar control. U-factors in this range are already in use in some European countries. Whether 0.20 or 0.10 or somewhere in between is considered the future net-zero target, the IECC window performance change from cycle to cycle is not on a track to achieving close to net zero window performance by 2030. Even if we assume 0.15 BTU/^{o}f.hr.ft^{2} is the target to meet, and we consider the current 0.29 in climate zone 8, the 2024, 2027 and 2030 values would need to be 0.24, 0.19 and 0.15 respectively. The lower climate zones need to have larger changes. For climate zone 6, to get to 0.15 BTU/^{o}f.hr.ft^{2} in 2030, the values in 2024 and 2027 if changed linearly would need to be 0.28 and 0.21 respectively. If the target is 0.20, the reduction would be 0.29 and 0.24 in 2024 and 2027. This represents a significantly more aggressive path than we have proposed here, and the committee could consider taking larger steps in the IECC net zero path. The proposals here are in-line with what is deemed to be cost-effective (albeit with aged energy cost), and most recommendations FTI is making are on average cost-effective in at least one of the two building types without including the social cost of carbon and are proposed to drive to consensus. A more aggressive approach based on SCC and recognizing that higher energy costs will be higher in the future (and are currently higher) could be considered, especially since this code will not be used widely until 2026 or beyond. Higher performance fenestration may also allow HVAC system downsizing and resultant cost savings that represent offsets against the increased first cost of the façade. These higher performing solutions will also provide real, but difficult to quantify, benefits to owners in terms of the resilience of buildings to extreme weather and loss of power.

We have not included changes for operable fenestration because we do not want to discourage the use of operable fenestration, as this is very important for natural ventilation and indoor air quality. We would be open to suggestions on U-factor values for operable fenestration that would be equivalent to the fixed fenestration, with this in mind. More broadly there is a growing interest in the role of fenestration design and optimization with respect to occupant comfort, health and productivity, with its direct impact on daylight and access to views.

Bibliography: [1] LBNL 60049: Zero Energy Windows; https://eta-publications.lbl.gov/sites/default/files/60049.pdf

[2] H. Sanders, U-factor matters in hot climates, Façade Tectonics World Congress 2020. https://www.facadetectonics.org/papers/u-factor-mattersin-hot-climates

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

The cost-effectiveness analysis for each climate zone is detailed in the rationale and more detail can be found in the attached documentation. The proposals FTI is making here are in-line with what is deemed to be cost-effective (with old energy cost assumptions), and most recommendations are on average cost-effective in at least one if not both of the two building types analyzed without including the social cost of carbon.

A more aggressive approach based on using SCC only and recognizing that higher energy costs will be higher in the future (and are currently higher) could be considered by the committee, especially since this code will not be used widely until 2026 and beyond.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Because these reductions in U-factors are technically feasible and cost-effective.

Final Hearing Results

CED1-126-22	AS

CED1-128-22

Original Proposal

IECC: C402.6.1, C402.6.1.1, C402.6.2.1

Proponents: Emily Lorenz, consulting engineer, self (emilyblorenz@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.6.1 Air barriers. A continuous *air barrier* shall be provided throughout the *building thermal envelope*. The *air barrier* is permitted to be located at any combination of inside, outside, or within the *building thermal envelope*. The *air barrier* shall comply with Sections C402.6.1.2, and C402.6.1.3. The *air leakage* performance of the *air barrier* shall be verified in accordance with Section C402.6.2.

Exception: *Air barriers* are not required in buildings located in*Climate Zone* 2B.

C402.6.1.1 Air barrier design and documentation requirements . Design of the continuous *air barrier* shall be documented as follows~~in the following manner~~:

1. Components comprising the continuous *air barrier* and their position within each *building thermal envelope* assembly shall be identified.
2. Joints, interconnections, and penetrations of the continuous *air barrier* components shall be detailed.
3. The continuity of the *air barrier* building element assemblies that enclose conditioned space or provide a boundary between conditioned space and unconditioned space shall be identified.
4. Documentation of the continuous *air barrier* shall detail methods of sealing the *air barrier* such as wrapping, caulking, gasketing, taping or other *approved* methods at the following locations:
   - 4.1 Joints around fenestration and door frames.
   - 4.2 Joints between walls and floors, between walls at building corners, between walls and roofs including parapets and copings, where above-grade walls meet foundations, and similar intersections.
   - 4.3 Penetrations or attachments through the continuous *air barrier* ~~in building envelope roofs, walls, and floors~~.
   - 4.4 Building assemblies used as ducts or plenums.
   - 4.5 Changes in continuous *air barrier* materials and assemblies.
5. Identify where testing will or will not be performed in accordance with Section C402.6 ~~5~~.2 Where testing will not be performed, a plan for field inspections required by C402. 6 ~~5~~.2.3 shall be provided that includes the following:
   - 5.1 Schedule for periodic inspection,
   - 5.2 Continuous *air barrier* scope of work,
   - 5.3 List of critical inspection items,
   - 5.4 Inspection documentation requirements, and
   - 5.5 Provisions for corrective actions where needed.

C402.6.2.1 Whole building test method and reporting. The *building thermal envelope* shall be tested by an *approved* third ~~thrid~~ party for *air leakage* in accordance withASTM E3158 or an equivalent *approved* method. ~~method~~ A report that includes the tested surface area, floor area, air by volume, stories above grade, and *air leakage* rates shall be submitted to the code official and the building owner.

Exceptions: ~~Add optional paragraph text here~~

1. For buildings less than 10,000 ft^2 (1000 m^2) the entire *building thermal envelope* shall be permitted to be tested in accordance with ASTM E779, ASTM E3158, ~~or~~ ASTM E1827 , or an equivalent *approved* method.
2. For buildings greater than 50,000 ft^2 (4645 m^2), portions of the building shall be permitted to be tested and the measured *air leakage* shall be area-weighted by the surface areas of the *building thermal envelope* in each portion. The weighted average tested *air leakage* shall not be greater than the whole building *air leakage* limit. The following portions of the building shall be tested:

   2.1 The entire *building thermal envelope* area of stories that have any conditioned spaces directly under a roof.

   2.2 The entire *building thermal envelope* area of stories that have a building entrance, a floor over unconditioned space, a loading dock, or that are below grade.

   2.3 Representative above-grade portions of the building totaling not less than 25 percent of the wall area enclosing the remaining conditioned space.

Reason: This proposal is editorial and is not meant to change the meaning or stringency of the requirements. Any changes submitted as part of the errata proposal for CECPI-3 are also included in this proposal to assist with correlation. Only five changes are included in this proposal that are new:

1. Section C402.6.1, changed "any combination of" to "located"

2. Section C402.6.1.1, changed "in the following manner" to "as follows"

3. Section C402.6.2.1, added "air" to "...and air leakage rates shall be submitted..." in the second sentence.

4. Section C402.6.2.1, exception 1, deleted "or" in "...ASTM E3158, ~~or~~ ASTM E1827, or an equivalent..."

5. Section C402.6.2.1, exception 2, added "air" to "...building air leakage limit." in the second sentence.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Proposal only includes editorial changes to language.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: clean-up of some terminology related to the use of "air leakage" and general grammar.

Final Hearing Results

CED1-128-22 AM

CED1-130-22

Original Proposal

IECC: C402.6.1.2

Proponents: Robert A. Zabcik, Z-tech Consulting LLC, Metal Construction Association (bob@ztech-consulting.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.6.1.2 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 comprise the building thermal envelope 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 differentials such as those from ~~design~~ wind ~~loads~~, stack effect and mechanical ventilation.
3. Penetrations of the air barrier shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Sealing shall allow for expansion, contraction and mechanical vibration.Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the pnetrations' ability to resist positive and negative pressure. Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommended by the fire sprinkler 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 C402.6.1.2.1. Where similar objects are installed that penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.
5. Electrical and communication boxes shall comply with C402.6.1.2.2 to maintain the integrity of the air barrier.
6. Electrical and communication boxes shall comply with C402.6.1.2.2. Where similar objects are installed that penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.

Reason: Using the term "design wind loads" implies that the continuous air barrier should be designed to the pressure as a structural element would be. Design wind speeds for typical buildings (i.e., Risk Category II in ASCE-7) are based on a 7% probability of exceedance in 50 years, which equated to a mean recurrence interval of 700 years. Higher Risk Category buildings are even higher. Designing the CAB for a 700-year wind event is excessive.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change is needed to correct misuse of a term commonly used in building design for a completely different purpose.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Design wind loads has specific structural meaning and may causes confusion to the intent of this section.

Final Hearing Results

CED1-130-22	AS

Original Proposal

IECC: C402.6.1.3

Proponents: Theresa Weston, The Holt Weston Consultancy, Air Barrier Association of America (ABAA) (holtweston88@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.6.1.3 Air leakage compliance. Air leakage of the building thermal envelope shall be tested by an approved third party in accordance with C402.6.2.1. The measured air leakage shall not be greater than 0.35 cfm/ft (1.8 L/s x m) of the building thermal envelope area at a pressure differential of 0.3 inch water gauge (75 Pa) with the calculated building thermal envelope surface area being the sum of the above- and below-grade building thermal envelope.

Exceptions: Add optional paragraph text here

1. Where the measured air leakage rate is greater than 0.35 cfm/f^{2}t (1.8 L/s x m^2) but is not greater than 0.45 cfm/ft^2 (2.3 L/s x m^2), the approved third party shall perform a diagnostic evaluation using smoke tracer or infrared imaging. The evaluation shall be conducted while the building is pressurized <u>or depressurized</u> along with a visual inspection of the air barrier in accordance with ASTM E1186. All identified leaks shall be sealed where such sealing can be made without damaging existing building components. A report specifying the corrective actions taken to seal leaks shall be deemed to establish compliance with the requirements of this section where submitted to the code official and the building owner. Where the measured air leakage rate is greater than 0.45 cfm/ft^2 (2.3 L/s x m^2), corrective actions must be made to the building and an additional test completed for which the results are 0.45 cfm/ft^2 (2.3 L/s x m^2), or less.
2. Buildings in Climate Zone 2B.
3. Buildings larger than 25,000 square feet (2300 m) floor area in Climate Zones 0 through 4, other than Group R and I occupancies, that comply with C402.6.2.3
4. As an alternative, buildings or portions of building, containing Group R and I occupancies, shall be permitted to be tested by an approved third party in accordance with C402.6.2.2. The reported air leakage of the building thermal envelope shall not be greater than 0.27 cfm/ft^2 (1.4 L/s x m^2) of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa).

Reason: This proposal adds the option of inspection with the building under depressurization in addition to the current requirement for the building to pressurized. ASTM E1186 contains instructions for conducting the evaluation under either depressurization or pressurization. In some situations, depressurization may be more efficient than pressurization to conduct the inspection.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not add or delete requirements from the code. It provides more options on conducting a field evaluation to locate building air leakage.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal adds the option of inspection with the building under depressurization in addition to the current requirement for the building to pressurized. ASTM E1186 contains instructions for conducting the evaluation under either depressurization or pressurization. In some situations, depressurization may be more efficient than pressurization to conduct the inspection.

Final Hearing Results

CED1-131-22 AS

CED1-132-22

Original Proposal

IECC: C402.6.1.3

Proponents: Theresa Weston, The Holt Weston Consultancy, Air Barrier Association of America (ABAA) (holtweston88@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.6.1.3 Air leakage compliance. Air leakage of the building thermal envelope shall be tested by an approved third party in accordance with C402.6.2.1. The measured air leakage shall not be greater than 0.35 cfm/ft (1.8 L/s x m) of the building thermal envelope area at a pressure differential of 0.3 inch water gauge (75 Pa) with the calculated building thermal envelope surface area being the sum of the above- and below-grade building thermal envelope.

Exceptions: Add optional paragraph text here

1. Where the measured air leakage rate is greater than 0.35 cfm/f^{2}t (1.8 L/s x m^2) but is not greater than 0.45 cfm/ft^2 (2.3 L/s x m^2), the approved third party shall perform a diagnostic evaluation using smoke tracer or infrared imaging. The evaluation shall be conducted while the building is pressurized along with a visual inspection of the air barrier in accordance with ASTM E1186. All identified leaks shall be sealed where such sealing can be made without damaging existing building components. A report specifying the corrective actions taken to seal leaks shall be deemed to establish compliance with the requirements of this section where submitted to the code official and the building owner. Where the measured air leakage rate is greater than 0.45 cfm/ft^2 (2.3 L/s x m^2), corrective actions must be made to the building and an additional test completed for which the results are 0.45 cfm/ft^2 (2.3 L/s x m^2), or less.
2. Buildings in Climate Zone 2B.
3. Buildings larger than 25,000 square feet (2300 m) floor area in Climate Zones 0 through 4, other than Group R and I occupancies, that comply with C402.6.2.3
4. As an alternative, buildings or portions of building, containing Group R-2 and I-1 occupancies, shall be permitted to be tested by an approved third party in accordance with C402.6.2.2. The reported air leakage of the building thermal envelope shall not be greater than 0.27 cfm/ft^2 (1.4 L/s x m^2) of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa).

Reason: This proposal reflects the text that was approved during the committee review of CEPI-58, and so may be considered errata. It limits the dwelling/sleeping unit testing exception (vs. whole building testing) to R-2 and I-1 occupancies instead of the entire R and I occupancies.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not change which buildings are tested. It only provides more precise guidance on which buildings are appropriate to use dwelling unit testing as an alternate to whole building testing.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal corrects one of the air leakage section exceptions from “Group R and I occupancies” to “Group R-2 and I-1 occupancies”. While not reflected in the public comment draft, this is an erratum because we already voted last round to make that change to limit that exception to R-2 and I-1. As the public review draft mistakenly included just the Group R and I, and because it would be a substantive change to someone in the public who was not aware of what the committee did, we decided to handle it like a change and vote on it. Specifically, CEPI-58 was modified to allow dwelling unit air leakage testing in lieu of whole building air leakage testing in Group R-2 and I-1 occupancies instead of in all of Group R and I.

Final Hearing Results	
CED1-132-22	AS

CED1-134-22

Original Proposal

IECC: C402.6.2.2

Proponents: Theresa Weston, The Holt Weston Consultancy, Air Barrier Association of America (ABAA) (holtweston88@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.6.2.2 Dwelling and sleeping unit enclosure method and reporting. The *building thermal envelope* shall be tested for air leakage in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent approved method. Testing shall be conducted by an approved third party.Where multiple dwelling units or sleeping units or other spaces are contained within one *building thermal envelope*, each shall be considered an individual testing unit, and the building air leakage shall be the weighted average of all tested unit results, weighted by each *testing unit enclosure area*. ~~testing unit's enclosure area~~. Units shall be tested without simultaneously testing adjacent units and shall be separately tested as follows:

1. Where buildings have less than eight total dwelling or sleeping units, each unit shall be tested.
2. Where buildings have eight or more dwelling or sleeping units, the greater of seven units or 20 percent of the units in the building shall be tested, including a top floor unit, a middle floor unit, a ground floor unit and a unit with the largest testing unit enclosure area. For each tested unit that exceeds the maximum air leakage rate, an additional three units shall be tested, including a mixture of testing unit types and locations.
3. Enclosed spaces with not less than one exterior wall in the building thermal envelope shall be tested in accordance with Section C402.6.2.1.

   Exception: Corridors, stairwells, and enclosed spaces having a conditioned floor area not greater than 1,500 ft (139 m2)shall be permitted to comply with Section C402.6.2.3 and either Section C402.6.2.3.1 or Section C402.6.2.3.2.

Reason: This proposal updates to the text to use defined terms.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not add or delete requirements. It is solely intended to use current defined terminology with in the text.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Per proponent's reasoning statement, This proposal updates to the text to use defined terms "testing unit enclosure area."

Final Hearing Results

CED1-134-22	AS

CED1-138-22

Original Proposal

IECC: C402.7.1, C402.7.5, TABLE C402.1.4
Proponents: Alyson Hallander, Schoeck, Schoeck

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.7.1 Balconies and floor decks. Balconies and concrete floor decks shall not penetrate the building thermal envelope. Such assemblies shall be separately supported or shall be supported by structural attachments or elements that minimize thermal bridging through the building thermal envelope.

Exceptions: Balconies and concrete floor decks shall be permitted to penetrate the *building thermal envelope* where:

1. an area-weighted *U*-factor is used for *above-grade wall* compliance which includes a *U*-factor of 0.8 Btu/h-°F-ft^2 for the area of the *above-grade wall* penetrated by the concrete floor deck, or
2. an approved ~~structural~~ thermal break device ~~of~~ with not less than R-10 insulation material is installed in accordance with the manufacturer's instructions.

C402.7.5 Parapets. Parapets shall comply with one or more of the following as applicable:

1. Where continuous insulation is installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the continuous insulation shall extend up both sides of the parapet not less than 2 feet (610 mm) above the roof covering or to the top of the parapet, whichever is less. Parapets that are an integral part of a fire-resistance rated wall, and the exterior continuous insulation applied to the parapet, shall comply with the fire resistance ratings of the building code.
2. Where continuous insulation is installed on the exterior side of the above-grade wall and the roof insulation is below the roof deck, the continuous insulation shall extend up the exterior side of the parapet to not less than the height of the top surface of the roof assembly.
3. Where continuous insulation is not installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the wall cavity or integral insulation shall extend into the parapet up to the exterior face of the roof insulation or equivalent R-value insulation shall be installed not less than 2 feet (610 mm) horizontally inward on the underside of the roof deck.
4. Where continuous insulation is not installed on the exterior side of the *above-grade wall* and the roof insulation is below the roof deck, the wall and roof insulation components shall be adjacent to each other at the roof-ceiling-wall intersection.
5. Where a ~~structural~~ thermal break device with not less than R-10 insulation material aligned with the above-grade wall and roof insulation is installed in accordance with the manufacturer's instructions.

Exception: An *approved* design where the *above-grade wall U*-factor used for compliance accounts for the parapet *thermal bridge*.

TABLE C402.1.4 PSI- and CHI-FACTORS TO DETERMINE THERMAL BRIDGES FOR THE COMPONENT PERFORMANCE ALTERNATIVE

Thermal Bridge per Section C402.7	Thermal Bridge Compliant with Section C402.7		Thermal Bridge Non-Compliant with Section C402.7	
	psi-factor (Btu/h-ft-°F)	chi-factor (Btu/h-ft-°F)	psi-factor (Btu/h-ft-°F)	chi-factor (Btu/h-ft-°F)

C402.7.1 Balconies, slabs, and decks	0.2	n/a	0.5	n/a
C402.7.2 Cladding supports	0.2	n/a	0.3	n/a
C402.7.3 Structural beams and columns	n/a	1.0-carbon steel 0.3-concrete	n/a	2.0-carbon steel 1.0-concrete
C402.7.4 Vertical fenestration	0.15	n/a	0.3	n/a
C402.7.5 Parapets	0.2	n/a	0.4	n/a

For SI: W/m-K = 0.578 Btu/h-ft-°F; 1 W/K = 1.90 Btu/h-°F
n/a = not applicable

Reason: C402.7.1 reasons:

The proposed wording will make it feasible to meet thermal performance requirements with current structural thermal break products on the market.

The tweaks to the wording clarify that a manufactured structural thermal break is acceptable and that the R-value applies only to the **insulated material** of the manufactured assemblies.

Typical manufactured structural thermal breaks incorporate at least R-15 insulation material; however, when the thermal properties of the stainless steel reinforcement and the compression material of the devices are considered, the resulting assembly R-value is less than R-10 for nearly all structural thermal break assemblies.

C402.7.5 reasons:

Regarding parapets with adding C402.7.5.5, incorporating a structural thermal break within the parapet ensures a truly continuous building envelope compared to extending insulation 2' up along the parapet.

See below image for where a structural thermal break can be incorporated at a parapet to maintain continuous insulation:

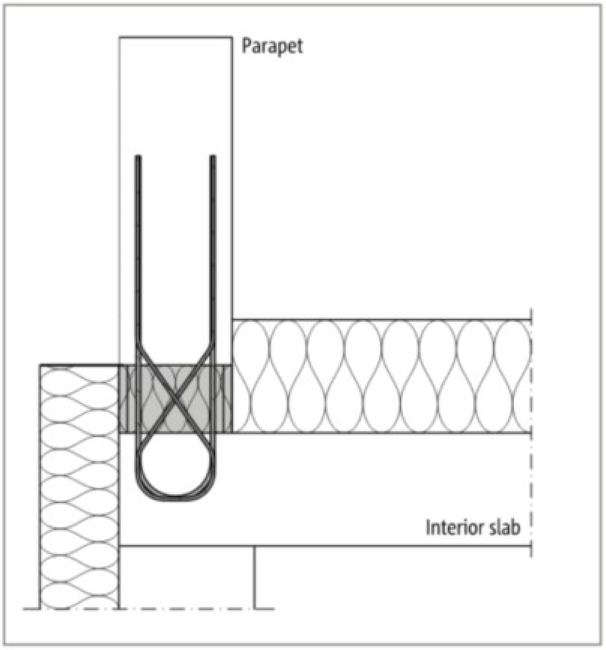
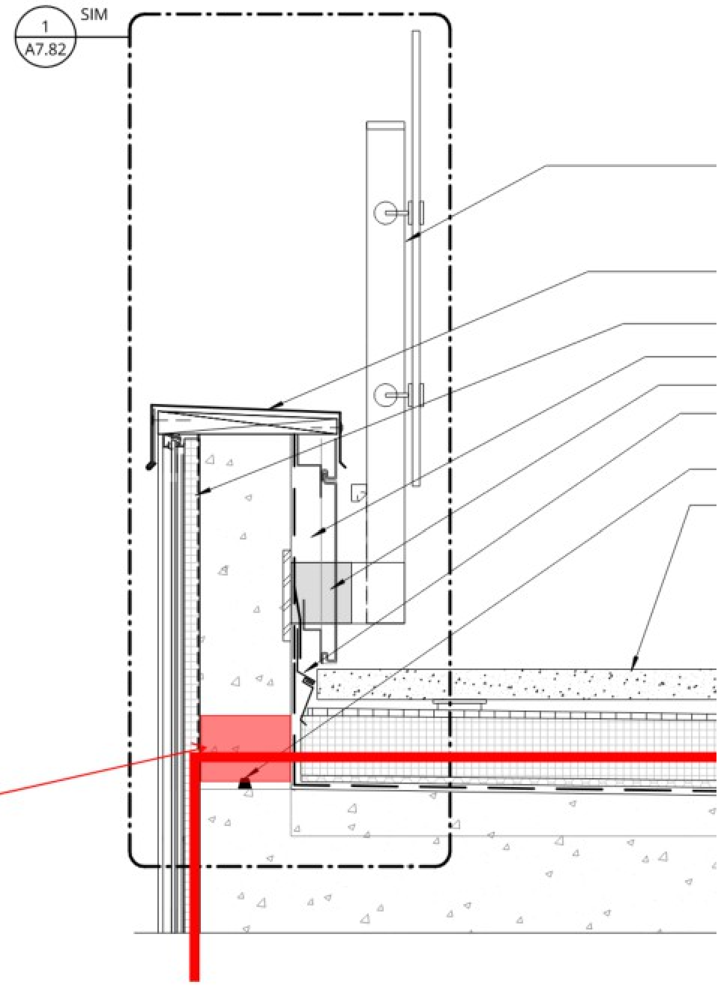


Fig. 1: Schöck Isokorb® Type CPA parapet connection with vertical orientation



4 PAVER TERRACE
1 1/2" = 1'-0"

Table C402.1.4 reasons:

The units for chi are Btu/h-°F. The units are currently correct in the footnotes of the table but not in the table.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed code changes will make it feasible to meet thermal performance requirements with current structural thermal break products on the market.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposed wording change will make it easier for current structural thermal break products on the market to meet the thermal performance requirements.

Final Hearing Results

CED1-138-22 AM

CED1-139-22

Original Proposal

IECC: C402.7.2

Proponents: Theresa Weston, The Holt Weston Consultancy, Rainscreen Association in North America (RAiNA) (holtweston88@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.7.2 Cladding supports. Linear elements supporting opaque cladding shall be off-set from the structure with attachments that allow the continuous insulation, where present, to pass behind the cladding support element except at the point of attachment.

Exceptions:

1. An *approved* design where the above-grade wall *U*-factor used for compliance accounts for the cladding support element *thermal bridge*.
2. Anchoring for curtain wall and window wall systems where curtain wall and window wall systems comply with C402.7.4.

Reason: This proposal's intention is to make it clear that curtain wall and window wall systems are not being exempted from thermal bridge mitigation, but rather they are covered by a different section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There is no addition or deletion of code requirements. It only includes which sections cover which materials/assemblies.

Public Hearing Results

Committee Action **As Modified**

Final Hearing Results

CED1-139-22	AM

CED1-141-22

Original Proposal

IECC: C406.3.4

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov); Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov); Ellen Franconi, Pacific Northwest National Laboratory, Pacific Northwest National Laboratory (ellen.franconi@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C406.3.4 G03 Automated Shading Load Management. Where fenestration on east, south, and west exposures ~~exceeds~~is greater than 20 percent of wall area, load management credits shall be achieved as follows:

1. Automatic exterior shading devices or dynamic glazing that are capable of reducing solar gain (SHGC) through sunlit fenestration by ~~at least~~ not less than 50 percent when fully closed shall receive the full credits in Tables C406.3(1) through C406.3(9). The exterior shades shall have fully open and fully closed SHGC determined in accordance with AERC 1.
2. Automatic interior shading devices with a ~~minimum~~ solar reflectance of not less than 0.50 for the surface facing the fenestration shall receive 40 percent of the credits in Tables C406.3(1) through C406.3(9).
3. All shading devices, dynamic glazing, or shading attachments shall:
   - 3.1 Provide ~~at least~~ not less than 90 percent coverage of the total fenestration on east, south, and west exposures in the *building* to achieve the credits determined in items 1 or 2. Alternatively, provide not less than 70 percent coverage of the total fenestration on the south and west exposures in the *building* to achieve 50 percent of the credits determined in items 1 or 2.
   - 3.2 Be automatically controlled and shall modulate in multiple steps or continuously the amount of solar gain and light transmitted into the space in response to peak periods and either daylight levels or solar intensity.
   - 3.3 Include a manual override located in the same enclosed space as the shaded vertical fenestration that shall override operation of automatic controls for no longer than four hours. Such override shall be locked out during peak periods.

For this section, directional ~~east, south, or west~~ exposures shall exclude fenestration that ~~is plus or minus~~ has an orientation deviating by more than 45 degrees of facing the cardinal direction. ~~true north in the northern hemisphere~~. In the southern hemisphere, where the south exposure is referred to, it shall be replaced by the north exposure ~~and the referenced sourth exposure shall be replaced by the north exposure~~.

Reason: The alternative approach for reduced credits for a reduced automatic shading area allows flexibility for certain building types and configurations. A simplified alternative approach was preferred to a formula that adjusts for actual shading area as it is less complex and aligned with a typical alternative choice regarding building exposures with automated shading.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The selection of individual load management credits is up to the designer, so individual specific credits are not specifically required by the code. Allowing for a reduced credit option here with less shading required could reduce cost in some situations when this option is chosen.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The alternative approach for reduced credits for a reduced automatic shading area allows flexibility for certain building types and configurations.

Final Hearing Results	
CED1-141-22	AM

CED1-144-22

Original Proposal

IECC: C503.2.1

Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C503.2.1 ~~Roof alterations, insulation entirely above deck~~Roof, ceiling, and attic alterations. Insulation complying with Section C402.1 and Section C402.2.1, or an *approved* design that minimizes deviation from the insulation requirements, shall be provided for the following ~~roof~~ alterations:

1. An alteration of roof-ceiling construction where there is no insulation above conditioned space.
2. Roof replacement for roofs with insulati ~~it~~on entirely above deck.

   Exceptions: Where compliance with Section C402.1 cannot be met due to limiting conditions on an existing roof, an *approved* design shall be submitted with the following:

   1. *Construction documents* that include a report by a registered design professional or other *approved* source documenting details of the limiting conditions affecting compliance with the insulation requirements.
   2. *Construction documents* that include a roof design by a registered design professional or other *approved* source that minimizes deviation from the insulation requirements.

3. Conversion of unconditioned attic space into conditioned space.
4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling construction.

Insulation shall be installed in accordance with the requirements of Sections C402.2.1.2 through C402.2.1.5.

Reason: This proposal makes three minor modifications to Section C503.2.1:
1. A section title that encompasses the four enumerated alterations is added.
2. The word "roof" is removed because not all the alterations in the list are roof alterations.
3. A spelling error is corrected.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal improves clarity of the section without making technical changes. No change in cost of construction should be expected if this comment is adopted.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal makes three minor changes to Section C503.2.1:
1) A section title that encompasses the enumerated alterations is added.
2) The word "roof" is removed because it is redundant; the section’s title and scope of alterations only addresses matters related to roof alterations.
3) A spelling error is corrected

Final Hearing Results

CED1-144-22	AS

CED1-145-22

Original Proposal

IECC: C503.2.1

Proponents: Jay Crandell, P.E., ABTG / ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C503.2.1 . Insulation complying with Section C402.1 and Section C402.2.1, or an*approved* design that minimizes deviation from the insulation requirements, shall be provided for the following roof alterations:

1. An alteration of roof-ceiling construction other than *reroofing* where existing ~~there is no~~ insulation located below the roof deck or on an attic floor above conditioned space does not comply with Table C402.1.2.
2. Roof replacement for roofs with insulaiton entirely above deck.

   Exceptions: Where compliance with Section C402.1 cannot be met due to limiting conditions on an existing roof, an*approved* design shall be submitted with the following:

   1. *Construction documents* that include a report by a registered design professional or other*approved* source documenting details of the limiting conditions affecting compliance with the insulation requirements.
   2. *Construction documents* that include a roof design by a registered design professional or other*approved* source that minimizes deviation from the insulation requirements.

3. Conversion of unconditioned attic space into conditioned space.
4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling construction.

~~Insulation shall be installed in accordance with the requirements of Sections C402.2.1.2 through C402.2.1.5~~.

Reason: The deleted sentence is redundant with requirements already referenced in the charging language of Section C503.2.1. It also was not included as part of CEPI-221 which updated this section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is a clean-up and removes redundant text without any technical or cost impact.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Removes redundant text and clarifies requirements for item 1.

Final Hearing Results

CED1-145-22	AM

CED1-146-22

Original Proposal

IECC: C503.2.1

Proponents: Jeff Mang, Consultant, Polyisocyanurate Insulation Manufacturers Association (PIMA) (jeff@jcmangconsulting.com); Marcin Pazera, Polyisocyanurate Insulation Manufacturers Association, Polyisocyanurate Insulation Manufacturers Association (mpazera@pima.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C503.2.1 . Insulation complying with Section C402.1 and Section C402.2.1, or an*approved* design that minimizes deviation from the insulation requirements, shall be provided for the following roof alterations:

1. An alteration of roof-ceiling construction where there is no insulation above conditioned space.
2. *Roof replacement*~~for roofs with insulaiton entirely above deck~~. or a roof *alteration* that includes removing and replacing the *roof covering*, where the *roof assembly* includes insulation entirely above the *roof* deck.

   Exceptions: Where compliance with Section C402.1 cannot be met due to limiting conditions on an existing roof, an*approved* design shall be submitted with the following:

   1. *Construction documents* that include a report by a registered design professional or other*approved* source documenting details of the limiting conditions affecting compliance with the insulation requirements.
   2. *Construction documents* that include a roof design by a registered design professional or other*approved* source that minimizes deviation from the insulation requirements.

3. Conversion of unconditioned attic space into conditioned space.
4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling construction.

Insulation shall be installed in accordance with the requirements of Sections C402.2.1.2 through C402.2.1.5.

Reason: This proposed amendment clarifies which types of roof alterations trigger the insulation requirements under Section C503. As reflected in the Public Review Draft #1, the Commercial Consensus Committee has already approved several improvements related to roof alterations under Section C503.2.1. This proposed amendment builds on these improvements with further clarifying language.

The changes under Section C503.2.1 already approved by the Committee reinforce the long-standing requirement that all alterations involving roofs with insulation entirely above deck, other than roof recovers, are required to meet the insulation requirements under the energy code. This proposed amendment will eliminate confusion that can arise on jobs due to unique circumstances or work involved in completing a specific roof alteration project.

For example, this proposal clarifies that compliance with the energy code's insulation requirements is required where the roof membrane is removed, and various amounts of other existing roof materials are left in place (including existing insulation). This result is consistent with both the letter and the long-standing spirit of the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal clarifies an existing provision in the code and does not add any new requirements.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies requirements for roof replacements where insulation is located entirely above deck.

Final Hearing Results	
CED1-146-22	AM

CED1-147-22

Original Proposal

IECC: C503.2.1

Proponents: Glen Clapper, National Roof Contractors Association, National Roof Contractors Association (gclapper@nrca.net)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C503.2.1 ~~Roof Alterations~~<u>Roof, ceiling, and attic alterations</u>. Insulation complying with Section C402.1 and Section C402.2.1, or an *approved* design that minimizes deviation from the insulation requirements, shall be provided for the following roof alterations:

1. An alteration of roof-ceiling construction where there is no insulation above conditioned space.
2. Roof replacement for roofs with ~~insulaiton~~ <u>insulation</u> entirely above deck.

   Exceptions: Where compliance with Section C402.1 cannot be met due to limiting conditions on an existing roof, an *approved* design shall be submitted with the following:

   1. *Construction documents* that include a report by a registered design professional or <u>an</u> ~~other~~ *approved* ~~source~~ <u>third party</u> documenting details of the limiting conditions affecting compliance with the insulation requirements.
   2. *Construction documents* that include a roof design by a registered design professional or <u>an</u> ~~other~~ *approved* ~~source~~ <u>third party</u> that minimizes deviation from the insulation requirements.

3. Conversion of unconditioned attic space into conditioned space.
4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling construction.

Insulation shall be installed in accordance with the requirements of Sections C402.2.1.2 through C402.2.1.5.

Reason: This proposal adds the omitted section title included in CEPI-221 AM and corrects a typo. In addition, the proposal modifies who is allowed to provide the report and roof design, since *approved source* is a newly defined term approved as modified in the first Public Input Initial Draft and excludes qualified parties, such as the contractor and the suppliers. The proposed term "entity" is more inclusive as to who may provide the information required of this section and more closely aligns with published Addendum t of ASHRAE Standard 90.1-2019.

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

This code change proposal will decrease the cost of construction when the information required is provided by an entity already on site to perform the work.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The modification which requires a third-party report of roof conditions better meets the proponent's intent.

Final Hearing Results

CED1-147-22	AM

CED1-148-22

Original Proposal

IECC: 503.3.8 (New), Table 503.3.8 (New)

Proponents: Jeff Mang, Consultant, Polyisocyanurate Insulation Manufacturers Association (PIMA) (jeff@jcmangconsulting.com); Marcin Pazera, Polyisocyanurate Insulation Manufacturers Association, Polyisocyanurate Insulation Manufacturers Association (mpazera@pima.org)

2024 International Energy Conservation Code [CE Project]

Add new text as follows:

503.3.8 Replacement or added roof mounted mechanical equipment. For *roofs* with insulation entirely above the roof deck and where existing roof-mounted mechanical equipment is replaced or new equipment is added, and the existing roof does not comply with the insulation requirements for new construction in accordance with Section C402.1 and Section C402.2.1, curbs for added or replaced equipment shall be of a height necessary to accommodate the future addition of above-deck roof insulation to be installed in accordance with Section C503.2.1, Item 2. Alternatively, the curb height shall comply with Table C503.3.8. Curb height shall be the distance measured from the top of the curb to the top of the roof deck.

Revise as follows:

Table 503.3.8 Roof Mounted Mechanical Equipment Curb Heights

CLIMATE ZONE	CURB HEIGHT, MINIMUM[a]
0 and 1	15.0 inches (381 mm)
0, 1, 2 and 3	16.0 inches (406.4 mm)
4, 5 and 6	17.0 inches (431.8 mm)
7 and 8	18.0 inches (457.2 mm)

~~a. Curb height shall be the distance measured from the top of the curb to the roof deck.~~

Reason: This proposed amendment complements the revisions to C503.2.1 of the Public Comment Draft #1 related to the insulation requirements for roof replacements. C503.2.1 of the Public Comment Draft creates a new exception regarding insulation requirements for roof replacements where there are practical difficulties for compliance caused by existing rooftop features. Equipment curbs that are too short are one of the most common difficulties to meeting the insulation requirements when roofs are replaced.

This intention of this proposed amendment is to mitigate challenges caused by low curb heights by requiring, at a relatively low (or no) cost, the installation of higher curbs when rooftop mechanical equipment is replaced even if the replacement work does not occur at the same time as the roof replacement project. The intent of the IECC is to move existing buildings toward compliance as alterations occur, which results in continual improvements to building energy efficiency. Modifying existing roof curbs during equipment replacement work adds minimal upfront costs and eliminates the cost of having to install a higher curb later during a roof replacement and when it would be more expensive.

Installation of curbs with minimum heights calculated to accommodate the amount of insulation needed for each climate zone would be required. Compliance can be met by either following the minimum heights listed in Table C503.3.8 or the contractor's or designer's best judgement. This flexibility may be needed to address situations that arise with tapered roof assemblies or sloped roofs. In these cases, the minimum curb heights listed under Table C503.3.8 may not be necessary or may be insufficient to achieve the goals of this amendment, depending on where the curb is located within the tapered or sloped system (i.e., at the low point, high point, or somewhere in between).

A similar amendment proposed by PIMA (CEPI-74) was disapproved by a close vote of 17-14-2 during consideration by the Commercial Subcommittee in May. In response to specific concerns raised about the original amendment, this amendment adds flexibility to deal with unusual roof conditions, drops the proposed changes to Chapter 4, and makes editorial changes. With respect to the potential burden on building owners, the intent of this requirement is to make it easier and less expensive to comply with the energy code when a roof is eventually replaced, which happens every 15 or 20 years on average. Adding a higher curb (if needed) when the equipment is being replaced is far less expensive than having to lift the equipment to install a higher curb during a roof replacement.

Explanation of Table C503.3.8: the minimum heights in the table would accommodate: (1) the 10 inches of curb height that is above the roof membrane/covering specified under the AHRI/SMACNA Guideline B-1997, “Guidelines for Roof Mounted Outdoor Air-Conditioner Installations”; (2) the amount of insulation necessary to comply with the prescriptive R-value requirements for each climate zone under the IECC; and (3) other materials that are typically part of the roof assembly, such as cover boards, slip sheets and membranes. While this proposal would require heights of between 15 to 18 inches depending on the specific climate zone, the Committee may decide to simply require 18 inches as the minimum curb height for all climate zones if that approach makes it easier for purposes of product supply and inventory.

Bibliography: *Guidelines for Roof Mounted Outdoor Air-Conditioner Installations* (Guideline B-1997), Air-Conditioning, Heating, and Refrigeration Institute (AHRI) and Sheet Meal and Air-Conditioning Contractors National Association (SMACNA). Available at: https://www.ahrinet.org/App_Content/ahri/files/Guidelines/AHRI_Guideline_B_1997.pdf.

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

A small increase in cost related to the purchase and installation of a new curb may be incurred. However, over the service life of the curb and mechanical equipment, this code change proposal is life-cycle cost effective due to decreased compliance costs for future reroofing work that is common for all buildings to undergo during the building service life as well as reduced energy costs resulting from the installation of a future, IECC-compliant replacement roof system.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Adds needed provisions for equipment curbs to facilitate future roof replacements.

Final Hearing Results

CED1-148-22	AM

CED1-149-22

Original Proposal

IECC: SECTION 202, C503.6

Proponents: Jay Crandell, P.E., ABTG / ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Delete without substitution:

~~**EXTERIOR WALL ENVELOPE.** A system or assembly of exterior wall components, including exterior wall finish materials, that provides protection of the building structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment.~~

Revise as follows:

C503.6 Additional energy efficiency credits. *Alterations* shall comply with measures from Sections C406.2 and C406.3 to achieve not less than 10 percent the number of required efficiency credits from Table C406.1.1 based on building occupancy group and *climate zone*. Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of this section.

Exceptions:

1. *Alterations* that include replacement of no more than one of the following:
   1.1 HVAC unitary systems or HVAC central heating or cooling equipment serving the *work area* of the *alteration*.
   1.2 Water heating equipment serving the *work area* of the alteration.
   1.3 50 percent or more of the lighting fixtures in the *work area* of the alteration.
   1.4 50 percent or more of the area of interior surfaces of the thermal envelope in the *work area* of the alteration.
   1.5 50 percent or more of the ~~building's~~ *exterior wall* <u>area of the *building thermal*</u> *envelope*, including <u>vertical</u> fenestration <u>area</u>.
2. *Alterations* to *buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, High-Hazard Group H.
3. *Alterations* that do not contain conditioned space.
4. Portions of *buildings* devoted to manufacturing or industrial use.
5. *Buildings* in Climate Zone 0A.
6. *Alterations* that are permitted with an *addition* complying with Section C502.3.7.
7. *Alterations* that comply with Section C407.

Reason: The newly added "exterior wall envelope" definition is used only once in the entire IECC in the newly added Section C503.6, exception 1.5. The term is deleted and existing defined terms are used instead to revise exception 1.5 in Section C503.6 to retain its intent while not requiring a new term to be created and defined. The exception is also clarified to apply the percentage trigger on the basis of area, not length of walls, number of walls, or other possible metrics that are currently left open to interpretation. In addition, it is clarified that only vertical fenestration should be included in the area, not fenestration (which includes skylights). Finally, the new "exterior wall envelope" definition overlaps with the defined term "exterior wall covering" as used in the IBC and IRC and this could create confusion in coordination between the I-codes. Deleting the term and using existing definitions resolves this concern as well.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal deletes and unnecessary definition and clarifies wording without changing requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: cleans up wording using existing defined terms and removes an unneeded definition that is used only once in this one exception item and potentially conflicts with "exterior wall covering" defined term in the building code.

Final Hearing Results

CED1-149-22	AS

CED1-150-22

Original Proposal

IECC: AISI Chapter 06

Proponents: Jonathan Humble, American Iron and Steel Institute, American Iron and Steel Institute (jhumble@steel.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

AISI

American Iron and Steel Institute
25 Massachusetts Avenue, NW, Suite 800
Washington, DC 20001

AISI S250-~~21~~ 22	North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing, with Supplement 1, dated 2022

Reason: Supplement #1 - 2022 modified Section B4.2 Standard Truss Framing equations by removing the parenthesis in the denominator, which were not intended to be included, in order to correctly illustrate the equation. No other modifications were made to Standard S250.

Bibliography: AISI S250-21w/S1-22 North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing, American Iron and Steel Institute, Washington, DC, 2022.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This modification to Standard S250 corrected an error to the 2021 edition.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Agreed with the proponent’s reason statement that this proposal corrected an error within the 2021 edition of the standard.

Final Hearing Results

CED1-150-22	AS

CED1-151-22

Original Proposal

IECC: ASTM Chapter 06

Proponents: Theresa Weston, The Holt Weston Consultancy, Air Barrier Association of America (ABAA) (holtweston88@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

ASTM

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

D8052/D8052M–~~2017~~2022:	Standard Test Method for Quantification of Air Leakage in Low-Sloped Membrane Roof Assemblies
E283/E283M-2019–~~2004(2012)~~:	Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen
E779–~~10(2018):~~2019:	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
E1186-~~17~~2022:	Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
E1677–~~11:~~2019:	Specification for Air Barrier (AB) Material or ~~Systems~~ Assemblies for Low-rise Framed Building Walls
E1827–~~2011(2017):~~2022:	Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
E2178–~~13:~~2021a:	Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permanence of Building Materials
E2357–~~2018:~~2022:	Standard Test Method for Determining Air Leakage of Air Barriers Assemblies

Reason: This proposal updates the ASTM standards that relate to air leakage performance (Section C402.6) to their most recent version.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does add or delete any requirements, but only updates currently referenced standards to their most recent version.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: it keeps the reference standards up to date with the most recent version.

Final Hearing Results

CED1-151-22 AS

CED1-156-22

Original Proposal

IECC: C403.3.2, ASHRAE Chapter 06

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

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.3.2 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2(16) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of AHRI 400. 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. Efficiency values and metrics in tables shall be equal to the values and metrics shown in ASHRAE 90.1-2022.

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

90.1 —~~2019~~ 2022: Energy Standard for Buildings Except Low-rise Residential Buildings

Reason: ASHRAE 90.1-2022 will be published by November 2022 with updated mechanical efficiency tables. This change is a "marker" to have the IECC update its tables to be aligned with the updated values and metrics approved for ASHRAE 90.1-2022.

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

For buildings that use equipment where the efficiency values in the IECC are increased to match the values in ASHRAE 90.1-2022.

Where the efficiency values and metrics are the same in IECC 2021/2024 and ASHRAE 90.1-2022, there is no increase in the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposal updates the table to match new DOE regulations, less those elements currently under legal challenge.

Final Hearing Results

CED1-156-22 AM

CED1-157-22

Original Proposal

IECC: TABLE C403.3.2(6)

Proponents: Nicholas O'Neil, Energy 350, NEEA (noneil@energy350.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C403.3.2(6) GAS- AND OIL-FIRED BOILERS—MINIMUM EFFICIENCY REQUIREMENTS[i-]

Portions of table not shown remain unchanged.

EQUIPMENT TYPE[b]	SUBCATEGORY OR RATING CONDITION	SIZE CATEGORY (INPUT)	~~MINIMUM EFFICIENCY~~	MINIMUM EFFICIENCY ~~AS OF 3/2/2022~~	TEST PROCEDURE[a]
Boilers, hot water	Gas fired	< 300,000 Btu/h[g, h] for applications outside US	~~82% AFUE~~	84~~2~~% AFUE	DOE 10 CFR 430 Appendix N
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	~~80% E_t~~[d]	84~~0~~% E_t[d]	DOE 10 CFR 431.86
		> 2,500,000 Btu/h and ≤ 10,000,000 Btu/h[b]	~~82% E_c~~[c]	82% E_c[c]	
		> 10,000,000 Btu/h[b]		82% E_c[c]	
	Oil fired[f]	< 300,000 Btu/h[g,h] for applications outside US	~~84% AFUE~~	86~~4~~% AFUE	DOE 10 CFR 430 Appendix N
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	~~82% E_t~~[d]	82% E_t[d]	DOE 10 CFR 431.86
		> 2,500,000 Btu/h and ≤ 10,000,000 Btu/h[b]	~~84% E_c~~[c]	84% E_c[c]	
		> 10,000,000 Btu/h[b]		84% E_c[c]	
Boilers, steam	Gas fired	< 300,000 Btu/h[g] for applications outside US	~~80% AFUE~~	82~~0~~% AFUE	DOE 10 CFR 430 Appendix N
	Gas fired-all, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	~~79% E_t~~[d]	79% E_t[d]	DOE 10 CFR 431.86
			~~79% E_t~~[d]	79% E_t[d]	
		>> 2,500,000 Btu/h and ≤ 10,000,000 Btu/h[b] 10,000,000 Btu/h[b]		79% E_t[d,i]	
	Gas fired–natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	77% E_t[d]	79% E_t[d]	
		> 2,500,000 Btu/h[b]	77% E_t[d]	79% E_t[d]	
	Oil fired[f]	< 300,000 Btu/h[g] for applications outside US	~~82% AFUE~~	82% AFUE	DOE 10 CFR 430 Appendix N
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	~~81% E_t~~[d]	84~~1~~% E_t[d]	DOE 10 CFR 431.86
		> 2,500,000 Btu/h and ≤ 10,000,000 Btu/h[b]	~~81% E_t~~[d]	81% E_t[d]	
		> 10,000,000 Btu/h[b]		81% E_t[d]	

For SI: 1 British thermal unit per hour = 0.2931 W.

a. Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

b. 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.

c. E_C = Combustion efficiency (100 percent less flue losses).

d. E_t = Thermal efficiency.

e. Maximum capacity—minimum and maximum ratings as provided for and allowed by the unit's controls.

f. Includes oil-fired (residual).

g. Boilers shall not be equipped with a constant burning pilot light.

h. A boiler not equipped with a tankless domestic water-heating coil shall be equipped with an automatic means for adjusting the temperature of the water such that an incremental change in inferred heat load produces a corresponding incremental change in the temperature of the water supplied.

i. ~~This table is a replica of ASHRAE 90.1 Table 6.8.1-6 Gas- and Oil-Fired Boilers—Minimum Efficiency Requirements~~.

i. Prior to March 2, 2022, for natural draft very large gas-fired steam commercial packaged boilers, a minimum thermal efficiency level of 77 percent is permitted and meets Federal commercial packaged boiler energy conservation standards

Reason: On January 10, 2020 DOE published new boiler efficiency requirements for boilers manufacturer after 1/20/2023. This proposal updates the table for the 2024 IECC, with updates based on US DOE final rulemakings and removing values in effect for equipment installed before 3/2/2022. It also removes the reference to ASHRAE table under footnote i which may no longer apply until ASHRAE updates tables to reflect the proposed DOE rulemaking.

Finally, it removes the separate natural draft and non-natural draft commercial boiler categories as the new DOE rule does not differentiate efficiency requirements based on this technology. The one exception is for very large gas-fired boilers manufacturer prior to March 2022 which can have a 77% Et instead of 79% Et. Hence, a footnote is added to mark this single adjustment and shortens the table to avoid confusion.

Bibliography: Energy Conservation Standards for Residential Boilers - Final Rule, US Department of Energy, Washington DC, January 10, 2020

https://www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-431/subpart-E/subject-group-ECFRe1ae92ed608f22e/section-431.87

Energy Conservation Standards for Residential Boilers - Final Rule, US Department of Energy, Washington DC, January 15, 2016 (as published in the US Federal Register, 81 Fed. Reg. 2320)

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This update simply aligns federal requirements with the efficiency tables listed in the IECC so they are up to date. These are DOE minimum efficiency standards and therefore no increase or decrease in cost is expected.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The residential boiler standards have been updated by DOE. However, even though DOE updated the commercial boiler energy conservation standards, there is a lawsuit to reverse the action that is still under contest. If the standards are reversed, jurisdictions that adopt the updated standards would be in violation of federal preemption, so those changes were struck from the proposal.

Final Hearing Results	
CED1-157-22	AM

CED1-158-22

Original Proposal

IECC: C403.3.4, C403.3.4.1, TABLE C403.3.4.1

Proponents: Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov); Michael Rosenberg, Pacific Northwest National Laboratory, Pacific Northwest National Laboratory (michael.rosenberg@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.3.4 Boilers. Boiler Systems shall comply with the following:

1. Combustion air positive shut-off shall be provided on all newly installed boiler systemsthat ~~complywith~~ meetone or more of the following conditions ~~as follows~~:
   1.1 ~~All boiler systems with an~~ The total input capacity is no less than ~~of~~ 2,500,000 Btu/h (732 kW) and~~above~~ one or more of ~~in which~~ the boiler s ~~is~~ are designed to operate with a nonpositive vent static pressure.

   1.2 Any stack serving the ~~All~~ boiler system~~s~~ is connected to ~~where one stack serves~~ two or more boilers with a total combined input capacity ~~per stack~~ of not less than 2,500,000 Btu/h (732 kW).
2. ~~Each newly~~ Newlyinstalled boilers or *boiler systems* with a ~~Boiler system~~ combustion air fan~~s with~~ motor~~s~~ *nameplate horsepower* rating of 10 horsepower (7.46 kW) or ~~larger~~ more shall comply with ~~meet~~ one of the following~~ for newly installed boilers~~:
   2.1 The fan motor shall be variable speed, or

   2.2 The fan motor shall include controls that~~ limit the fan motor demand to no more than 30 percent of the total design wattage at~~ modulate fan airflow as a function of the load to a ~~minimum~~ speed 50 percent or less of design air volume.

C403.3.4.1 Boiler oxygen concentration controls. Newly installed boilers with an input capacity of 5,000,000 Btu/h (1465 kW) and steady state full-load less than 90 percent shall maintain stack-gas oxygen concentrations not greater than the values specified in Table C403.3.4.1. Combustion air volume shall be controlled with respect to measured flue gas oxygen concentration. The use of a common gas and combustion air control linkage or jack shaft is not permitted ~~prohibited~~.

Exception: These concentration limits do not apply where 50 percent or more of the boiler system capacity serves Group R-2 occupancies.

TABLE C403.3.4.1 BOILER OXYGEN CONCENTRATIONS

Boiler System Application	Minimum Maximum stack-gas oxygen concentration[a]
Commercial boilers or where ≤ 10% of the boiler system capacity is used for process applications at design conditions	5%
Process boilers	3%

a. Concentration levels measured by volume on a dry basis over firing rates of 20 to 100 percent.

Exception: These concentration limits do not apply 50 percent or more of the boiler system capacity serves Group R-2 occupancies.

Reason: This proposal is editorial and recommends alternative language to reduce ambiguity.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is editorial and does not impact the cost effectiveness of the requirement.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal combines CED1-158-22 and CED1-159-22. Most of the changes are to add clarity. The 30 percent power at 50 percent speed for the fan was removed because boiler fans maintain constant pressure and do not move a long a system curve.

Final Hearing Results

CED1-158-22	AM

CED1-160-22

Original Proposal

IECC: C403.4.6.2, C403.4.2.3, C403.4.7

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.4.6.2 All other ~~HVAC~~ <u>heating and cooling</u> systems. Thermostats for ~~HVAC~~ <u>heating and cooling</u> systems shall be provided with a demand responsive control that complies with one of the following:

1. Certified OpenADR 2.0a VEN, as specified under Clause 11, Conformance
2. Certified OpenADR 2.0b VEN, as specified under Clause 11, Conformance
3. Certified by the manufacturer as being capable of responding to a demand response signal from a certified OpenADR 2.0b VEN by automatically implementing the control functions requested by the VEN for the equipment it controls
4. IEC 62746-10-1
5. The communication protocol required by a controlling entity, such as a utility or service provider, to participate in an automated demand response program
6. The physical configuration and communication protocol of CTA 2045-A or CTA 2045-B.

C403.4.2.3 Optimum start and stop. Optimum start and stop controls shall be provided for each~~HVAC~~ <u>heating and cooling</u> system with direct control of individual zones. The optimum start controls shall be configured to automatically adjust the daily start time of the ~~HVAC~~ <u>heating and cooling</u> system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy. . The optimum stop controls shall be configured to reduce the ~~HVAC~~ <u>heating and cooling</u> system's heating temperature setpoint and increase the cooling temperature setpoint by not less than 2°F (1.11ºC) before scheduled unoccupied periods based on the thermal lag and acceptable drift in space temperature that is within comfort limits.

Exception: Dwelling units and sleeping units are not required to have optimum start controls.

C403.4.7 ~~HVAC~~ <u>Heating and cooling</u> system controls for operable openings to the outdoors . All doors from a conditioned space to the outdoors and all other operable openings from a conditioned space to the out-doors that are larger than 40 square feet (3.7 m^2) when fully open, shall have automatic controls interlocked with the heating and cooling system. The controls shall be configured to do the following within 5 minutes of opening:

1. Disable mechanical heating to the zone or reset the space heating temperature setpoint to 55°F (12.7°C) or less.
2. Disable mechanical cooling to the zone or reset the space cooling temperature setpoint to 90°F (32°C) or more. Mechanical cooling can remain enabled if the outdoor air temperature is below the space temperature.

Exceptions:

1. Building entrances with automatic closing devices.
2. Emergency exits with an automatic alarm that sounds when open.
3. Operable openings and doors serving enclosed spaces without a thermostat or~~HVAC~~ <u>heating or cooling</u> temperature sensor.
4. Separately zoned areas associated with the preparation of food that contain appliances that contribute to the~~HVAC~~ <u>heating or cooling</u> loads of a restaurant or similar type of occupancy.
5. Warehouses that utilize operable openings for the function of the occupancy where approved by the*code official*.

6. The first entrance doors where located in the exterior wall and are part of a vestibule system.
7. Operable openings into spaces served by radiant heating and cooling systems.
8. Alterations where walls would have to be opened solely for the purpose of meeting this requirement and where approved.
9. Doors served by air curtains meeting the requirements of Section C402.6.6.

Reason: Section C403.4 is entitled, "Heating and cooling system controls." As noted in the text within this charging section to subsection C403.4.6, the entire section is only applicable to controls for heating and cooling systems. A careful read of the subsections also supports the conclusion that the section only applies to controls for heating and cooling systems. To ensure that the terms in the section align with the meaning, please replace references to "HVAC" (i.e., heating, ventilation and cooling) with "heating and cooling."

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This is an editorial clarification with no bearing on cost.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This modification improves the language of this section.

Final Hearing Results

CED1-160-22	AS

CED1-161-22

Original Proposal

IECC: C403.4.6, C406.3.3, TABLE C406.3.3 (New)

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov); Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov); Ellen Franconi, Pacific Northwest National Laboratory, Pacific Northwest National Laboratory (ellen.franconi@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.4.6 Demand responsive controls. Buildings shall be provided with *demand responsive controls* capable of executing the following actions in response to a demand response signal:

1. Automatically increasing the zone operating cooling set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).
2. Automatically decreasing the zone operating heating set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).

Where a *demand response signal* is not available the heating and cooling system controls shall be capable of performing all other functions. Where thermostats are controlled by direct digital control including, but not limited to, an energy management system, the system shall be capable of *demand responsive control* and capable of adjusting all thermal set-points to comply. The demand responsive controls shall comply with either Section C403.4.6.1 or Section C403.4.6.2

Exceptions:

1. Group I occupancies
2. Group H occupancies
3. Controls serving data center systems
4. Occupancies or applications requiring precision in indoor temperature control as approved by the code official
5. Controls that serve only fossil fuel equipment
6. Buildings that comply with Load Management measure G02 in Section C406.3.3

C406.3.3 G02 HVAC Load Management. Automatic load management controls shall be configured as follows:

1. Cooling termperature shift: Where electric cooling is in use ~~to~~ controls shall gradually increase the cooling setpoint by at least 3°F (1.7°C) over a minimum of three hours or reduce effective cooling capacity to 60% of installed capacity during the peak period or adjust cooling temperature setpoint as described in Section C403.6.1.
2. Heating temperature shift: Where electric heating is in use ~~to~~ controls shall gradually decrease the heating setpoint by at least 3°F (1.7°C) over a minimum of three hours or reduce effective heating capacity to 60% of installed capacity during the peak period or adjust heating temperature setpoint as described in Section C403.6.1.
3. Ventilation shift: Where HVAC systems ~~are~~ serv e ~~ing~~ multiple zones and have less than 70 percent outdoor air required, include controls that provide excess outdoor air preceding the peak period and reduce outdoor air by at least 30 percent during the peak period, in accordance with ASHRAE Standard 62.1 Section 6.2.5.2 Short Term Conditions or provisions for *approved* engineering analysis in the International Mechanical Code Section 403.3.1.1, Outdoor Airflow Rate.

Credits achieved for measure G02 shall be calculated as follows:

(Equation #)

$$EC_{G02\_ach} = EC_{G02\_base} * EC_{G02\_adj}$$

where: EC_{G02_ach} = Demand responsive control credit achieved for Project
EC_{G02_base} = G02 Base energy credit from Section 406.3
EC_{G02_adj} = energy credit adjustment factor from Table C406.3.3

Add new text as follows:

TABLE C406.3.3 Energy Credit Adjustment Based on Use of Ventilation Shift or Demand Response

DEMAND RESPONSE SIGNAL AVAILABLE[a]	DEMAND RESPONSE REQUIRED BY SECTION C403.4.6.1[b]	INCLUDES VENTILATION SHIFT[c]	EC_{G02_Adj}
No	No	Yes	100%
No	Yes	Yes	80%
Yes	No	Yes	80%
Yes	Yes	Yes	40%
No	No	No	70%
No	Yes	No	50%
Yes	No	No	50%
Yes	Yes	No	0%

a. "Demand Response Signal Available" is "Yes" where a controlling entity other than the owner makes a demand response signal available to the building.
b. Where the exception is invoked in Section C403.4.6.1 for buildings that comply with Load Management measure G02, then "Demand Response Required" is "Yes".
c. Ventilation shift controls in accordance with Section C406.3.3, item 3.

-

Reason: Providing an exception to HVAC demand response in Section C403.4.6 is appropriate where buildings comply with energy credit G02 in Section C406.3.3. G02 provides a generally superior method of control including gradually ramping temperature setpoints, ventilation deferment, and options for capacity reduction rather than temperature control. Further, G02 is not restricted to only open ADR methods, but can work with local building demand monitoring or a scheduled peak approach in smaller buildings. Including an exception for C403.4.6 also avoids the perception that a building must comply with both (possibly conflicting) requirements, as measures in C406 are chosen by the building designer to meet a required credit level.

To coordinate with C403.4.6 requirements, where an openADR demand response signal is available from the serving utility, the credits are reduced by half.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

In some cases the cost of construction is reduced, as the exception allows clear compliance with either requirement and not both.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Standing on the reason statement with the proposal but with clearer language.

Final Hearing Results

CED1-161-22 AM

CED1-164-22

Original Proposal

IECC: C403.4.6

Proponents: Shannon Corcoran, AGA, American Gas Association (corcoransm@att.net); Renee Lani, American Public Gas Association, American Public Gas Association (rlani@apga.org); Bruce Swiecicki, National Propane Gas Association, National Propane Gas Association (bswiecicki@npga.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.4.6 Demand responsive controls. ~~Buildings~~ Electric heating and cooling systemsshall be provided with demand responsive controls capable of executing the following actions in response to a demand response signal:

1. Automatically increasing the zone operating cooling set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).
2. Automatically decreasing the zone operating heating set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).

Where a demand response signal is not available the heating and cooling system controls shall be capable of performing all other functions. Where thermostats are controlled by direct digital control including, but not limited to, an energy management system, the system shall be capable of demand responsive control and capable of adjusting all thermal set-points to comply. The demand responsive controls shall comply with either Section C403.4.6.1 or Section C403.4.6.2

Exceptions:

1. Group I occupancies
2. Group H occupancies
3. Controls serving data center systems
4. Occupancies or applications requiring precision in indoor temperature control as approved by the code official
5. ~~Controls that serve only fossil fuelgas or fuel oil equipment~~

Reason: The term "fossil fuel" is an undefined term and should not be used in the IECC. In place of "fossil fuel", the terms "fuel gas or fuel oil" should be used. These terms are defined in the International Fuel Gas Code/National Fuel Gas Code or NFPA 31 respectively, and the terminology should be consistent amongst the various model codes.

There are 24 instances throughout the document where "fossil fuel" is used and should be changed to "fuel gas or fuel oil."

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal does not change the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposal clarifies that this section only applies to electric heating and cooling systems.

Final Hearing Results

CED1-164-22 AM

CED1-165-22

Original Proposal

IECC: C403.7.1

Proponents: Thomas Nagy, enVerid Systems, enVerid Systems (tnagy@enverid.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.7.1 Demand control ventilation. Demand control ventilation (DCV) shall be provided for the following:

1. Spaces with ventilation provided by single-zone systems where an air-side economizer is provided in accordance with Section C403.5.
2. Spaces larger than 250 square feet (23.2 m^2) in climate zones 5A, 6, 7, and 8 and spaces larger than 500 square feet (46.5 m^2) in other climate zones which have a design occupant load of 15 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 are served by systems with one or more of the following:
   - 2.1 An air-side economizer.
   - 2.2 Automatic modulating control of the outdoor air damper.
   - 2.3 A design outdoor airflow greater than 3,000 cfm (1416 L/s)

Exceptions:

1. Spaces served by systems with energy recovery in accordance with Section C403.7.4.2 and that have a floor area less than:
   - 1.1 6000 square feet (2600 m^2) in climate zone 3C.
   - 1.2 2000 square feet (190 m^2) in climate zones 1A, 3B, and 4B.
   - 1.3 1000 square feet (90 m^2) in climate zones 2A, 2B, 3A, 4A, 4C, 5 and 6.
   - 1.4 400 square feet (40 m^2) in climate zones 7 and 8.
2. Multiple-zone systems without direct digital control of individual zones communicating with a central control panel.
3. Spaces served by multiple-zone systems with a system design outdoor airflow less than 750 cfm (354 L/s).
4. Spaces where more than 75 percent of the space design outdoor airflow is required for makeup air that is exhausted from the space or transfer air that is required for makeup air that is exhausted from other spaces.
5. Spaces with one of the following occupancy classifications as defined in Table 403.3.1.1 of the *International Mechanical Code*: correctional cells, education laboratories, barber, beauty and nail salons, and bowling alley seating areas.
6. ~~Spaces using air cleaning in compliance with the ASHRAE 62.1 Indoor Air Quality Procedure~~. Spaces where the registered design professional demonstrates an engineered ventilation system design that complies with the following:
   - 6.1. It prevents the maximum concentration of contaminants from exceeding that obtainable by the required rate of outdoor air ventilation, and
   - 6.2 It allows the required minimum design rate of outdoor air to be reduced by no less than 15%.

Reason: There is a contradiction with ASHRAE Standard 62.1-2019 when it comes to using DCV. In section 6.2.6.1 of ASHRAE 62.1-2019 there is an exception that states the following: "CO_2-based DCV shall not be applied in zone with indoor sources of CO_2 other than occupants, or with CO_2 removal mechanisms, such as gaseous air cleaners." The reason for this is that using air cleaners with CO_2 scrubbing in conjunction with the Indoor Air Quality Procedure (IAQP) will allow for a lower OA minimum than the typical prescriptive OA minimum used with the ventilation rate procedure (VRP). If DCV was then used to lower the outside airflow further, that may lead to higher levels of other volatile organic compounds, above the acceptable limits.

Bibliography: ASHRAE 62.1-2019, page 25

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: To clarify DCV exception for engineered ventilation systems and for alignment with the International Mechanical Code.

Final Hearing Results

CED1-165-22	AM

CED1-166-22

Original Proposal

IECC: C403.7.2, SECTION 202

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.7.2 Parking garage ventilation systems. Ventilation systems employed in enclosed parking garages ~~used for storing or handling automobiles operating under their own power~~ shall comply with Section 404.1 of the *International Mechanical Code* and the following: ~~meet all of the following~~:

1. Separate ventilation systems and control systems shall be provided for each parking garage section.
2. Control systems for each parking garage section shall ~~automatically detect and control contaminant levels in accordance with the *International Mechanical Code*, and~~ shall be capable of and configured to reduce fan airflow to not less than 0.05 cfm per square foot [0.00025 $m^3/(s \cdot m^2)$] of the floor area served and not more than 20 percent ~~or less~~ of the design capacity.
3. The ventilation system for each parking garage section shall have controls and devices that result in fan motor demand of no more than 30 percent of design wattage at 50 percent of the design airflow.

Exception: Garage ventilation systems serving a single parking garage section having a total ventilation system motor nameplate horsepower (ventilation system motor nameplate kilowatt) not exceeding 5 hp (3.7 kW) at fan system design conditions and where the parking garage section has no mechanical cooling or mechanical heating.

Nothing in this section shall be construed to require more than one parking garage section in any parking structure.

PARKING GARAGE SECTION. A part of an enclosed parking garage that is separated from all other parts of the garage by full-height solid walls or operable openings that are intended to remain closed during normal operation and where vehicles cannot pass to other parts of the garage. A parking garage can have one or more parking garage sections and parking garage sections can include multiple floors ~~. It may include multiple floors if there are ramps to allow vehicles to pass between the floors~~.

Reason: C403.7.2, as drafted, eliminates the distinction between enclosed and open parking garages. This would require ventilation systems even in garage systems open to exterior atmosphere. Further, the proposal does not clearly correlate with the International Mechanical Code.

The proposed resolution directs users to the IMC for pollutant detection and control. It also specifies the minimum standby ventilation rate required by the IMC of 0.05 cfm per square foot of the floor area served. This better correlates with IMC.

The proposed resolution also clarifies that an enclosed parking garage may have only one section, which was clearly stated in the foreword to ASHRAE 90.1-2019 Addendum d.

Several editorial improvements are suggested.

On cost justification: It simply is not adequate to say something is cost effective because of the opinion of the ASHRAE 90.1 committee. If it existed, the proponents of CECPI-6-21 - the original code change - should provide the same data and calculations that the 90.1 committee relied upon when it decided to publish Addendum d to ASHRAE 90.1-2019. Note that cost-effectiveness was not actually calculated for Addendum d. Instead, the foreword to Addendum d stated this:

"*Cost effectiveness is assured by the LCCA done for VAV systems, variable-flow chilled-water pumps, and cooling tower fans, which have the same 5 hp threshold yet operate fewer hours and/or much less turndown than garage ventilation fans.*"

In other words, the rationale for CECPI-6-21 relied upon cost justification that was not done.

The original proponents of CECPI-6-21 should do their own arithmetic and show the consensus committee the numbers.

Bibliography:
https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/90_1_2019_d_2021

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Some costs may be avoided through clearer language.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposal adds clarity to the parking garage ventilation requirements.

Final Hearing Results

CED1-166-22	AM

CED1-167-22

Original Proposal

IECC: C403.7.4, C403.7.4.1

Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org); Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com); Armin Rudd, AB Systems LLC, self, Principal (arudd@absystems.us)

2024 International Energy Conservation Code [CE Project]

C403.7.4 Energy recovery systems. Energy recovery ventilation systems shall be provided as specified in either Section C403.7.4.1 or C403.7.4.2, as applicable.

Revise as follows:

C403.7.4.1 Nontransient dwelling units. Nontransient dwelling units shall be provided with outdoor air energy recovery ventilation systems with an *enthalpy recovery ratio* of not less than 50 percent at cooling design condition and not less than 60 percent at heating design condition.

Exceptions:

1. Nontransient dwelling units in Climate Zone 3C.
2. Nontransient dwelling units with not more than 500 square feet (46 m^2) of *conditioned floor area* in Climate Zones 0, 1, 2, 3, 4C and 5C ~~and either adjoin an open-ended corridor or do not adjoin a corridor~~**.**
3. ~~Nontransient dwelling units with not more than 500 square feet (46 m²) of conditioned floor area that are located in Climate Zones 1A, 2B, 3B, and 3C.~~
4. 3. *Enthalpy recovery ratio* requirements at heating design condition in Climate Zones 0, 1 and 2.
5. 4. *Enthalpy recovery ratio* requirements at cooling design condition in Climate Zones 4, 5, 6, 7 and 8.

Reason: “Corridor” is not defined in Chapter 2 Definitions and adds a restriction that is not supported by the cost-effectiveness analysis provided.

The cost-effectiveness analysis provided with this change had significant issues that must be addressed before the proposal can go forward. The proponent hand-picked the most favorable set of inputs and design assumptions possible to help justify the proposal. A more representative and evenhanded analysis will significantly change the results. We are prepared to review the analysis with the proponent in detail. This change applies only to very small apartments - 500 sqft or less - the most affordable type of housing. Just a few issues are mentioned below:

o The baseline case used for comparing the proposal assumes a balanced system without HRV/ERV. This is the most favorable point of comparison and a system that is not commonly used in practice. Section 403 of the IMC allows other ventilation options that are commonly used in buildings. This assumption by the proponent significantly overestimates the energy savings from installing HRV/ERV and significantly underestimates the incremental costs.

o One hour of labor for installing HRV/ERV significantly underestimates the level of effort that would be needed.

o The proponent does not explain the indoor ERV duct connections or ventilation air distribution strategy. These assumptions make a significant difference in energy use and construction costs and must be disclosed so that reviewers can evaluate this aspect of the analysis. These design choices also can make HRV/ERV unacceptable to the occupant.

o The proponent removes independent bathroom fan exhausts and combines ducting of all bathroom exhausts with the ERV. This strategy will not be acceptable to many designers and occupants. In addition, the analysis did not account for a needed boost in capacity when bathrooms are being used.

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

This change will restore the exception for very small dwelling units (500 sqft and less) and will decrease the cost of construction for the most affordable type of housing -- small apartment units.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: To clarify DCV exception for engineered ventilation systems and for alignment with the International Mechanical Code.

Final Hearing Results

CED1-167-22	AS

CED1-168-22

Original Proposal

IECC: C403.7.8, C403.7.8.1, C403.7.8.2

Proponents: Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov); Michael Rosenberg, Pacific Northwest National Laboratory, Pacific Northwest National Laboratory (michael.rosenberg@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.7.8 Occupied standby controls. Occupied-standby controls, in accordance with C403.7.8.1~~and C403.7.8.2~~, shall be ~~are~~ required for each zone of a system that complies with the following:~~zones and systems serving zones where all spaces served by the zone are required to have occupant sensor lighting controls by Section C405.2.1 and are an ASHRAE Standard 62.1 occupancy category where the ASHRAE Standard 62.1 Ventilation Rate Procedure allows the ventilation air to be reduced to zero when the space is in occupied-standby mode.~~

1. All spaces served by the zone are required to have occupant sensor lighting controls in accordance with C405.2.1.
2. ASHRAE Standard 62.1 Ventilation Rate Procedure allows the ventilation air to be reduced to zero in all spaces served by the zone during *occupied standby mode*. Spaces meeting these criteria include:

   2.1 Post-secondary classrooms/lecture/training rooms

   2.2 Conference/meeting/multipurpose rooms

   2.3 Lounges/breakrooms

   2.4 Enclosed offices

   2.5 Open plan office areas

   2.6 Corridors

   Exception: Zones that are part of a Multiple zone system without automatic zone flow control dampers.

~~Spaces meeting these criteria include~~:

1. ~~Post-secondary classrooms/lecture/training rooms~~
2. ~~Conference/meeting/multipurpose rooms~~
3. ~~Lounges/breakrooms~~
4. ~~Enclosed offices~~
5. ~~Open plan office areas~~
6. ~~Corridors~~

C403.7.8.1 Occupied Standby Zone Controls. ~~For zones meeting the occupied-standby control criteria, within~~ Within five (5) minutes of all ~~rooms~~ spaces in that zone entering *occupied-standby mode*, the zone control shall operate as follows:

1. Active heating set point shall be setback~~at least~~ by not less than 1°F (0.55°C).
2. Active cooling set point shall be setup~~at least~~ by not less than 1°F(0.55°C).
3. All airflow supplied to the zone shall be shut off whenever the space temperature is between the active heating and cooling set points.
4. Multiple zone systems shall comply with C403.7.8.1.1

~~**Exception:** Multiple zone systems without automatic zone flow control dampers.~~

~~**C403.7.8.2**~~**C403.7.8.1.1** ~~**Occupied Standby System Controls**~~**Multiple zone system controls.** Multiple zone systems required to ~~that can~~ automatically reset the effective minimum outdoor air setpoint, per Section C403.6.6 ~~and that serve zones with occupied-standby zone controls~~ shall reset the effective minimum outdoor air set-point based on a zone outdoor air requirement of zero for all zones in *occupied-standby mode*. Sequences of operation for system outside air reset shall comply with an approved method.

Reason: This proposal is editorial and recommends alternative language to reduce ambiguity.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is editorial and does not impact cost effectiveness.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This modification improves the language of this section.

Final Hearing Results

CED1-168-22	AM

CED1-172-22

Original Proposal

IECC: TABLE C406.2(1), TABLE 406.2(3), TABLE C406.2.3.4

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov); Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C406.2(1) BASE ENERGY CREDITS FOR GROUP R-2, R-4, AND I-1 OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
W09	SHW distribution sizing	C406.2.3.5	45	46	55	54	63	65	74	73	89	75	80	89	74	81	95	68	77	72	70
W09	SHW flow reduction	C406.2.3.5	22	22	27	26	31	32	37	37	45	38	40	45	38	41	48	35	39	37	36

a. "x" indicates credit is not available for that measure.

TABLE 406.2(3) BASE ENERGY CREDITS FOR GROUP R-1 OCCUPANICES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
W09	SHW flow reduction	C406.2.3.5	13	14	16	16	18	20	22	22	23	25	25	28	27	26	29	26	27	26	25
W09	SHW flow reduction	C406.2.3.5	6	7	8	8	9	10	11	11	12	13	13	14	14	13	15	13	14	14	13

a. "x" indicates credit is not available for that measure.

TABLE C406.2.3.4 Maximum Flow Rating for Residential Plumbing Fixtures with Heated Water

Plumbing Fixture	Maximum Flow Rate
Faucet for private lavatory,[a] hand sinks, or bar sinks	1.50 1.2 gpm at 60 psi (0.095 L/s 4.5 L/m at 410 kPa)
Faucet for residential kitchen sink[a,b, c]	1.8 gpm at 60 psi 0.11 L/s 6.8 L/m at 410 kPa)
Shower head (including hand-held shower spray)[a, b, d]	2.0 1.8 gpm at 80 psi (0.13 L/s 6.8 L/m at 550 kPa)

a. Showerheads, lavatory faucets and kitchen faucets are subject to U.S. Federal requirements listed in 10 CFR 430.32(o)- (p).

b. Maximum flow allowed is less than required by flow rates listed in U.S. 10 CFR 430.32(o)-(p) for showerheads and kitchen faucets.

c. Residential kitchen faucet may temporarily increase the flow above the maximum rate, but not above 2.2 gallons per minute at 60 psi (~~0.14 L/s~~ 8.3 L/m at 410 kPa) and must default to the maximum flow rate listed.

d. When a shower is served by multiple shower heads, the combined flow rate of all shower heads controlled by a single valve shall not exceed the maximum flow rate listed or the shower shall be designed to allow only one shower head to operate at a time.

Reason: The uniform pluming code recently lowered the flow limit for showerheads from 2.5 to 2.0 gpm (9.5 to 7.6 L/m). To maintain a savings for this energy credit measure, the limit for measure W09 is reduced to 1.8 gpm (6.8 L/m). In addition, other residential fixture flow is reduced to 1.2 gpm (4.5 L/m) This aligns with appliance standards in California, Colorado, Washington and possibly other jurisdictions. In addition, the maximum flow for residential lavatory fixtures is reduced to 1.2 gpm (4.5 L/m), aligning with those jurisdictions.

The energy impact was reanalyzed with the new differentials between base and improved, with the energy credits being cut in half.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The lower flow fixtures are readily available nationally, and there is not a cost increase related to flow. The primary cost driver for these finish pluming fixtures is related to finish and other parameters.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The uniform pluming code recently lowered the flow limit for showerheads from 2.5 to 2.0 gpm (9.5 to 7.6 L/m). To maintain a savings for this energy credit measure, the limit for measure W09 is reduced to 1.8 gpm (6.8 L/m). In addition, other residential fixture flow is reduced to 1.2 gpm (4.5 L/m) This aligns with appliance standards in California, Colorado, Washington and possibly other jurisdictions. In addition, the maximum flow for residential lavatory fixtures is reduced to 1.2 gpm (4.5 L/m), aligning with those jurisdictions. The energy impact was reanalyzed with the new differentials between base and improved, with the energy credits being cut in half.

Final Hearing Results

CED1-172-22	AS

CED1-173-22

Original Proposal

IECC: C406.2.2.5

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov); Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C406.2.2.5 H05 Dedicated Outdoor Air System. Credits for this measure are only allowed where single zone HVAC units are not required to have multi-speed or variable-speed fan control in accordance with Section C403.8.6.1. HVAC controls and ventilation systems shall include all of the following:

1. Zone controls shall cycle the heating/cooling unit fans off when not providing required heating and cooling or shall limit fan power to 0.12 watts/cfm of zone ~~outdoor~~ supply air.
2. Outdoor air shall be supplied by an independent ventilation system designed to provide no more than ~~110~~ 130 percent of the minimum outdoor air to each individual occupied zone, as specified by the *International Mechanical Code*. **Exception:** Outdoor airflow is permitted to increase during emergency or economizer operation implemented as described in item 4.
3. The ventilation system shall have energy recovery with an *enthalpy recovery ratio* of 65 percent or more at heating design conditions in climate zones 3 through 8 and an *enthalpy recovery ratio* of 65 percent or more at cooling design conditions in climate zones 0, 1, 2, 3A, 3B, 4A, 4B, 5A, and 6A. In "A" climate zones, energy recovery shall include latent recovery. Where no humidification is provided, heating energy recovery effectiveness is permitted to be based on sensible *energy recovery ratio*. Where energy recovery effectiveness is less than the 65 percent required for full credit, adjust the credits from Section C406.2 by the factors in Table C406.2.2.5.
4. Where the ventilation system serves multiple zones and the system is not in a latent recovery outside air dehumidification mode. partial economizer cooling through an outdoor air bypass or wheel speed control shall automatically do one of the following:
   4.1. Set the energy recovery leaving-air temperature 55°F (13°C) or 100 percent outdoor air bypass when a majority of zones require cooling and outdoor air temperature is below 70°F (21°C).
   4.2. The HVAC ventilation system shall include supply-air temperature controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperatures. The controls shall reset the supply-air temperature not less than 25 percent of the difference between the design supply-air temperature and the design room-air temperature.
5. Ventilation systems providing mechanical dehumidification shall use recovered energy for reheat within the limits of item 4. This shall not limit the use of latent energy recovery for dehumidification.

Where only a portion of the building is permitted to be served by constant air volume units or the enthalpy recovery ratio or sensible *energy recovery ratio* is less than 65 percent, the base energy credits shown in Section C406.2 shall be prorated as follows:

(Equation 4-20)

$$EC_{DOAS} = EC_{BASE} \times FLOOR_{CAV} \times ERE_{ADJ}$$

Where: EC_{DOAS} = Energy credits achieved for H05 ~~H06~~

EC_{base} = H05 ~~H06~~ base energy credits in Section C406.2

$FLOOR_{CAV}$ = Fraction of whole project gross conditioned fl oor area not required to have variable speed or multi-speed fan airflow control in accordance with Section C403.8.6.

ERE_{adj} = The energy recovery adjustment from Table C406.2.2.5 based on the lower of actual cooling or heating *enthalpy recovery ratio* or *sensible energy recovery ratio* where required for the climate zone. Where recovery ratios vary, use a weighted average by supply airflow.

Reason: Three minor changes are made to energy credit measure H05 (DOAS) to allow for flexibility.

1. The reference to heating/cooling supply fan operation during ventilation only mode of 0.12 W/cfm is changed from outdoor air to supply air. This is intended to allow continuous operation of destratification convective cooling fans or VRF cassette fans at low speed when heating or cooling is not active.
2. The maximum normal operation outdoor air is increased from 110% to 130% of the IMC minimum outdoor air required to allow for LEED indoor air quality points.
3. An exception for increased economizer operation of the DOAS system is added along with an allowance for emergency outdoor air flushing of spaces. An increased airflow economizer approach can save energy two ways: 1) using cool outdoor air instead of mechanical cooling, and 2) oversizing the ductwork for economizer operation resulting in reduced fan energy during normal operation.

In addition, there are editorial corrections in the formula symbols section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The changes allow for optional additional controls or increased ductwork sizing that are not required. This measure is not a requirement of the code as it is one of multiple additional energy credit options that can be selected to meet C406 requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Three minor changes are made to energy credit measure H05 (DOAS) to allow for flexibility.

Final Hearing Results

CED1-173-22 AS

CED1-174-22

Original Proposal

IECC: C406.2.3.2

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C406.2.3.2 Water-heating distribution temperature maintenance. A project is allowed to claim energy credits from only one of the following SHW distribution temperature maintenance measures.

1. **W04: Service Hot Water Piping Insulation Increase.** Where service hot water is provided by a central water heating system, the hot water pipe insulation thickness shall be at least 1.5 times the thickness required in Section C404.4. All service hot water piping shall be insulated from the hotwater source to the fixture shutoff. Where no more than 50 percent of hot water piping does not have increased insulation due to installation in partitions, the credit shall be prorated as a percentage of lineal feet of piping with increased insulation.
2. **W05 Point of use water heaters.** Credits are available for office or school buildings larger than 5000 square feet ~~10,000 ft^2~~ (~~930~~ 460 m^2) where service water heating systems meet the following requirements:

2.1. Fixtures requiring hot water shall be supplied from a local ~~ized source of hot~~ water heater with no recirculating system or heat trace piping.

Exception: Commercial kitchens or showers in locker rooms shall be permitted to have a local recirculating system or heat trace piping where water heaters are located not more than 50 lineal feet (15 m) from the furthest fixture served.

2.2. Supply piping from the water heater to the termination of the fixture supply pipe shall be insulated to the levels shown in Table C404.4.1. ~~C403.12.3 without e~~

Exceptions:

1. Piping at locations where a vertical support of the piping is installed.
2. Where piping passes through a framing member and insulation requires increasing the size of the framing member.

2.3. The water volume in the piping from the water heater to the termination of ~~the~~ any individual fixture ~~supply pipe~~ shall be limited as follows:

~~2.1~~ 2.3.1. Non-residential ~~lavatories~~ Public lavatory faucets that are available for use by members of the general public: not more than 2 oz (60 mL)

2.3.2 Commercial kitchens or showers in locker rooms with recirculating systems or heat trace piping: not more than 24 oz (0.75 L) from the recirculating system or heat trace piping.

~~2.2~~ 2.3.3. All other plumbing fixtures or appliances: not more than ~~0.25 gallons~~ 16 oz (~~0.95~~ 0.5 L)

~~**Exception:** Where all remotely located hot water uses meet the requirements for measure W05, separate water heaters serving commercial kitchens or showers in locker rooms shall be permitted to have a local recirculating system or heat trace piping.~~

3. **W06 Thermostatic balancing valves.** Credits are available where service water heating is provided centrally and distributed throughout the building. Each recirculating system branch return connection to the main SHW supply piping shall have an automatic thermostatic balancing valve set to a minimal return water flow when the branch return temperature is greater than 115°F (46°C).
4. **W07 Heat trace system.** Credits are available for projects with gross floor area greater than 10,000 square feet (930 m^2) and a central water-heating system. The energy credits achieved shall be from Tables C406.1.2(1) through C406.1.2(9). This system shall include self-regulating electric heat cables, connection kits, and electronic controls. The cable shall be installed directly on the hot water supply pipes underneath the insulation to replace standby losses.

Reason: The changes are primarily editorial and for purposes of clarification. Two substantial changes include:

- Reducing the size of building where the credit is allowed, allowing for more applicability.
- Reducing the volume of fluid in the piping to other fixtures to 16 ounces. With 3/8" supply piping, a 3 or 4 floor stack of restrooms with 4 lavatories on each floor can be effectively served while allowing timely delivery of hot water to the fixtures.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The measure can be selected from a number of options, so this measure (W05) is not specifically required by the code.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The changes are primarily editorial and for purposes of clarification. Three substantial changes include:

1) Reducing the size of building where the credit is allowed, allowing for more applicability.

2) The IECC HVACR and Water Heating Subcommittee added water piping volume requirements for commercial kitchens and showers.

3) Reducing the volume of fluid in the piping to other fixtures to 16 ounces. With 3/8" supply piping, a 3 floor stack of restrooms with 4 lavatories on each floor can be effectively served while allowing timely delivery of hot water to the fixtures.

Final Hearing Results

CED1-174-22	AM

CED1-175-22

Original Proposal

IECC: C406.3

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov); Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C406.3 Renewable and Load Management Credits ~~achieved~~ Achieved. Renewable energy and load management measures shall achieve credits as follows:
~~installed in the building that comply with Sections C406.3.1 through C406.3.8 shall achieve the credits listed for the occupancy group in Tables C406.3(1) through C406.3(9) or where calculations are required in Sections C406.3 to determine credits or modify the table credits, the credits achieved shall be based upon the Section C406.3 calculations.~~

1. **General measure requirements.** Credits are achieved for measures installed in the *building* that comply with Sections C406.3.1 through C406.3.8

2. **Achieved credits** are determined as follows:

   2.1. Measure credits achieved shall be determined in one of two ways, depending on the measure:

      2.1.1 ~~1~~ The measure credit shall be the base ~~energy~~ credit listed by occupancy group and climate zone for the measure in Tables C406.3(1) through C406.3(9) where no adjustment factor or formula is shown in the description of the measure in Section C406.3.

      2.1.2 ~~2~~ The measure credit shall be the base energy credit for the measure adjusted by a factor or formula as stated in the description of the measure in Section C406.3. Where adjustments are applied, each measure energy credit shall be rounded to the nearest whole number.

   2.2 Load management and renewable credits achieved for the project shall be the sum of credits for individual measures included in the project. Credits are available for the measures listed in this Section.

   2.3 Where a project contains multiple building use groups, credits achieved for each building use group shall be summed and then weighted by the ~~gross~~ floor area of each building use group to determine the weighted average project energy credits achieved.

3. **Load management control requirements**. The load management measures in Sections C406.3.2 (G01) through C406.3.7 (G06) require load management control sequences that are capable of and configured to automatically provide the load management operation specified based on indication of a peak period related to high short-term electric prices, grid condition, or peak building load. Such a peak period shall, where possible, be initiated by a *demand response signal* from the controlling entity, such as a utility or service operator. When communications are disabled or unavailable, all *demand responsive controls* shall continue backup demand response based on a local schedule or building demand monitoring. The local building schedule shall be adjustable without programming and reflect the electric rate peak period dates and times. The load management control sequences shall be activated for peak period control by either:

   3.1 ~~1.~~ A certified OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in the applicable OpenADR 2.0 Specification, or

3.2 ~~2.~~ A device certified by the manufacturer as being capable of responding to a demand response signal from a certified OpenADR 2.0b VEN by automatically implementing the control functions requested by the VEN for the equipment it controls, or

3.3 The physical configuration and communication protocol of CTA 2045-A or CTA 2045-B, or

3.4 For air conditioners and heat pumps with two or more stages of control and cooling capacity of less than 65,000 Btu/h (19 kW), thermostats with a demand responsive control that complies with the communication and performance requirements of AHRI 1380, or

3.5 ~~3~~. A device that complies with IEC 62726-10-1, an international standard for the open automated demand response system interface between the appliance, system, or energy management system and the controlling entity, or

3.6 4. An interface that complies with the communication protocol required by a controlling entity, to participate in an automated demand response program, or

3.7 ~~5~~. Where the controlling entity does not have a *demand response signal* ~~program or protocol~~ available for the building type and size, local ~~demand response~~ load management control shall be provided based on either:

3.7.1 ~~5.1~~ Building demand management controls that monitor building electrical demand and initiate controls to minimize monthly or peak time period demand charges, or,

3.7.2 ~~5.2~~ Where buildings are less than 25,000 gross square feet, a local building schedule that reflects the electric rate peak period dates and times. In this case a binary input to the control system shall be provided that activates the demand response sequence.

Reason: The proposed changes provide structure and clarification while reducing redundancy. There is no change in requirements.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The changes are editorial for clarification and do not change any requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal provides clarification for achieving C406 renewable and load management credits. The proposal does not change any of the requirements.

Final Hearing Results

CED1-175-22	AS

CED1-176-22

Original Proposal

IECC: C406.3.7, TABLE C406.3.7 (New)

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov); Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C406.3.7 G06 SWH Energy Storage. Where SHW is heated by electricity, automatic load management controls that comply with ANSI/CTA-2045-B shall preheat stored SHW before the peak period and suspend electric water heating during the peak period. Storage capacity shall be provided by either:

1. Preheating water above 140°F (60°C) delivery temperature with at least 1.34 kWh of energy storage per kW of water-heating capacity. Tempering valves shall be provided at the water heater delivery location.
2. Providing additional heated water tank storage capacity above peak SHW demand with equivalent peak storage capacity to item 1. ~~Where heat pump water heating is used, the credits achieved shall be 1/3 of the credits in Tables C406.3(1) through C406.3(9~~).

Credits achieved for measure G06 shall becalculated using Equation 4-32:

(Equation #)

$$EC_{G06\ ach} = EC_{G06\ base}\ x\ EC_{G06\ adj}$$

where: EC_{G06_ach} = SWH Energy Storage credit achieved for Project
EC_{G06_base} = G06 Base energy credit from Section 406.3
EC_{G06_adj} = energy credit adjustment factor from Table C406.3.7

Add new text as follows:

TABLE C406.3.7 Energy Credit Adjustment Based on Use of Heat Pump Water Heater or Demand Response

DEMAND RESPONSE READY PER SECTION C404.10	DEMAND RESPONSE SIGNAL AVAILABLE[a]	HAS HPWH	$EC_{G06\ Adj}$[b]
NO	NA	NO	100%
NO	NA	YES	33%
YES	NO	NO	50%
YES	NO	YES	17%
YES	YES	NA	0%

a. "Demand Response Signal Available" is "Yes" where a controlling entity currently makes a *demand response signal* available to the building.

b. The lower values of $EC_{G06\ adj}$ in this column apply when no less than 67 percent of the whole-building design end use service water heating requirements are met using only heat pump heating at the conditions described in Section C406.2.3.1.2.

-

Reason: The credit adjustments added here account for the difference between a capability being required in the base code and full implementation though the credit measure. Full credit is given here when either the base code requirement does not apply or there is not a demand response program available. Half credit is given when there is a demand response program and the base code requires compatible demand response controls.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The changes here are in response to base code changes and allow for partial credit when there is a capability requirement in the base code that is fully implemented here.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Ensures that double credit is not given where baseline DR requirements exist. The modified proposal is clearer than the original.

Final Hearing Results

CED1-176-22	AM

CED1-177-22

Original Proposal

IECC: C408.2

Proponents: Aaron McEwin, Jordan & Skala Engineers, Industry Professional (amcewin@jordanskala.com)

2024 International Energy Conservation Code [CE Project]

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* 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. Buildings with less than 10,000 square feet (929 m^2) gross conditioned floor area and combined heating, cooling, and service water-heating capacity of less than 960,000 Btu/h (280kW). ~~2. Systems included in Section C403.5 that serve individual dwelling units and sleeping units.~~ 2. Components within dwelling units and sleeping units served on of the following systems:

   2.1. Simple unitary or packaged HVAC equipment listed in Table C403.3.2(1), Table C403.3.2(2), Table C403.3.2(4), Table C403.3.2(5) each serving one zone and controlled by a single thermostat in the zone served.

   2.2 Two-pipe heating systems installed in the dwelling serving one or more zones.

Reason: Under the 2012 IECC, the referenced section referred to "Simple" Systems. In the 2015 IECC, the definition of "Simple" system was removed and only the "Economizer" section was provided. The "Economizer" Section was referenced and did not make since from a commissioning stand point since economizers generally have complex controls that activate mechanical dampers based on a control input (i.e. dry bulb, enthalpy, etc.).

This change gets back to the original intent of less complex systems that serve individual dwelling units and sleeping units do not need to be commissioned.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This clarifies the original intent of the commissioning section prior to the removal of the "Simple" system section of the code.

A: It is the opinion of staff that Exception 2 of Section C408.2 only applies to packaged and split systems serving individual sleeping units and dwelling units. Subject to the approval of the Code Official, it is reasonable to determine that the intent of Exception 2 of Section C408.2 in the 2015 IECC is to exempt HVAC systems that serve individual sleeping units and dwelling units from the commissioning requirement when the systems are packaged or split systems. Exception 2 Section C408.2 of the 2015 IECC states the following.

"Systems included in Section C403.3 that serve individual dwelling units and sleeping units."

Note that Section C403.3 of the 2015 IECC is an economizer provision and does not provide specific language for dwelling units and sleeping units.

In the 2012 IECC Exception 2 of Section C408.2 had similar language. It stated the following.

"Systems included in Section C403.3 that serve dwelling units and sleeping units in hotels, motels, boarding houses or similar units."

Section C403.3 of the 2012 IECC stated the following.

"**C403.3 Simple HVAC systems and equipment (Prescriptive).** This section applies to buildings served by unitary or packaged HVAC equipment listed in Tables C403.2.3(1) through C403.2.3(8), each serving one zone and controlled by a single thermostat in the zone served. It also applies to two-pipe heating systems serving one or more zones, where no cooling system is installed."

In the 2012 IECC the intent of Exception 2 of Section C408.2 was to exempt the dwelling units and sleeping units described when they were served by simple HVAC systems that met the criteria of Section C403.3 (Simple HVAC systems). Exception 2 of Section C408.2 of the 2012 IECC was brought into the code through Public Comment 4 of the code change proposal EC147-09/10. EC147-09/10 was approved as modified with several public comments, including Public Comment 4. A portion of the reason statement for Public Comment 4 stated the following.

"… An exception was also placed in the requirements that will exempt systems installed in hotel/motel and high-rise residential that meet the simple building definition in Section 503.3. This will, for example, exempt packaged terminal heat pump (PTHP) systems commonly used in hotel/motel sleeping rooms that are intermittently occupied and where there may be additional costs of commissioning multiple small systems."

During the 2015 code development cycle Sections C403.3 of the 2012 IECC and C403.4 of the 2012 IECC were modified to, among other things, remove the distinction between simple and complex HVAC systems to make the 2015 IECC more user-friendly. In the process Section C403.3.1 of the 2012 IECC (Economizers) was renumbered to Section C403.3 of the 2015 IECC (Economizers).

Public Hearing Results

Committee Action **As Modified**

Committee Reason: To clarify the commissioning requirements for simple systems and the exception for certain components within dwelling units.

Final Hearing Results

CED1-177-22	AM

CED1-182-22

Original Proposal

IECC: SECTION 202, C409.3, C409.5.3.1, C409.6.1.1, C409.6.1.1.1, C409.6.1.2, C409.6.1.3.1, C409.6.1.4.1, C409.6.1.4.2, C409.6.1.4.3, C409.6.1.4.4, C409.6.1.4.5, C409.6.1.4.6, C409.6.1.10.2, TABLE C409.6.1.10.2(1), C409.6.2.2

Proponents: Martha VanGeem, Martha G VanGeem, Masonry Alliance for Codes and Standards

2024 International Energy Conservation Code [CE Project]

Revise as follows:

<u>THERMAL</u> BLOCK. A generic concept used in energy simulation. It can include one or more thermal zones. It represents a whole building or portion of a building with the same use type served by the same HVAC system type.

C409.3 Core & Shell / Initial Build-Out, and Future System Construction Analysis. Where the building permit applies to only a portion of the HVAC system in a *building* and the remaining components will be designed under a future building permit or were previously installed, the future or previously installed components shall be modeled as follows:

1. Where the HVAC zones that do not include HVAC systems in the current permit will be or are served by independent systems, then the <u>thermal</u> block including those zones shall not be included in the model.
2. Where the HVAC zones that do not include complete HVAC systems in the permit are intended to receive HVAC services from systems in the permit, their proposed zonal systems shall be modeled with equipment that meets, but does not exceed, the requirements of Section C403.
3. Where the zone equipment in the permit receives HVAC services from previously installed systems that are not in the permit, the previously installed systems shall be modeled with equipment matching the certified value of what is installed or equipment that meets the requirements of Section C403.
4. Where the central plant heating and cooling equipment is completely replaced and HVAC zones with existing systems receive HVAC services from systems in the permit, their proposed zonal systems shall be modeled with equipment that meets, but does not exceed, the requirements of Section C403.

C409.5.3.1 Compliance Report. Building permit submittals shall include:

1. A report produced by the simulation software that includes the following:

   1.1 Address of the building.

   1.2 Name of individual completing the compliance report.

   1.3 Name and version of the compliance software tool

   1.4 The dimensions, floor heights and number of floors for each<u>thermal</u> block.

   1.5 By <u>thermal</u> block, the U-factor, C-factor, or F-factor for each simulated opaque envelope component and the U-factor and SHGC for each fenestration component.

   1.6 By <u>thermal</u> block or by surface for each <u>thermal</u> block, the fenestration area.

   1.7 By <u>thermal</u> block, a list of the HVAC equipment simulated in the proposed design including the equipment type, fuel type, equipment efficiencies and system controls.

   1.8 Annual site HVAC energy use by end use for the proposed and baseline building.

   1.9 Annual sum of heating and cooling loads for the baseline building.

   1.10 The HVAC total system performance ratio for both the standard reference design and the proposed design.

2. A mapping of the actual building HVAC component characteristics and those simulated in the proposed design showing how individual pieces of HVAC equipment identified above have been combined into average inputs as required by Section C409.6.1.10 including:

   2.1 Fans

   2.2 Hydronic pumps

   2.3 Air handlers

   2.4 Packaged cooling equipment

   2.5 Furnaces

   2.6 Heat pumps

   2.7 Boilers

   2.8 Chillers

   2.9 Heat rejection equipment (open and closed-circuit cooling towers; dry coolers)

   2.10 Electric resistance coils

   2.11 Condensing units

   2.12 Motors for fans and pumps

   2.13 Energy recovery devices

3. For each piece of equipment identified above include the following as applicable:

   3.1 Equipment name or tag consistent with that found on the design documents.

   3.2 Rated Efficiency level.

   3.3 Rated Capacity.

   3.4 Where not provided by the simulation program report in item a, documention of the calculation of any weighted equipment efficiencies input into the program.

   3.5 Electrical input power for fans and pumps (before any speed or frequency control device) at design condition and calculation of input value (W/cfm or W/gpm).

4. Floor plan of the building identifying:

   4.1 How portions of the buildings are assigned to the simulatedthermal blocks.

   4.2 Areas of the building that are not covered under the requirements of Section C403.1.1.

C409.6.1.1 ~~Block~~Thermal block Geometry. The geometry of buildings shall be configured using one or more thermal blocks. Each thermal block shall define attributes including thermal block dimensions, number of floors, floor to floor height and floor to ceiling height. Simulation software may allow the use of simplified shapes (such as rectangle, L shape, H Shape, U shape or T shape) to represent thermal blocks. Where actual building shape does not match these pre-defined shapes, simplifications are permitted providing the following requirements are met:

1. The conditioned floor area and volume of eachthermal block shall match the proposed design within 10 percent.
2. The area of each exterior envelope component from Table C402.1.4 is accounted for within 10 percent of the actual design.
3. The area of vertical fenestration and skylights is accounted for within 10 percent of the actual design.
4. The orientation of each component in 2 and 3 above is accounted for within 45 degrees of the actual design.

The creation of additional thermal blocks may be necessary to meet these requirements. A more complex zoning of the building shall be allowed where all thermal zones in the reference and proposed model are the same and rules related to thermal block geometry and HVAC system assignment to thermal blocks are met with appropriate assignment to thermal zones.

Exception: Portions of the building that are unconditioned or served by systems not covered by the requirements of Section C403.1.1

shall be omitted.

C409.6.1.1.1 Number of ~~Blocks~~thermal blocks. One or more thermal blocks may be required per building based on the following restrictions:

1. Each thermal *block* can have only one occupancy type (multifamily*dwelling unit*, multifamily common area, office, library, education, hotel/motel or retail). Therefore, at least one single thermal *block* shall be created for each unique use type.
2. Each thermal block can be served by only one type of HVAC system. Therefore, a single block shall be created for each unique HVAC system and use type combination. Multiple HVAC units of the same type may be represented in one thermal block. Table D601.10.2 provides directions for combining multiple HVAC units or components of the same type into a single block.
3. Each thermal block can have a single definition of floor to floor or floor to ceiling heights. Where floor heights differ by more than two feet, unique thermal blocks should be created for the floors with varying heights.
4. Each block can include either above grade or below grade floors. For buildings with both above grade and below grade floors, separate blocks should be created for each. For buildings with floors partially above grade and partially below grade, if the total wall area of the floor(s) in consideration is greater than or equal to 50 percent above grade, then it should be simulated as a completely above grade block, otherwise it should be simulated as a below grade block.
5. Each wall on a façade of a block shall have similar vertical fenestration. The product of the proposed design U-factor times the area of windows (UA) on each façade of a given floor cannot differ by more than 15 percent of the average UA for that façade in each block. The product of the proposed design SHGC times the area of windows (SHGCA) on each façade of a given floor cannot differ by more than 15 percent of the average SHGCA for that façade in each block. If either of these conditions are not met, additional blocks shall be created consisting of floors with similar fenestration.
6. For a building model with multiple blocks, the blocks should be configured together to have the same adjacencies as the actual building design.

C409.6.1.2 Thermal Zoning. Each floor in a thermal block shall be modeled as a single thermal zone or as five thermal zones consisting of four perimeter zones and a core zone. Below grade floors shall be modeled as a single thermal block. If any façade in the thermal block is less than 45 feet in length, there shall only be a single thermal zone per floor. Otherwise each floor shall be modeled with five thermal zones. A perimeter zone shall be created extending from each façade to a depth of 15 feet. Where facades intersect, the zone boundary shall be formed by a 45 degree angle with the two facades. The remaining area or each floor shall be modeled as a core zone with no exterior walls.

C409.6.1.3.1 Occupancy Type. The occupancy type for each thermal block shall be consistent with the building area type as determined in accordance with Section C405.4.2.1. Portions of the building that are building area types other than multifamily dwelling unit, multifamily common area, office, school (education), library, or retail shall not be included in the simulation. Surfaces adjacent to such building portions shall be modeled as adiabatic in the simulation program.

C409.6.1.4.1 Roofs. Roofs will be modeled with insulation above a steel roof deck. The roof U-factor and area shall be modeled as in the proposed design. If different roof thermal properties are present in a single thermal block, an area weighted U-factor shall be used. Roof solar absorptance shall be modeled at 0.70 and emittance at 0.90.

C409.6.1.4.2 Above grade walls. Walls will be modeled as steel frame construction. The U-factor and area of above grade walls shall be modeled as in the proposed design. If different wall constructions exist on the façade of a thermal block an area-weighted U-factor shall be used.

C409.6.1.4.3 Below grade walls. The C-factor and area of below grade walls shall be modeled as in the proposed design. If different slab on grade floor constructions exist in a thermal block, an area-weighted C- factor shall be used.

C409.6.1.4.4 Above grade exterior floors. Exterior floors shall be modeled as steel frame. The U-factor and area of floors shall be modeled as in the proposed design. If different wall constructions exist in the thermal block an area-weighted U-factor shall be used.

C409.6.1.4.5 Slab on grade floors. The F-factor and area of slab on grade floors shall be modeled as in the proposed design. If different below grade wall constructions exist in a thermal block, an area-weighted F- factor shall be used.

C409.6.1.4.6 Vertical Fenestration. The window area and area weighted U-factor and SHGC shall be modeled for each façade based on the proposed design. Each exterior surface in a thermal block must comply with Section C409.6.1.1.1 item 5. Windows will be combined into a single window centered on each façade based on the area and sill height input by the user. When different U values, SHGC or sill heights exist on a single facade, area weighted average for each shall be input by the user.

C409.6.1.10.2 Proposed building HVAC system simulation. The HVAC systems shall be modeled as in the proposed design at design conditions unless otherwise stated with clarifications and simplifications as described in Tables C409.6.1.10.2(1) and C409.6.1.10.2(2). System parameters not described in the following sections shall be simulated to meet the minimum requirements of Section C403. All zones within a thermal block shall be served by the same HVAC system type as described in Section C409.6.1.1.1 item 2. Heat loss from ducts and pipes shall not be modeled. Table C409.6.1.10.2(1) Proposed Building System Parameters are based on input of full-load equipment efficiencies with adjustment using part-load curves integrated in the simulation program. Where other approaches to part-load adjustment are used, it is permitted for specific input parameter to vary. The simulation program shall model part-load HVAC equipment performance using either:

1. Full-load efficiency adjusted for fan power input that is modeled separately and typical part-load performance adjustments for the proposed equipment.
2. Part-load adjustments based on input of both full-load and part-load metrics, or
3. Equipment-specific adjustments based on performance data provided by the equipment manufacturer for the proposed equipment.

Where multiple system components serve athermal block, average values weighed by the appropriate metric as described in this section shall be used.

1. Where multiple fan systems serve a singlethermal block, fan power shall be based on weighted average using the design supply air cfm
2. Where multiple cooling systems serve a singlethermal block, COP shall be based on a weighted average using cooling capacity. DX coils shall be entered as multi-stage if more than 50 percent of coil capacity serving the thermal block is multi-stage with staged controls.
3. Where multiple heating systems serve a singlethermal block, thermal efficiency or heating COP shall be based on a weighted average using heating capacity.
4. Where multiple boilers or chillers serve a heating water or chilled water loop, efficiency shall be based on a weighted average for using heating or cooling capacity.
5. When multiple cooling towers serving a condenser water loop are combined, the cooling tower efficiency, cooling tower design approach and design range are based on a weighted average of the design water flow rate through each cooling tower.
6. Where multiple pumps serve a heating water, chilled water or condenser water loop, pump power shall be based on a weighted average for using design water flow rate.
7. When multiple system types with and without economizers are combined, the economizer maximum outside air fraction of the combined system shall be based on weighted average of 100 percent supply air for systems with economizers and design outdoor air for systems without economizers.
8. Multiple systems with and without ERVs cannot be combined.
9. Systems with and without supply air temperature reset cannot be combined.
10. Systems with different fan control (constant volume, multi-speed or VAV) for supply fans cannot be combined.

TABLE C409.6.1.10.2(1) PROPOSED BUILDING SYSTEM PARAMETERS

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
HVAC System Type	System Type	User Defined	Selected from Table C409.6.1.10.1	All
System Sizing	Design Day Information	Fixed	99.6% heating design and 1% dry-bulb and 1% wet-bulb cooling design	All
	Zone Coil Capacity	Fixed	Sizing factors used are 1.25 for heating equipment and 1.15 for cooling equipment	All
	Supply Airflow	Fixed	Based on a supply-air-to-room-air temperature set-point difference of 20°F(11.11°C) or	1-11
		Fixed	Equal to required outdoor air ventilation	12
Outdoor Ventilation Air	Portion of supply air with proposed Filter ≥MERV 13	User defined	Percentage of supply air flow subject to higher filtration (Adjusts baseline Fan Power higher. Prorated)	All
	Outdoor Ventilation Air Flow Rate	Fixed	As specified in ASHRAE Standard 90.1 Normative Appendix C, adjusted for proposed DCV control	All
	Outdoor Ventilation Supply Air Flow Rate Adjustments	Fixed	Based on ASHRAE Standard 62.1 Section 6.2.4.3 System Ventilation Efficiency (Evs) is 0.75	9-11
		Fixed	System Ventilation Efficiency (Evs) is 1.0	1-8, 12
		Fixed	Basis is 1.0 Zone Air Distribution Effectiveness	All
System Operation	Space temperature set points	Fixed	As specified in ASHRAE Standard 90.1 Normative Appendix C, except -multifamily which shall use 68°F(20°C) heating and 76°F(24.4°C) cooling setpoints. -hotel/motel that shall be 70°F(21.1°C) heating and 72°F(22.2°C) cooling	1-11
	Fan Operation - Occupied	User defined	Runs continuously during occupied hours or cycles to meet load. Multispeed fans reduce airflow related to thermal loads.	1-11
	Fan Operation - Occupied	Fixed	Fan runs continuously during occupied hours	12
	Fan Operation - Night Cycle	Fixed	Fan cycles on to meet setback temperatures	1-11
Packaged Equipment Efficiency	DX Cooling Efficiency	User defined	Cooling COP without fan energy calculated in accordance with Section C409.6.1.10.2	1, 2, 3, 4, 5,7, 8, 9, 11,12
	DX Coil Number of Stages	User defined	Single Stage or Multistage	3, 4, 9, 10, 11, 12
	Heat Pump Efficiency	User defined	Heating COP without fan energy calculated in accordance with Section C409.6.1.10.2	2, 4, 5, 7, 8, 12
	Furnace Efficiency	User defined	Furnace thermal efficiency	3, 9, 11, 12
Heat Pump Supplemental Heat	Heat Source	User defined	Electric resistance or gas furnace	2, 4, 7, 8, 12
	Control	Fixed	Supplemental electric heat locked out above 40°F(4°C) OAT. Runs as needed in conjunction with compressor between 40°F(4°C) and 0°F(-17.8°C). Gas heat operates in place of the heat pump when the heat pump cannot meet load.	2, 4, 7, 8, 12
System Fan Power and Controls	Part-load Fan Controls -Constant Volume -Two Speed or three speed -VAV	User defined	Static pressure reset included for VAV.	1-8 (CAV, two or three speed), 9, 10, 11 (VAV), 12 (CAV and VAV)
	Design Fan Power (W/cfm)	User defined	Input electric power for all fans required to operate at fan system design conditions divided by the supply airflow rate This is a "wire to air" value including all drive, motor efficiency and other losses.	All
	Low-speed and medium speed fan power	User defined	Low speed input electric power for all fans required to operate at low-speed conditions divided by the low speed supply airflow rate. This is a "wire to air" value including all drive, motor efficiency and other losses. Also provide medium speed values for three-speed fans.	1-8

Variable Air Volume Systems	Supply Air Temperature (SAT) Controls	User defined	If not SAT reset then constant at 55°F(12.8°C).Options for reset based on outside air temperature (OAT) or warmest zone. If warmest zone, then the user can specify the minimum and maximum temperatures. If OAT reset, SAT is reset higher to 60°F(15.6°C) at outdoor low of 50°F(10°C). SAT is 55°F(12.8°C) at outdoor high of 70°F(21.1°C).	9, 10, 11
	Minimum Terminal Unit airflow percentage	User defined	Average minimum terminal unit airflow percentage for thermal block weighted by cfm or minimum required for outdoor air ventilation, whichever is higher.	9, 10, 11
	Terminal Unit Heating Source	User defined	Electric or hydronic	9, 10, 11
	Dual set point minimum VAV damper position	User defined	Heating maximum airflow fraction	9, 10
	Fan Powered Terminal Unit (FPTU) Type	User defined	Series or parallel FPTU	11
	Parallel FPTU Fan	Fixed	Sized for 50% peak primary air at 0.35 W/cfm	11
	Series FPTU Fan	Fixed	Sized for 50% peak primary air at 0.35 W/cfm	11
Economizer	Economizer Presence	User defined	Yes or No	3, 4, 5, 6, 9, 10, 11
	Economizer Control Type	Fixed	Lockout on Differential dry-bulb temperature (OAT>RAT) in 6A, 5A, All B & C climate zones; fixed enthalpy>28 Btu/lb (47kJ/kg) or fixed dry-bulb OAT>75°F(24°C) in 0A to 4A climate zones	3, 4, 5, 6, 9, 10, 11
Energy Recovery	Sensible Effectiveness	User defined	Heat exchanger sensible effectiveness at design heating and cooling conditions	3, 4, 9, 10, 11, 12
	Latent Effectiveness	User defined	Heat exchanger latent effectiveness at design heating and cooling conditions	3, 4, 9, 10, 11, 12
	Economizer Bypass	User defined	If ERV is bypassed or wheel rotation is slowed during economizer conditions (Yes/No)	3, 4, 9, 10, 11, 12
	Economizer Bypass active	Fixed	If there is a bypass, it will be active between 45°F(7.2°C) and 75°F(23.9°C) outside air temperature.	3, 4, 9, 10, 11, 12
	Bypass SAT Setpoint	User defined	If bypass, target supply air temperature	3, 4, 9, 10, 11, 12
	Fan Power Reduction during Bypass (W/cfm)	User defined	If ERV system include bypass, static pressure set point and variable speed fan, fan power can be reduced during economizer conditions	3, 4, 9, 10, 11, 12
Demand Controlled Ventilation	DCV Application on/off	User defined	Percent of thermal block floor area under occupied standby controls, ON/OFF only with occupancy sensor and no variable control	3, 4, 9, 10, 11, 12
	DCV Application CO2	User defined	Percentage of thermal block floor area under variable DCV control (CO2); may include both variable and ON/OFF control	3, 4, 9, 10, 11, 12
DOAS	DOAS Fan Power W/cfm	User defined	Fan electrical input power in W/cfm of supply airflow	12
	DOAS Supplemental Heating and Cooling	User defined	Heating source, cooling source, energy recovery and respective efficiencies	12
	Maximum SAT Set point (Cooling)	User defined	SAT set point if DOAS includes supplemental cooling	12
	Minimum SAT Set point (Heating)	User defined	SAT set point if DOAS includes supplemental heating	12
Heating plant	Boiler Efficiency	User defined	Boiler thermal efficiency	1, 6, 7, 9, 10, 11, 12
	Heating Water Loop Configuration	User defined	Constant flow primary only; Variable flow primary only; Constant flow primary - variable flow secondary, Variable flow primary and secondary	1, 6, 7, 9, 10, 11, 12
	Heating Water Primary Pump Power (W/gpm)	User defined	Heating water primary pump input W/gpm heating water flow	1, 6, 7, 9, 10, 11, 12

	Heating Water Secondary Pump Power (W/gpm)	User defined	Heating water secondary pump input W/gpm heating water flow (if primary/secondary)	1, 6, 7, 9, 10, 11, 12
	Heating Water Loop Temperature	User defined	Heating water supply and return temperatures, °F(°C)	1, 6, 9, 10,11
	Heating Water Loop Supply Temperature Reset	Fixed	Reset HWS by 27.3% of design delta-T (HWS-70°F(21.1°C) Space Heating temperature set point) between 20°F(-6.7°C) and 50°F(10°C) OAT	1, 6, 7, 9, 10, 11, 12
	Boiler type	Fixed	Non-condensing boiler where input thermal efficiency is less than 86%; Condensing boiler otherwise	1, 6, 7, 9, 10, 11, 12
Chilled Water Plant	Chiller Compressor Type	User defined	Screw/Scroll, Centrifugal or Reciprocating	6, 10, 11, 12
	Chiller Condenser Type	User defined	Air cooled or water cooled	6, 10, 11, 12
	Chiller Full Load Efficiency	User defined	Chiller COP	6, 10, 11, 12
	Chilled Water Loop Configuration	User defined	Variable flow primary only, constant flow primary - variable flow secondary, variable flow primary and secondary	6, 10, 11,12
	Chilled Water Primary Pump Power (W/gpm)	User defined	Primary pump input W/gpm chilled water flow	6, 10, 11,12
	Chilled Water Secondary Pump Power (W/gpm)	User defined	Secondary Pump input W/gpm chilled water flow (if primary/secondary)	6, 10, 11,12
	Chilled Water Temperature Reset Included	User defined	Yes/No	6, 10, 11,12
Chilled Water Plant (cont.)	Chilled Water Temperature Reset Schedule (if included)	Fixed	Outdoor air reset: CHW supply temperature of 44°F(6.7°C) at 80°F(26.7°C) outdoor air dry bulb and above, CHW supply temperature of 54°F(12.2°C) at 60°F(15.6°C) outdoor air dry bulb temperature and below, ramped linearly between	6, 10, 11,12
	Condenser Water Pump Power (W/gpm)	User defined	Pump input W/gpm condenser water flow	6, 7, 8, ,10, 11, 12
	Condenser Water Pump Control	User defined	Constant speed or variable speed	6, 7, 8, 10, 11,12
	Heat Rejection Equipment Efficiency	User defined	gpm/hp tower fan	6, 7, 10, 11, 12
	Heat Rejection Fan Control	User defined	Constant or variable speed	6, 7, 10, 11, 12
	Heat Rejection Approach and Range	User defined	Design cooling tower approach and range temperature	6, 7, 10, 11, 12
Heat Pump Loop	Loop flow and Heat Pump Control Valve	Fixed	Two position Valve with VFD on Pump. Loop flow at 3 gpm/ton	7, 8
	Heat Pump Loop minimum and maximum temperature control	User defined	User input: restrict to minimum 20°F(11.1°C) and maximum 40°F(22.2°C) temperature difference	7
GLHP Well Field	-	Fixed	Bore depth = 250 ft(76 m) Bore length 200 ft/ton (1.5 m/kW) for the greater of cooling or heating load Bore spacing = 15 ft(4.6 m) Bore diameter = 5 in (127 mm) ¾" (19 mm)Polyethylene pipe Ground and grout conductivity = 4.8 Btu-in/h-ft2-°F (0.69 W/(mK))	8

a. Part load fan power and pump power modified in accordance with Table C409.6.1.10.2(2)

C409.6.2.2 ~~Blocks~~Thermal blocks. Same as proposed design.

Reason: This proposal is to change the new term "block" to "thermal block" in the definitions and leave the remainder of the definition the same.

The term "block" is already used in the IECC with a lot of different meanings that are different from the one in thisnew definition of block in the current draft. The phrase "thermal block" is already used in C407 on simulations. So, I recommend that "thermal block" continue to be used in C407; and the sections in C407 that inserted the word "block" in this draft use the phrase "thermal block" or some other compound phrase in the next draft.

"Block" is already used in the IECC to mean many different things that are not defined: a concrete masonry unit, a thermal spacer block, something that gets in the way of sunlight, and as "blocking" (a type of framing).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is just a change in the definition for clarity throughout the standard.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal would change the definition of “block” to “thermal block” in the context of energy simulation. This definition change aligns with the use of “thermal block” in C407. A modification is proposed that updates the definition in C409.

Final Hearing Results

CED1-182-22	AM

CED1-185-22

Original Proposal

IECC: SECTION C406, C406.1, TABLE C406.1.2, C406.1.1.1, C406.1.3, C406.1.4, C406.2, TABLE C406.2(1), TABLE 406.2(2), TABLE 406.2(3), TABLE 406.2(4), TABLE 406.2(5), TABLE 406.2(6), TABLE 406.2(7), TABLE 406.2(8), TABLE 406.2(9), C406.2.1.6, C406.2.2, C406.2.2.2, C406.2.2.3, C406.2.2.5, TABLE C406.2.2.5, C406.2.3, C406.2.3.1.1, C406.2.3.1.2, C406.2.3.1.3, C406.2.3.2 (New), C406.2.3.2, C406.2.5.4, C406.2.6.1, TABLE C406.2.6.2(1), C406.3.1, C406.3.6, C406.3.8, C407.2, CF102.1

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov); Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

SECTION C406 ADDITIONAL EFFICIENCY, RENEWABLE, AND LOAD MANAGEMENT REQUIREMENTS. *Staff note: proposed code changes to existing C406 having been removed by CEPI-193-21 are not incorporated into this draft*

Revise as follows:

C406.1 Compliance. *Buildings* shall comply as follows:

1. *Buildings* with greater than 2000 square feet (190 m^2) of floor area shall comply with Section C406.1.1.
2. *Buildings* with greater than 5000 square feet (465 m^2) of *conditioned floor area* shall comply with Sections C406.1.1 and C406.1.2.
3. Build-out construction greater than 1000 square feet (93 m^2) of *conditioned floor area* that does not have final lighting or final HVAC systems installed under a prior building permit shall comply with Section C406.1.3.

Exceptions: Core and shell *buildings* where no less than 20 percent of the*net floor area* is without final lighting or final HVAC that comply with all of the following:

1. *Buildings* with greater than 5000 (465 m) of*conditioned floor* area shall comply with Section C406.1.2.
2. Portions of the *building* where the *net floor area* is without final lighting or final HVAC shall comply with Section C406.1.3
3. Portions of the *building* where the *net floor area* has final lighting and final HVAC systems shall comply with C406.1.1.

TABLE C406.1.2 RENEWABLE AND LOAD MANAGEMENT CREDIT REQUIREMENTS BY BUILDING OCCUPANCY GROUP

Building Occupancy Group	Climate Zone																	
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	64	59	70	69	73	89	72	90	90	63	90	70	51	75	66	48	48 58	50	42
I-2	31	32	33	32	33	36	31	40	34	32	43	32	29	37	33	34	34 33	27	23
R-1	41	40	48	44	48	58	54	61	63	50	61	47	42	55	50	41	41 51	40	32
B	63	64	74	75	78	89	83	90	90	77	90	86	68	90	83	72	72 81	68	58
A-2	12	12	13	13	12	17	13	17	17	12	17	13	12	12	12	12	12	8	7
M	71	70	84	84	90	90	90	90	90	81	90	90	77	90	90	76	76 84	71	58
E	49	55	64	61	69	83	73	90	90	67	90	75	61	86	74	66	66 76	60	47
S-1 and S-2	90	90	90	90	90	90	90	90	90	90	90	90	70	90	90	61	61 85	61	53
All Other	56	55	66	63	69	80	69	87	88	59	86	68	51	72	66	51	51 60	48	40

[Note to staff and reviewers: some of the above revisions are overwritten by proposal 717 which takes precedence]

~~C406.1.1.1~~ C406.1.3 Building Core/Shell and ~~Initial~~ Build-Out Construction. Where separate permits are issued for core and shell buildings and build-outconstruction, compliance shall be in accordance with the following requirements.

1. Core and shell buildings or portions of buildings shall comply with one of the following:
   1.1. Where the permit includes a central HVAC system or service water heating system with chillers, heat pumps, boilers, service water heating equipment, or loop pumping systems with heat rejection, the project shall achieve not less than 50 percent of the energy credits required in Table C406.1.1 in accordance with Section C406.2.

   1.2. Alternatively, the project shall achieve not less than 33 percent of the energy credits required in Table C406.1.1.

2. For core and shell *buildings* or portions of *buildings* the energy credits achieved shall be subject to the following adjustments:
   2.1. Lighting measure credits shall be determined only for areas with final lighting installed.

   2.2. Where HVAC or service water heating systems are designed to serve the entire building, full HVAC or service water heating measure credits shall be achieved.

   2.3. Where HVAC or service water heating systems are designed to serve individual areas, HVAC or service water heating measure credits achievedshall be reduced in proportion to the floor area with final HVAC systems or final service water heating systems installed.

3. Build-out construction shall be deemed to comply with Section C406.1 where either:
   3.1. Where heating and cooling generation are provided by a previously installed central system, the energy credits achieved in accordance with Section C406.2 under the build-out project are not less than 33 percent of the credits required in Table C406.1.1.

   3.2. Where heating and cooling generation are provided by an HVAC system installed in the build out, the energy credits achieved in accordance with Section C406.2 under the build-out project are not less than 50 percent of the credits required in Table C406.1.1

   3.3. Where the core and shell building was approved in accordance with C407 under 2021 IECC or later.

Delete without substitution:

~~**C406.1.3 Substantial Alterations to Existing Buildings.** The *building envelope*, *equipment*, and *systems* in *alterations* to *buildings* exceeding 5000 square feet (46.5 m^2) of *gross conditioned floor area* shall comply with the requirements of Section C406.1.1 and C406.1.2 where the alteration includes replacementof two or more of the following:~~

1. ~~HVAC unitary systems or HVAC central heating or cooling equipment serving the alteration area, not including ductwork or *piping*.~~
2. ~~80% or more of the lighting fixtures in the *alteration* area.~~
3. ~~Building envelope components in the *alteration* area including new exterior cladding, fenestration, or insulation~~.

~~**C406.1.4 Energy Credits Achieved.** Energy credits achieved for the project shall be the sum of measure energy credits for individual measures included in the project.Credits are available for the measures listed in Section C406.2. Base energy credits are shown in Tables C406.1.4(1) through C406.1.4(9) based on building occupancies and climate zones. Measure energy credits achieved shall be determined in one of three ways, depending on the measure:~~

1. ~~The measure energy credit shall be the base energy credit for the measure where no adjustment factor or formula is shown in the measure description in Section C406.2.~~

~~2. The measure energy credit shall be the base energy credit for the measure adjusted by a factor or formula as stated in the measure description in Section C406.2. Where adjustments are applied, each measure energy credit shall be rounded to the nearest whole number.~~

~~3. The measure energy credit shall be by direct formula as stated in the measure description in Section C406.2, where each individual measure credit shall be rounded to the nearest whole number.~~

Revise as follows:

C406.2 Additional Energy Efficiency Credits Achieved. Each energy efficiency credit measure used to meet credit requirements for the project shall have efficiency that is greater than the requirements in Sections C402 through C405. Measures installed in the project that meet the requirements in Sections C406.2.1 through C406.2.7 shall achieve the base credits listed for the measure and occupancy type in Tables C406.2(1) through C406.2(9) or, where calculations required by Sections C406.2.1 through C406.2.7 create or modify the table credits, the credits achieved shall be based upon the calculations. Energy credits achieved for measures shall be determined by one of the following, as applicable:

1. The measure's energy credit shall be the base energy credit from Tables C406.2(1) through C406.2(9) for the measure where no adjustment factor or calculation is included in the description of the measure in Section C406.2.
2. The measure's energy credit shall be the base energy credit for the measure adjusted by a factor or equation as stated in the description of the measure in Section C406.2. Where adjustments are applied, each measure's energy credit shall be rounded to the nearest whole number.
3. The measure's energy credit shall be calculation as stated in the measure~~s~~ description in Section C406.2, where each individual measure credit shall be rounded to the nearest whole number.

Energy credits achieved for the project shall be the sum of the individual measure’s energy credits. Credits are available for the measures listed in this Section. Where a project contains multiple building occupancy groups:

1. Credits achieved for each occupancy group shall be summed and then weighted by the floor area of each occupancy group to determine the weighted average project energy credits achieved.
2. ~~Credits for improved~~ Improved envelope efficiency (E01 through E06) and lighting reduction (L06) measure credits shall be determined for the building or permitted floor area as a whole. Credits for other measures shall be determined for each occupancy separately. Credits shall be taken from applicable tables or calculations for each occupancy and weighted by the building occupancy group floor area.

TABLE C406.2(1) BASE ENERGY CREDITS FOR GROUP R-2, R-4, AND I-1 OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E03	Envelope leakage reductionReduced air leakage	C406.2.1.3	15	10	12	8	6	16	13	5	1	7	7	9	65	16	~~1~~ 11	73	43	52	26
E04	Add Roof Insulation	C406.2.1.4	1	1	1	1	1	1	4	3	1	5	3	4	6	5	~~1~~ 4	7	7	6	8
E05	Add Wall Insulation	C406.2.1.5	10	10	6	8	5	6	8	4	1	8	3	4	11	7	~~1~~ 3	14	12	13	13

a. "x" indicates credit is not available for that measure.

[Note to reviewers and staff: Other proposals may update credits for E02 and W09 in all tables and take precedence]

TABLE 406.2(2) BASE ENERGY CREDITS FOR GROUP I-2 OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E03	Envelope leakage reductionReduced air leakage	C406.2.1.3	5	3	4	3	5	8	8	3	2	6	2	2	7	3	1	9	7	19	5

a. "x" indicates credit is not available for that measure.

TABLE 406.2(3) BASE ENERGY CREDITS FOR GROUP R-1 OCCUPANICES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E03	Envelope leakage reductionReduced air leakage	C406.2.1.3	~~5~~	~~3~~	~~4~~	~~2~~	~~2~~	~~2~~	~~5~~	~~1~~	~~1~~	~~8~~	~~1~~	~~2~~	13	~~4~~	1	18	~~9~~	18	~~7~~
E03	Envelope leakage reductionReduced air leakage	C406.2.1.3	15	9	12	8	6	16	7	5	10	14	3	1	19	5	1	28	16	28	18
E04	Add Roof Insulation	C406.2.1.4	~~2~~	~~2~~	~~2~~	2	2	~~2~~	~~3~~	~~2~~	1	~~3~~	1	2	~~3~~	~~2~~	2	3	~~3~~	2	3
E04	Add Roof Insulation	C406.2.1.4	1	1	1	2	2	1	2	1	1	2	1	2	2	1	2	3	**2**	**2**	**3**
E05	Add Wall Insulation	C406.2.1.5	13	14	~~8~~	11	~~4~~	4	~~7~~	~~4~~	~~1~~	~~5~~	2	4	~~6~~	4	~~3~~	~~9~~	~~7~~	10	~~8~~
E05	Add Wall Insulation	C406.2.1.5	18	26	11	25	3	4	5	3	1	6	2	4	7	4	4	8	6	8	5
E06	Improve Fenestration	C406.2.1.6	~~5~~	~~5~~	~~4~~	~~5~~	~~7~~	~~7~~	~~8~~	~~2~~	1	~~8~~	~~2~~	4	10	~~5~~	~~1~~	21	17	10	~~9~~
E06	Improve Fenestration	C406.2.1.6	2	2	1	2	2	3	5	3	1	6	3	4	9	7	6	13	8	6	6

a. "x" indicates credit is not available for that measure.

[Note to reviewers and staff: replacements shown in separate rows for clarity; repeated cell values do not change unless struckout and underlined - typical for several tables]

TABLE 406.2(4) BASE ENERGY CREDITS FOR GROUP B OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E02	UA reduction (15%)	C406.2.1.2	4	7	4	7	3	4	7	2	~~0~~ 1	7	2	3	10	6	4	12	9	19	11
E03	Envelope leakage reductionReduced air leakage	C406.2.1.3	5	3	4	2	2	2	5	1	~~0~~ x	8	~~0~~ x	2	13	4	~~0~~ x	18	9	18	7

a. "x" indicates measure is not available for building occupancy in that climate zone.

TABLE 406.2(5) BASE ENERGY CREDITS FOR GROUP A-2 OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E03	Envelope leakage reductionReduced air leakage	C406.2.1.3	2	1	1	1	2	3	11	2	1	24	4	6	33	9	3	42	29	36	16
E04	Add Roof Insulation	C406.2.1.4	1	1	~~0~~ x	1	1	1	2	1	1	1	1	1	2	2	1	2	2	1	2
E05	Add Wall Insulation	C406.2.1.5	1	1	~~0~~ x	1	1	2	3	3	1	2	1	1	2	2	2	2	2	2	2

L02	Lighting dimming & tuning	C406.2.5.2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1	1	1	~~0~~ x
L03	Increase occp. sensor	C406.2.5.3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	~~0~~ x

a. "x" indicates measure is not available for that measure.

TABLE 406.2(6) BASE ENERGY CREDITS FOR GROUP M OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E03	Envelope leakage reductionReduced air leakage	C406.2.1.3	3	3	2	2	3	3	19	3	1	44	6	11	56	13	6	64	44	43	19
W05	Point of Use Water Heaters	C406.2.3.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

a. "x" indicates credit is not available for that measure.

TABLE 406.2(7) BASE ENERGY CREDITS FOR GROUP E OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E03	Envelope leakage reductionReduced air leakage	C406.2.1.3	4	3	3	3	2	5	2	1	1	1	1	1	1	1	1	2	1	1	1
E06	Improve Fenestration	C406.2.1.6	8	10	6	9	11	11	15	9	1	16	8	15	22	18	19	33	~~9~~ 29	19	18

a. "x" indicates measure is not available for that measure.

TABLE 406.2(8) BASE ENERGY CREDITS FOR GROUP S-1 AND S-2 OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E03	Envelope leakage reductionReduced air leakage	C406.2.1.3	2	2	1	2	1	3	31	3	1	77	14	17	92	25	8	95	71	69	26

a. "x" indicates measure is not available for building occupancy in that climate zone.

TABLE 406.2(9) BASE ENERGY CREDITS FOR OTHER OCCUPANCIES[a,b]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
H05	DOAS/fan control	C406.2.2.5	~~7~~ 37	36	31	34	30	28	43	32	23	61	42	49	75	61	49	90	77	93	90
W08	SHW submeters	C406.2.3.4	11	11	13	13	15	16	18	18	22	19	20	22	19	20	24	17	20	18	18
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	29	30	36	35	41	43	48	48	56	50	53	59	51	54	62	47	52	49	48
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

a. "x" indicates measure is not available for that measure.

b. Other occupancy groups include all Groups except for Groups A-2, B, E, I, M, and R.

C406.2.1.6 E06 Improve fenestration. Energy credits ~~for one selected fenestration energy credit ID~~ shall be achieved for improved energy characteristics of all vertical fenestration in the project meeting the requirements in ~~one of the rows of~~ Table C406.2.1.6. The area-weighted average U-factor and SHGC of all vertical fenestration shall be equal to or less than the value shown in the ~~selected~~ table ~~row~~. The area-weighted average visible transmittance (VT) of allvertical fenestration shall be equal to or greater than the value shown in the ~~selected~~ table ~~row~~.

C406.2.2 More Efficient HVAC Equipment Performance. All heating and cooling systems shall meet the minimum requirements of Section C403 and efficiency improvements shall be referenced to minimum efficiencies listed in Tables referenced by Section C403.3.2. Where multiple efficiency requirements are listed, equipment shall meet the seasonal or part-load efficiencies including SEER, ~~EER/~~ integrated energy efficiency ratio (IEER), integrated part load value (IPLV), or AFUE. Equipment that is larger than the maximum capacity range indicated in Tables referenced by Section C403.3.2 shall utilize the values listed for the largest capacity equipment for the associated equipment type shown in the table. Where multiple individual heating or cooling systems serve the project, the improvement shall be the weighted average improvement based on individual system capacity. Systems are permitted to achieve HVAC energy credits by meeting the requirements of either:

1. C406.2.2.1 H01
2. C406.2.2.2 H02
3. C406.2.2.3 H03
4. C406.2.2.4 H04
5. C406.2.2.5 H05
6. Any combination of H02, H03, H04 and H05
7. The combination of H01 and H04

C406.2.2.2 H02 More efficient HVAC equipment heating performance. No less than 90 percent of the total HVAC capacity serving the total *conditioned floor area* of the entire ~~building~~ *building*, or tenant space in accordance with Section C406.1.1, shall comply with the requirements of this Section.

1. Equipment installed shall be types that ~~are~~ have their efficiency listed in Tables referenced by Section C403.3.2. Electric resistance heating capacity shall be limited to 20 percent of system capacity, with the exception of heat pump supplemental heating.
2. Equipment shall exceed the minimum heating efficiency requirements listed in Tables referenced by Section C403.3.2 by at least 5 percent. Where equipment exceeds the minimum annual heating efficiency requirements by more than 5 percent, energy efficiency credits for heating shall be determined using Equation 4-18 rounded to the nearest whole number.

(Equation 4-18)

$$EEC_{HEH} = EEC_{H5} \times (HEI / 0.05)$$

where: EEC_{HEH} = energy efficiency credits for heating efficiency improvement
EEC_{H5} = C406.2.2.2 credits from Tables C406.2(1) through C406.2(9)
HEI = the lesser of: the improvement (as a fraction) above minimum heating efficiency requirements, or 20 percent(0.20). Where heating equipment with different minimum efficiencies are included in the ~~building~~ *building*, a heating capacity weighted average improvement shall be used. Where electric resistance primary heating or reheat is included in the ~~building~~ *building* it shall be included in the weighted average improvement with an HEI of 0. Supplemental gas and electric heat for heat pump systems shall be excluded from the weighted HEI. For heat pumps rated at multiple ambient temperatures, the efficiency at 47ºF (8.3ºC) shall be used.

For metrics that increase as efficiency increases, HEI shall be calculated as follows:
$HEI = (HM_{DES}/HM_{MIN})-1$
Where:
HM_{DES}= Design heating efficiency metric, part-load or annualized where available
HM_{MIN}= Minimum required heating efficiency metric, part-load or annualized where available from Section C403.3.2

Exception: In low energy spaces complying with Section C402.1.1, no less than 90 percent of the installed heating capacity is provided by electric infrared or gas-fired radiant heating equipment for localized heating applications. Such spaces shall only achieve base energy credits for EEC_{H5}.

C406.2.2.3 H03 More efficient HVAC cooling equipment ~~cooling~~ and fan performance. No less than 90 percent of the total HVAC cooling capacity serving the total conditioned floor area of the entire building or tenant space in accordance with Section C406.1.1, shall comply with all of the requirements of this section.

1. Equipment installed shall be types that are listed in Tables referenced by Section C403.3.2.
2. Equipment shall exceed the minimum cooling efficiency requirements listed in Tables referenced by Section C403.3.2 by at least 5 percent. For water-cooled chiller plants, heat rejection equipment ~~efficiency~~ performance in Table C403.3.2(7) shall also be increased by at least the chiller efficiency improvement. Where equipment exceeds both the minimum annual cooling efficiency and heat rejection efficiency requirements by more than 5 percent, energy efficiency credits for cooling shall be determined using Equation 4-19, rounded to the nearest whole number.

Where fan energy is not included in packaged equipment rating or it is and the fan size has been increased from the as-rated equipment condition, fanpower or horsepower shall be less than 95 percent of the allowed fan power in Section C403.8.1.

(Equation 4-19)

$$EEC_{HEC} = EEC_5 \times (CEI /0.05)$$

where: EEC_{HEC}= energy efficiency credits for cooling efficiency improvement
EEC_5= the lesser of: the improvement above minimum cooling efficiency and heat rejection ~~efficiency~~ performance requirements expressed as a fraction, or 0.20 (20percent). Where cooling equipment with different minimum efficiencies are included in the ~~building~~ *building*, a cooling capacity weighted average improvement shall be used. Where multiple cooling efficiency or performance requirements are provided, the equipment shall exceed the annualized energy or part-load requirement. Meeting both part-load and full-load efficiencies is not required.
For metrics that increase as efficiency increases, CEI shall be calculated as follows:
$CEI = (CM_{DES}/CM_{MIN}) - 1$
For metrics that decrease as efficiency increases, CEI shall be calculated as follows:
$CEI = (CM_{MIN}/CM_{DES}) - 1$
Where:
CM_{DES}= Design cooling efficiency metric, part-load or annualized where available
CM_{MIN}= Minimum required cooling efficiency metric, part-load or annualized where available from Section C403.3.2
For Data Centers using ASHRAE Standard 90.4, CEI shall be calculated as follows:
$CEI = (AMLC_{MAX} / AMLC_{DES}) - 1$
Where:
$AMLC_{DES}$= As-Designed Annualized Mechanical Load Component calculated in accordance with ASHRAE Standard 90.4, Section 6.5
$AMLC_{MAX}$= Maximum Annualized Mechanical Load Component from ASHRAE Standard 90.4, Table 6.5

C406.2.2.5 H05 Dedicated Outdoor Air System. Credits for this measure are only allowed where single zone HVAC units are not required to have multi-speed or variable-speed fan control in accordance with Section C403.8.6.1. HVAC controls and ventilation systems shall include all of the following:

1. Zone controls shall cycle the heating/cooling unit fans off when not providing required heating and cooling or shall limit fan power to 0.12 watts/cfm of zone outdoor air.

2. Outdoor air shall be supplied by an independent ventilation system designed to provide no more than 110 percent of the minimum outdoor air to each individual occupied zone, as specified by the *International Mechanical Code*.
3. The ventilation system shall have energy recovery with an*enthalpy recovery ratio* of 65 percent or more at heating design conditions in climate zones 3 through 8 and an *enthalpy recovery ratio* of 65 percent or more at cooling design conditions in climate zones 0, 1, 2, 3A, 3B, 4A, 4B, 5A, and 6A. In"A" climate zones, energy recovery shall include latent recovery. Where no humidification is provided, heating energy recovery effectiveness is permitted to be based on sensible *energy recovery ratio*. Where energy recovery effectiveness is less than the 65 percent required for full credit, adjust the credits from Section C406.2 by the factors in Table C406.2.2.5.
4. Where the ventilation system serves multiple zones and the system is not in a latent recovery outside air dehumidification mode. partial economizer cooling through an outdoor air bypass or wheel speed control shall automatically do one of the following:
    4.1. Set the energy recovery leaving-air temperature 55°F (13°C) or 100 percent outdoor air bypass when a majority of zones require cooling and outdoor air temperature is below 70°F (21°C).
    4.2. The HVAC ventilation system shall include supply-air temperature controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperatures. The controls shall reset the supply-air temperature not less than 25 percent of the difference between the design supply-air temperature and the design room-air temperature.
5. Ventilation systems providing mechanical dehumidifi cation shall use recovered energy for reheat within the limits of item 4. This shall not limit the use of latent energy recovery for dehumidification.

Where only a portion of the building is permitted to be served by constant air volume units or theenthalpy recovery ratio or sensible *energy recovery ratio* is less than 65 percent, the base energy credits shown in Section C406.2 shall be prorated as follows:

(Equation 4-20)

$$EC_{DOAS} = EC_{BASE} \times FLOOR_{CAV} \times ERE_{ADJ}$$

where:EC_{DOAS}= Energy credits achieved for H05 ~~H06~~
EC_{base}= ~~H06~~ H06 base energy credits in Section C406.2
$FLOOR_{CAV}$= Fraction of whole project gross conditioned fl oor area not required to have variable speed or multi-speed fan airflow control in accordance with Section C403.8.6.
ERE_{adj}= The energy recovery adjustment from Table C406.2.2.5 based on the lower of actual cooling or heating*enthalpy recovery ratio* or *sensible energy recovery ratio* where required for the climate zone. Where recovery ratios vary, use a weighted average by supply airflow.

TABLE C406.2.2.5 DOAS Energy Recovery Adjustments

ERE_{adj} based on lower of actual heating or cooling energy recovery effectiveness where required		
Cooling ERR is ≥ at least	Heating enthalpy recovery ratio or sensible energy recovery ratio is ≥ at least	Energy Recovery Effectiveness Adjustment (ERE_{adj})
65%	65%	1.00
60%	60%	0.67
55%	55%[a]	0.33
50%	50%[a]	0.25

a. In climate zones where heating recovery is required in Section C403 ~~for this measure~~, for dwelling units a heating recovery effectiveness below 60 percent is not allowed.

C406.2.3 Reduced Energy Use In-service Water Heating. Projects with service water-heating equipment that serves the whole building, a building addition or a tenant space shall achieve credits through compliance with the requirements of this section. Systems are permitted to achieve energy credits by meeting the requirements of either:

1. C406.2.3.1 by selecting one allowed measure W01, W02, ~~or~~ W03 , or a combination in accordance with Section C406.2.3.1.4
2. C406.2.3.2 W04
3. C406.2.3.3 by selecting one allowed measure W05, W06, or W07
4. C406.2.3.4 W08
5. C406.2.3.5 W09
6. C406.2.3.6 W10
7. Any combination of measures in C402.2.3.1 through C402.2.3.6 as long no more than one allowed measure from C406.2.3.1 and C406.2.3.3 are selected.

C406.2.3.1.1 W01 Recovered or renewable water heating. The *building* service water-heating system shall have one or more of the following that are sized to provide not less than 30 percent of the *building's* annual hot water requirements, or sized to provide not less than 70 percent of the *building's* annual hot water requirements if the *building* is required to comply with Section C403.10.5:

1. Waste heat recovery from SHW, heat recovery chillers, *building* equipment, or process equipment.
2. A water-to-water heat pump that precools chilled water return for *building* cooling while heating SHW.
3. On-site renewable energy water-heating systems.

C406.2.3.1.2 W02 Heat pump water heater. Air-source heat pump water heaters shall be installed according to manufacturer's instructions and at least 30 percent of design end use service water heating requirements shall be met using only heat pump heating at an ambient condition of 67.5 F, db without supplemental electric resistance or fossil fuel heating. For a heat pump water heater with supplemental electric resistance heating, the heat pump only capacity shall be deemed at 40 percent of first hour draw. Where the heat pump only capacity exceeds 50 percent of the design end use load excluding recirculating system losses, the credits from the Section C406.2 tables shall be prorated as follows:

$$EC_{HPWH} = (EC_{BASE}/0.5) \times \{(CAP_{HPWH})/(ENDLOAD)\ [\text{not greater than } 2]\} \quad \textbf{(Equation 4-21)}$$

where: EC_{HPWH} = Energy credits achieved for W02

EC_{BASE} = W02 base energy credits from Tables C406.2(1) through C406.2(9) ~~Section 13.5.3~~

ENDLOAD = End use peak hot water load, excluding load for heat trace or recirculation, Btu/hr or kW

CAP_{HPWH} = the heat pump only capacity at 50ºF (10ºC) entering air and 70ºF (21ºC) entering potable water without supplemental electric resistance or fossil fuel heat, Btu/hr or kW

The heat pump service water heating system shall comply with the following requirements:

1. For systems with an installed total output capacity of more than 100,000 Btu/hr (30 kW) at an ambient condition of 67.5ºF (19.7ºC), db a preheat storage tank with greater than or equal 0.75 gallons per 1000 Btu/hr (≥9.7 L/kW) of design end use service water heating requirements shall be heated only with heat pump heating when the ambient temperature is greater than 45ºF (7.2ºC).
2. For systems with piping temperature maintenance, either a heat trace system or a separate water heater in series for recirculating system and final heating shall be installed.
3. Heat pump water heater efficiency shall meet or exceed one of the following:
   3.1. Output-capacity-weighted-average UEF of 3.0 in accordance with 10 CFR 430 Appendix E.
   3.2. Output-capacity-weighted-average COP of not less than 4.0 tested at 50ºF (10ºC) entering air and 70ºF (21ºC) entering potable water in accordance with AHRI standard 1300.

Where the heat pump capacity at 50°F (10°C) entering air and 70°F (21°C) entering water exceeds 50 percent of the design end-use load excluding recirculating system losses, the base credits from Section C406.2 shall be prorated based on Equation 4-20.

$$\underline{\text{W02 credit = base W02 table credit x } (HP_{LF}/50\%)}$$ **(Equation 4-22)**

HP_{LF} = Heat pump capacity as a fraction of the design end-use SHW requirements excluding recirculating system losses, not to exceed 80 percent.

C406.2.3.1.3 W03 Efficient fossil fuel water heater. The combined input-capacity-weighted-average equipment rating of all gas water-heating equipment in the *building* shall be not less than 95 percent Et or 0.93 UEF. ~~This measure shall receive only thirty percent of the listed energy credits for *buildings* required to comply with C404.2.1. Projects where the installed *building* service water heating capacity is less than 200,000 Btu/hr (59 kW) and weighted UEF is not less than 0.82 shall achieve 25 percent of the base table W03 credit.~~ Adjustments shall apply as follows:

1. Where the service water heating system is required to comply with Section C404.2.1, this measure shall achieve 30 percent of the listed base W03 energy credits in Tables C406.2(1) through C406.2(9)
2. Where the installed *building* service water heating capacity is less than 200,000 Btu/hr (59 kW) and weighted UEF is less than 0.93 UEF and not less than 0.82 this measure shall achieve 25 percent of the base W03 credit in Tables C406.2(1) through C406.2(9)

Add new text as follows:

C406.2.3.2 W04: Service Hot Water Piping Insulation Increase. . Where service hot water is provided by a central water heating system, the hot water pipe insulation thickness shall be at least 1.5 times the thickness required in Section C404.4. All service hot water piping shall be insulated from the hot water source to the fixture shutoff. Where no more than 50 percent of hot water piping does not have increased insulation due to installation in partitions, the credit shall be prorated as a percentage of lineal feet of piping with increased insulation. ***[Note to reviewers and staff: this text is just relocated to a separate section from "Water heating distribution temperature maintenance" Renumber following sections as needed. Section numbers in tables already match new numbering]***

Revise as follows:

C406.2.3.3 ~~**C406.2.3.2**~~ **Water-heating distribution temperature maintenance.** A project is allowed to claim energy credits from only one of the following SHW distribution temperature maintenance measures.

~~1.~~ ~~**W04: Service Hot Water Piping Insulation Increase.** Where service hot water is provided by a central water heating system, the hot water pipe insulation thickness shall be at least 1.5 times the thickness required in Section C404.4. All service hot water piping shall be insulated from the hotwater source to the fixture shutoff. Where no more than 50 percent of hot water piping does not have increased insulation due to installation in partitions, the credit shall be prorated as a percentage of lineal feet of piping with increased insulation.~~

~~2~~ 1. **W05 Point of use water heaters.** Credits are available for ~~office or school buildings~~ Group B or E *buildings* larger than 10,000 ft^2 (930 m^2). Fixtures requiring hot water shall be supplied from a localized source of hot water with no recirculating system or heat trace piping. Supply piping from the water heater to the termination of the fixture supply pipe shall be insulated to the levels shown in Table C403.12.3 without exception. The volume in piping from the water heater to the termination of the fixture supply pipe shall be limited as follows:

~~2.1~~ 1.1. Non-residential lavatories: not more than 2 oz (60 mL)

~~2.2~~ 1.2. All other plumbing fixtures or appliances: not more than 0.25 gallons (0.95 L)

Exception: Where all remotely located hot water uses meet the requirements for measure W05, separate water heaters serving commercial kitchens or showers in locker rooms shall be permitted to have a local recirculating system or heat trace piping.

~~3~~ 2. **W06 Thermostatic balancing valves.** Credits are available where service water heating is provided centrally and distributed throughout the ~~building~~ *building* with a recirculating system. Each recirculating system branch return connection to the main SHW supply piping shall have an automatic thermostatic balancing valve set to a minimal return water flow when the branch return temperature is greater than 120°F (49°C) ~~115°F (46°C)~~.

4 3. **W07 Heat trace system.** Credits are available for projects with gross floor area greater than 10,000 square feet (930 m^2) and a central water-heating system. The energy credits achieved shall be from Tables C406.1.2(1) through C406.1.2(9). This system shall include self-regulating electric heat cables, connection kits, and electronic controls. The cable shall be installed directly on the hot water supply pipes underneath the insulation to replace standby losses.

[Renumber following water heating measures and tables as required]

C406.2.5.4 L04 Increase daylight area. The total daylight area of the project (DLA_{BLDG}) with continuous daylight dimming meeting the requirements of C405.2.4 shall be at least 5 percent greater than the typical daylit area (DLA_{TYP}).Credits for measure L04 shall be determined based on Equation 4-24:

(Equation 4-24)

$$EC_{DL} = EC_{DL5} \times 20 \times [(DLA_{BLDG}/GLFA) - DLA_{TYP}]$$

where:EC_{DL}= achieved L04 energy creditsECDL5= C406.2.5.4 L04 base energy credits from Section C406.2DLA_{BLDG} = The lesser of:

1. actual area of *daylight zones* in the *building* with continuous daylight dimming, ft^2 or m^2 ~~and~~
2. (GLFA x DLA_{max}) see TableC406.2.5.4.

Daylight zones shall meet the criteria in Sections C405.2.4.2 and C405.2.4.3 for primary sidelit *daylight zones*, secondary sidelit *daylight zones*, and toplit *daylight zones*.
GLFA = Project gross lighted fl oor area, f^2t or m^2
DLATYP= Typical ~~%~~ percentage of *building* area with daylight control (as a fraction) from Table C406.2.5.4:-
~~ECDL5= C406.2.5.4 L04 base energy credits from Section C406.2~~

C406.2.6.1 Q01 Efficient Elevator Equipment. Qualifying elevators in the building shall be Energy efficiency class A per ISO 25745-2, Table 7. Only buildings 3 or more floors above grade may use this credit. Credits shall be prorated based on Equation 4-26, rounded to the nearest whole credit. Projects with acompliance ratio below 0.5 do not qualify for this credit.

$$EC_e = EC_t \times CR_e$$

(Equation 4-26)

where:EC_e= Elevator energy credit achieved for the *building*
EC_t= C406.2.7.1 Table energy credit
CR_e= Compliance Ratio = (F_A/ F_B)
F_A= Sum of floors served by class A elevators
F_B= Sum of floors served by all *building* elevators and escalators

TABLE C406.2.6.2(1) Minimum Efficiency Requirements: Commercial Fryers

	Heavy-Load Cooking Energy Efficiency	Idle Energy Rate	Test Procedure
Standard Open Deep-Fat Gas Fryers	≥ 50%	≤ 9,000 Btu/hr (≤ 2,600 watts)	ASTM F1361
Standard Open Deep-Fat Electric Fryers	≥ 83%	≤ 800 watts	
Large Vat Open Deep-Fat Gas Fryers	≥ 50%	≤ 12,000 Btu/hr (≤ 3,500 watts)	ASTM F2144
Large Vat Open Deep-Fat Electric Fryers	≥ 80%	≤ 1,100 watts	

~~For SI: BTU/h = 0.293W~~

C406.3.1 R01 Renewable Energy. Projects installing on-site renewable energy systems with a capacity of at least 0.1 watts per gross square foot (1.08W/m2) of building area or securing off-site renewable energy shall achieve energy credits for this measure calculated as follows:

(Equation 4-28)

$$EC_R = EC_{0.1} \times (R_t + R_{off} - R_{ex}) / (0.1 \times PGFA)$$

where: EC_R= C406.3.1 R01 energy credits achieved for this project

~~R_t= Actual total rating of on-site renewable energy systems (W)~~

~~PGFA = Project gross fl oor area, ft^2~~

$EC_{0.1}$= C406.3.1 R01 base credits from Tables C406.3(1) through C406.3(9)

R_t= Actual total rating of on-site renewable energy systems (W)

R_{OFF}= Actual total equivalent rating of off-site renewable energy contracts (W), calculated as follows:

> R_{OFF}= TRE/(REN X 20)
>
> where:
>
> TRE = Total off-site renewable electrical energy in kilowatt-hours (kWh) that is procured in accordance with Sections C405.13.2.1 through C405.13.4
>
> REN = Annual off-site renewable electrical energy from Table C405.13.2, in units of kilowatt-hours per watt of array capacity

R_{ex}= Rating (W) of renewable energy resources capacity excluded from credit calculated as follows:

> R_{ex}= RR_r+ RR_x+ RR_c
>
> where:
>
> RR_r= Rating of on-site renewable energy systems required by Section C405.13.1, without exception (W).
>
> RR_x= Rating of renewable energy resources used to meet any exceptions of this code (W).
>
> RR_c= Rating of renewable energy resources used to achieve other energy credits in Section C406 (W).

PGFA = Project gross floor area, ft^2

> Where renewable requirements, exceptions, or credits are expressed in annual kWh or Btu rather than Watts of output capacity, they shall be converted as 3413 Btu = 1 kWh and converted to W equivalent capacity as follows:
>
> RR_w= Actual total equivalent rating of renewable energy capacity (W), calculated as follows:
>
> RR_w= TRE_x/ (REN × PGFA)
>
> where:
>
> TRE_x= Total renewable energy in kilowatt-hours (kWh) that is excluded from R01 energy credits

C406.3.6 G05 Cooling Energy Storage. Automatic load management controls shall be capable of activating ice or chilled water storage equipment to reduced demand during summer peak periods. Storage tank standby loss shall be demonstrated through analysis to be no more than 2 percent of storage capacity over a 24 hour period for the cooling design day.Base credits in Section C406.3 are based on storage capacity of the design peak hour cooling load with a 1.15 sizing factor. Credits shall be prorated for installed storage systems sized between 0.5 and 4.0 times the design day peak hour cooling load, rounded to the nearest whole credit. Larger storage shall be permitted but the associated credits are limited to the range above. Energy credits shall be determined as follows:

(Equation 4-31)

$$ECs = EC1.0 \times (1.44 \times SR + 0.71) / 2.15$$

[Note: Change EC1.0 to $EC_{1.0}$ with subscript in formula]

where:

ECs = Cooling Storage credit achieved for Project

$EC_{1.0}$ = G05 base energy credit for building use type and climate zone based on 1.0 ton-hours storage per design day ton (kWh/kW) of cooling load

SR = Storage ratio in ton-hours storage per design day ton (kWh/kW) of cooling load where 0.5 ≤ SR ≤ 4.0

C406.3.8 G07 Building Thermal Mass. The project shall have additional passive interior mass and a night flush control of the HVAC system. The credit is available to projects that have at least 80 percent of gross floor area unoccupied between midnight and 6:00 a.m. The project shall meet the following requirements:

1. Interior to the *building envelope* insulation, provide 10 lb/ft(50 kg/m) of project conditioned floor area of passive thermal mass in the *building interior wall*, the inside of the *exterior wall*, or interior floor construction. Mass *construction* shall have mass surfaces directly contacting the air in *conditioned spaces* with directly attached gypsum panels allowed. Mass with carpet or furred gypsum panels or *exterior wall* mass that is on the exterior of the insulation layer (e.g., the portion of CMU block on the exterior of insulation filled cell cavities) shall not be included toward the *building* mass required.
2. HVAC units for 80 percent or more of the supply airflow in the project shall be equipped with outdoor air economizers and fans that have variable or low speed capable of operating at 66 percent or lower airflow and be included in the night flush *control* sequence.
3. Night flush controls shall be configured with the following sequence or another night flush strategy shall be permitted where demonstrated to be effective, avoids added morning heating, and is approved by the *authority having jurisdiction*.
   - 3.1. Summer mode shall be activated when outdoor air temperature exceeds 70ºF (21ºC) and shall continue uninterrupted until deactivated when outdoor air temperature falls below 45ºF (7ºC). During summer mode, the occupied cooling *set point* shall be set 1ºF (0.6ºC) higher than normal and the occupied heating *set point* shall be reset 2ºF (1.1ºC) lower than normal.
   - 3.2. When all the following conditions exist, night flush shall be activated:
     - 3.2.1. Summer mode is active in accordance with item 3.1.
     - 3.2.2. Outdoor air temperature is 5ºF (2.8ºC) or more below indoor average zone temperature.
     - 3.2.3. Indoor average zone temperature is greater than morning occupied heating *set point*.
     - 3.2.4. In climate zones 0A, 1A, 2A, and ~~through~~ 3A, outdoor dewpoint is below 50ºF (10ºC) or outdoor air enthalpy is less than indoor air enthalpy.
     - 3.2.5. Local time is between 10:00 pm and 6:00 am.
   - 3.3. When night flush is active, *automatic* night flush controls shall operate outdoor air *economizers* at low fan speed not exceeding 66 percent during the unoccupied period with *mechanical cooling* and heating locked out.

C407.2 Mandatory requirements. Compliance based on total building performance requires that a proposed design meet all of the following:

1. The requirements of the sections indicated within Table C407.2(1).
2. An annual energy cost that is less than or equal to the percent of the annual energy cost (PAEC) of the *standard reference design* calculated in Equation 4-32. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's *State Energy Data System Prices and Expenditures* reports. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

Exceptions:

1. Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.
2. Where energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area is substituted for the energy cost, the energy use shall be calculated using source energy factors from Table C407.2(2) For electricity, U.S. locations shall use values eGRID subregions. Locations outside the United States shall use the value for "All other electricity" or locally derived values.

PAEC = 100 x (0.80 ~~0.85~~ + 0.025 - ECr/1000 **(Equation 4-32)**
where: PAEC = Percentage of annual energy cost applied to standard reference design

EC_r= Energy efficiency credits required for the building in accordance with Section C406.1 (do not include load management and renewable credits)

CF102.1 Advanced Energy Credit Package requirements. The requirements of this Section ~~supercede~~ supersede the requirements of Section C406.1.1. Projects shall comply with measures from C406.2 to achieve the minimum number of required efficiency credits from Table CD102.1 based on building occupancy group and climate zone. Projects with multiple occupancies, unconditioned parking garages, ~~*alterations*,~~ and *buildings* with separate shell-and-core and build-out construction permits shall comply as follows:Where a project contains multiple occupancies, credits in Table CD102.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406 and Appendix CD.

Exceptions:

1. Unconditioned parking garages that achieve 50 percent of the credits required for use groups S-1 and S-2 in Table CD102.1.
2. Portions of buildings devoted to manufacturing or industrial use.

Reason: This public comment reconciles the as voted document from Subcommittee as modified and voted by the consensus committee from May 12, 2022. The changes are editorial in nature. A few additional editorial changes were made:

- E06 fenestration language was clarified
- H03 heat rejection efficiency changed to performance to match C403 table.
- H05 reference to allowed heating systems clarified
- C406.2.3 clarified that combinations are allowed per C406.2.3.1.4
- W03 adjustment language clarified
- W04, SHW piping insulation separated from distribution temperature maintenance measure group
- Equation variable subscripts clarified and variables reordered to match equation order
- Other minor editorial changes
- Where an "x" was provided in intermediate climate zones due to rounding down a partial credit, it was updated to 1 credit

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal is editorial only.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal provides an editorial update to Section C406. Tables 406.2(4) and 406.2(5) have been modified by inserting an “x” to indicate that ECM credits are not available in certain climate zones. Envelope Subcommittee:
Agree with Modeling SC comments, and agree with envelope parts of the proposal. However, terminology regarding air leakage credit should be made consistent, and avoid any confusion between air leakage and water leakage.

ENVELOPE ADDITIONAL MOD: change “~~Envelope leakage reduction~~ Reduced air leakage” in Tables C406.2(1) through C406.2(9) to match the title of the E03 credit in C406.2.1.3.

Final Hearing Results

CED1-185-22 AM

CED1-187-22

Original Proposal

IECC: C406.1.1, C406.1, C406.2

Proponents: Jack Bailey, ONE LUX STUDIO, INTERNATIONAL ASSOCIATION OF LIGHTING DESIGNERS (jbailey@oneluxstudio.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C406.1.1 Additional energy efficiency credit requirements. *Buildings* shall comply with measures from C406.2 to achieve not less than the number of required efficiency credits from Table C406.1.1 based on building occupancy group and climate zone.Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the gross <u>*conditioned*</u> *floor area* to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of SectionC406.

~~**Exceptions**~~<u>**Exception**</u>**:**

~~1. Unconditioned parking garages that achieve 50% of the credits required for use groups S-1 and S-2 in Table C406.1.1~~.

~~2.~~ Portions of buildings devoted to manufacturing or industrial use.

C406.1 Compliance. Buildings shall comply as follows:

1. *Buildings* with greater than 2000 square feet (190 m) of<u>*conditioned*</u> *floor area* shall comply with Section C406.1.1.
2. *Buildings* with greater than 5000 square feet (465 m) of*conditioned floor area* shall comply with Sections C406.1.1 and C406.1.2.
3. Build-out construction greater than 1000 square feet (93 m) of*conditioned floor area* that does not have final lighting or final HVAC systems installed under a prior building permit shall comply with Section C406.1.3.

Exceptions: Core and shell *buildings* where no less than 20 percent of the*net floor area* is without final lighting or final HVAC that comply with all of thefollowing:

1. *Buildings* with greater than 5000 (465 m) of*conditioned floor* area shall comply with Section C406.1.2.
2. Portions of the *building* where the *net floor area* is without final lighting or final HVAC shall comply with Section C406.1.3
3. Portions of the *building* where the *net floor area* has final lighting and final HVAC systems shall comply with C406.1.1.

C406.2 Additional Energy Efficiency Credits Achieved. Each energy effi ciency credit measure used to meet credit requirements for the project shall have efficiency that is greater than the requirements in Sections C402 through C405. Measures installed in the project that meet the requirements in Sections C406.2.1 through C406.2.7 shall achieve the base credits listed for the measure and occupancy type in Tables C406.2(1) through C406.2(9) or, where calculations required by Sections C406.2.1 through C406.2.7 create or modify the table credits, the credits achieved shall be based upon the calculations. Energy credits achieved for measures shall be determined by one of the following, as applicable:

1. The measure's energy credit shall be the base energy credit for the measure where no adjustment factor or calculation is included in the description ofthe measure in Section C406.2.
2. The measure's energy credit shall be the base energy credit for the measure adjusted by a factor or equation as stated in the description of the measure in Section C406.2. Where adjustments are applied, each measure's energy credit shall be rounded to the nearest whole number.
3. The measure's energy credit shall be calculation as stated in the measures description in Section C406.2, where each individual measure credit shall be rounded to the nearest whole number.

Energy credits achieved for the project shall be the sum of the individual measure’s energy credits. Credits are available for the measures listed in this Section. Where a project contains multiple building occupancy groups:

1. Credits achieved for each occupancy group shall be summed and then weighted by the*conditioned floor area* of each occupancy group to determine the weighted average project energy credits achieved.
2. Credits for improved envelope efficiency and lighting reduction (L06) shall be determined for the building or permitted*conditioned floor area* as a whole. Credits for other measures shall be taken from applicable tables or calculations weighted by the building occupancy group floor area.

Reason: Because it is impossible for unconditioned spaces to comply the code as written.

Consider an unconditioned parking garage. Tis has no insulation, fenestration, heating, cooling, hot water, or kitchen equipment. L03 is not possible because base code already requires every fixture to have an occupant sensor. P01 is not possible unless the building is smaller than 10,000 square feet (which would be a very small parking garage). The only credits you could achieve are:

L02 Light Dimming

L06 Light Power Reduction

Q01 Efficient Elevator

In Climate Zone 8 this is a maximum of 12 possible points. Per Table 406.1.1 the project would be required to achieve 45 points (50% of 90).

In Climate Zone 5A this is a maximum of 20 possible points. Per Table 406.1.1 the project would be required to achieve 45 points (50% of 90).

This problem is not limited to parking garages. Elevated train platforms, unconditioned warehouses, sports stadiums, etc. will all encounter the same problem.

Finally, the scoring of lighting credits shows much greater energy savings in warmer climates. This would only make sense if the the lights were installed in a conditioned space, and this seems to be the assumption in the modelling. If this is the assumption, then these energy credits should not be applied to unconditioned spaces.

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

By eliminating compliance requirements from unconditioned spaces this proposal will reduce the cost of constructing these spaces.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal clarifies that only conditioned spaces are required to achieve C406 efficiency credits because it is impossible for unconditioned spaces to comply.

Final Hearing Results

CED1-187-22	AS

CED1-190-22

Original Proposal

IECC: C406.1.1, CD101.1, CF102.1, TABLE C406.1.1, TABLE C406.1.1(2) (New), TABLE CD101.1 (New), TABLE CF102.1, TABLE CF102.1(2) (New)

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C406.1.1 Additional energy efficiency credit requirements. *Buildings* shall comply with measures from C406.2 to achieve not less than the number of required efficiency credits from Table C406.1.1(1) based on building occupancy group and climate zone.Where a project contains multiple occupancies, credits in Table C406.1.1(1) from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of SectionC406.

Exceptions:

1. Unconditioned parking garages that achieve 50% of the credits required for use groups S-1 and S-2 in Table C406.1.1(1).
2. Portions of buildings devoted to manufacturing or industrial use.
3. Where a building achieves more renewable and load management credits in Section C406.3 than are required in Section C406.1.2, surplus credits shall be permitted to reduce the required energy efficiency credits as follows:

$$EEC_{red} = EEC_{tbl} - \left\{ the\ lesser\ of: \left(SRLM_{lim}, \quad SRLM_{adj} \times \left[RLM_{ach} - RLM_{req} \right] \right) \right\}$$

where:EEC_{red} = Reduced required energy efficiency credits **(Equation #)**

EEC_{tbl} = Required energy efficiency credits from Table C406.1.1(1)

$SRLM_{lim}$ = Surplus renewable and load management credit limit from Table C406.1.1(2)

$SRLM_{adj}$ = 1.0 for all-electric or all-renewable buildings (excluding emergency generation)

0.7 for buildings with fossil fuel equipment (excluding emergency generation)

RLM_{ach} = Achieved renewable and load management credits from Section C406.3

RLM_{req} = Required renewable and load management credits from Section C406.1.2

CD101.1 Prescriptive compliance. Where compliance is demonstrated using the prescriptive compliance option in Section C401.2.1, the number of additional efficiency credits required by Section C406.1 shall be 50 percent higher than that required by Table C406.1.1(1).

Exception: Where a building achieves more renewable and load management credits in Section C406.3 than are required in Section C406.1.2, surplus credits shall be permitted to reduce required energy efficiency credits as follows:

$$EEC_{red} = EEC_{tbl} - \left\{ the\ lesser\ of: \left(SRLM_{lim}, \quad SRLM_{adj} \times \left[RLM_{ach} - RLM_{req} \right] \right) \right\}$$

where:EEC_{red} = Reduced required energy efficiency credits **(Equation #)**

EEC_{tbl} = Required energy efficiency credits from Table C406.1.1(1)

$SRLM_{lim}$ = Surplus renewable and load management credit limit from Table CD101.1

$SRLM_{adj}$ = 1.0 for all-electric or all-renewable buildings (excluding emergency generation)

0.7 for buildings with fossil fuel equipment (excluding emergency generation)

RLM_{ach} = Achieved renewable and load management credits from Section C406.3

RLM_{req} = Required renewable and load management credits from Section C406.1.2

CF102.1 Advanced Energy Credit Package requirements. The requirements of this Section ~~supercede~~ supersede the requirements of Section C406.1.1. Projects shall comply with measures from C406.2 to achieve the minimum number of required efficiency credits from Table ~~CD~~ CF102.1(1) based on building occupancy group and climate zone. Projects with multiple occupancies, unconditioned parking garages, *alterations*, and *buildings* with separate shell-and-core and build-out construction permits shall comply as follows:Where a project contains multiple occupancies, credits in Table ~~CD~~ CF102.1(1) from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406 and Appendix CF ~~CD~~.

Exceptions:

1. Unconditioned parking garages that achieve 50 percent of the credits required for use groups S-1 and S-2 in Table CD102.1.
2. Portions of buildings devoted to manufacturing or industrial use.
3. Where a building achieves more renewable and load management credits in Section C406.3 than are required in Section Section C406.1.2, surplus credits shall be permitted to reduce required energy efficiency credits as follows:

$$EEC_{red} = EEC_{tbl} - \{the\ lesser\ of: (SRLM_{lim},\quad SRLM_{adj} \times [RLM_{ach} - RLM_{req}])\}$$

where: **(Equation #)**

EEC_{red} = Reduced required energy efficiency credits
EEC_{tbl} = Required energy efficiency credits from Table CF102.1(1)
$SRLM_{lim}$ = Surplus renewable and load management credit limit from Table CF102.1(2)
$SRLM_{adj}$ = 1.0 for all-electric or all-renewable buildings (excluding emergency generation)

0.7 for buildings with fossil fuel equipment (excluding emergency generation)
RLM_{ach} = Achieved renewable and load management credits from Section C406.3
RLM_{req} = Required renewable and load management credits from Section C406.1.2

TABLE C406.1.1(1) ENERGY CREDIT REQUIREMENTS BY BUILDING OCCUPANCY GROUP

Building Occupancy Group	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	65	66	67	77	80	86	80	81	90	86	90	90	86	90	90	70	89	80	78
I-2	43	42	38	37	36	38	32	32	30	36	36	35	43	43	44	46	47	50	53
R-1	63	62	66	65	70	71	77	80	84	81	83	88	85	86	90	83	87	87	85
B	62	62	64	66	66	65	64	64	68	70	72	74	71	73	77	71	74	74	71
A-2	70	70	72	72	75	75	70	73	82	69	74	78	67	72	78	60	67	57	51
M	80	79	83	79	81	84	67	74	87	80	66	65	79	62	50	75	67	75	58
E	56	57	55	58	58	57	59	62	59	61	66	62	64	67	67	65	67	63	58
S-1 and S-2	61	60	61	60	58	57	44	54	62	85	68	75	90	82	72	90	89	90	90
All Other	31	31	31	32	32	33	30	32	36	35	35	35	37	36	36	36	37	36	34

Add new text as follows:

TABLE C406.1.1(2) LIMIT TO ENERGY EFFICIENCY CREDIT CARRYOVER FROM RENEWABLE AND LOAD MANAGEMENT CREDITS

-	Climate Zone																		
Building Occupancy Group	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
I-2	16	14	11	8	6	5	5	5	5	5	5	5	6	15	18	10	14	10	25
R-1	7	5	8	5	19	5	13	20	20	5	20	20	5	16	18	5	5	5	5
B	7	5	5	8	6	6	5	10	14	5	21	15	5	16	26	5	5	5	9
A-2	18	16	14	15	13	9	5	5	11	5	5	5	5	5	7	5	5	5	5
M	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
E	13	13	18	16	17	14	6	20	25	9	26	13	7	15	10	5	5	9	5
S-1 and S-2	5	5	5	5	5	5	5	5	5	5	5	5	5	14	5	5	5	5	17
All Other	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

TABLE CD101.1 LIMIT TO ENERGY EFFICIENCY CREDIT CARRYOVER FROM RENEWABLE AND LOAD MANAGEMENT CREDITS

-	Climate Zone																		
Building Occupancy Group	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	19	25	27	29	33	20	15	37	36	5	37	34	5	8	36	5	5	5	5
I-2	17	13	10	5	5	5	5	5	5	5	5	5	7	16	20	15	21	20	43
R-1	9	5	9	5	22	7	13	23	25	5	22	19	5	18	16	5	5	5	6
B	5	5	5	5	6	6	5	9	13	10	26	20	9	25	34	5	9	9	32
A-2	31	28	25	26	23	16	5	8	16	5	8	7	5	5	9	5	5	5	5
M	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
E	17	15	23	16	20	14	5	22	27	10	32	16	10	21	12	5	5	15	10
S-1 and S-2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	43
All Other	5	5	5	5	5	5	5	5	6	5	5	5	5	5	5	5	5	5	5

Revise as follows:

TABLE CF102.1(1) Energy Credit Requirements by Building Occupancy Group

Building Occupancy Groups	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	179	174	188	197	200	200	200	200	200	200	200	200	193	200	200	200	200	200	200
I-2	78	75	73	71	80	90	100	85	90	97	83	90	99	90	96	107	106	130	117
R-1	106	100	110	105	109	122	123	125	131	137	129	136	157	139	147	171	158	180	176
B	114	110	112	115	108	107	116	111	114	126	118	123	135	125	125	152	142	153	141
A-2	83	81	82	82	86	86	108	91	97	126	99	111	147	117	113	160	143	163	151
M	113	113	121	118	123	127	116	116	133	109	100	92	99	134	125	171	146	150	137
E	91	95	91	100	96	100	105	104	101	113	110	110	120	117	122	131	132	126	131
S-1 and S-2	108	106	111	109	109	108	89	106	108	134	100	130	200	143	123	200	190	189	148
All Other	54	53	55	56	57	60	61	60	63	68	60	65	73	68	69	84	79	84	78

Add new text as follows:

TABLE CF102.1(2) LIMIT TO ENERGY EFFICIENCY CREDIT CARRYOVER FROM RENEWABLE AND LOAD MANAGEMENT CREDITS

-	Climate Zone																		
Building Occupancy Group	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	100	100	114	110	113	91	95	115	101	73	102	99	54	73	101	45	50	66	62
I-2	30	25	26	20	28	33	38	31	33	37	30	32	41	41	50	53	56	75	80

R-1	20	8	20	5	26	22	20	28	30	19	26	23	24	28	28	27	30	43	54
B	25	19	18	20	15	15	15	24	25	31	36	32	37	40	43	42	40	51	66
A-2	9	5	5	5	5	5	5	5	5	9	5	5	21	9	5	32	19	49	61
M	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	10
E	24	24	31	29	29	28	19	33	39	31	43	33	34	37	33	31	33	46	54
S-1 and S-2	5	5	5	5	5	5	5	5	5	5	5	5	37	19	5	49	41	51	56
All Other	5	5	5	5	5	5	5	5	15	5	6	8	5	11	15	5	5	9	20

Reason: This proposal allows for excess renewable and load management credits to be applied to the requirements for energy efficiency credits. This change accomplishes two objectives:

1. The change will make the additional credit section more aligned with ASHRAE Standard 90.1, which has a credit requirement and allows up to a 60% contribution of renewable and load management credits to be mixed with energy efficiency credits to meet the total credit requirement in that standard.
2. By creating more flexibility in the type of credits used, it will be easier to meet the energy efficiency requirement without using any efficiency improvements to federally regulated equipment and appliances.

A cost-effective demonstration credit package was separately published. Where the focus is cost-effectiveness, selecting cost-effective higher efficiency regulated equipment is appropriate. The purpose of this modification and review is to demonstrate that a reasonable package can be assembled that does not rely on improvements to the efficiency of federally regulated equipment. To this end, a package of measures was selected to find how many credits from the renewable and load management category would be necessary to meet the energy efficiency credit requirement. The following measures were selected by use group:

Alternate reasonable measure selections without EPACT regulated equipment efficiency improvements

Selections without EPACT regulated		R-2/4, I-1	I-2	R-1	B	A-2	M	E	S-1/2	
ID	Measure	MF	Health	Htl	Ofc	Rest	Rtl	Sch	Whse	
E03	Envelope Leakage Reduction	Y	Y	Y	Y	Y	Y	Y	Y	
E04	Add R-5 Roof Insulation	Y	Y	Y	Y	Y	Y	Y	Y	R-10 in CZ 8
E05	Add R-2.5ci Wall Insulation	Y	Y	Y	Y	Y	Y	Y	Y	R-5 in CZ 8
E06	Improve Fenestration	Y	Y	Y	Y	Y	Y	Y	Y	
H04	Residential HVAC control.	Y								
W01	SHW preheat recovery		30%							of SHW load
W02	Heat pump water heater			30%		30%				of SHW load
W04	SHW pipe insulation					Y	Y	Y		
W05	Point of use water heaters				Y			Y		
W06	Thermostatic balancing valves	Y	Y							
W07	SHW heat trace system			Y						
W09	SHW flow reduction	Y		Y						
L03	Increase occupancy sensor								Y	
L04	Increase daylight area				10%		20%		10%	of floor area
L05	Residential light control	Y								
L06	Lighting power reduction	10%	10%	10%	10%	10%	10%	10%	10%	of LPD
Q01	Efficient Elevator		Y	Y	Y	Y				
Q02	Efficient Commercial Kitchen Equipment					Y				
Q04	Fault detection		Y	Y	Y	Y	Y	Y	Y	

While in particular climate zones, all these measures would not need to be applied to meet the credit requirements, the same selections were applied across the board to determine how much extra credits from the renewable and load management category would be needed to meet the energy efficiency credit requirements without higher efficiency EPACT equipment. The needed points were determined as a percentage of the energy efficiency points as follows (a blank cell indicates that no additional points were required):

Carryover excess load management points needed as % of efficiency Requirement with no increases in EPACT regulated equipment efficiency

Use group and building type		0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, I-1	Multi-family/Dormitory								1%											
I-2	Healthcare	31%	29%	24%	16%	10%	4%					8%		8%	29%	36%	16%	26%	15%	43%
R-1	Hotel/Motel	1%		2%		14%		3%	13%	10%		11%	9%		3%	9%				
B	Office Buildings	19%	16%	17%	20%	18%	18%	6%	13%	17%	4%	26%	18%		19%	31%		5%	4%	17%
A-2	Restaurant Buildings	23%	20%	17%	18%	15%	7%		1%	10%		3%	2%			6%				
M	Retail Buildings															6%				
E	Education Buildings	19%	18%	29%	23%	26%	20%	7%	28%	39%	11%	36%	18%	7%	19%	11%			10%	
S-1, S-2	Warehouse														6%					13%

Based on this review, the exceptions were expanded to allow excess renewable and load management credits to be applied to the energy efficiency requirement with the following limits:

1. For use groups I-2 and E, up to 45% of carryover credits would be allowed.
2. For other use groups, up to 30% of carryover credits would be allowed.

While yet another table by climate zone could have been added to the code, this simplified limit was thought to be effective, while still preventing all energy efficiency to be replaced with renewable energy or load management. In addition to creating a requirement that can be met without using higher efficiency EPACT equipment, the carryover exceptions allow more flexibility in the energy credit structure. Appendix CF provides for a jurisdiction that has an aggressive energy saving policy to increase the energy credits required. A similar analysis was conducted, with higher requirements in the demonstration package, such as a 20% lighting power reduction, higher insulation levels, larger heat pump water heater load sizing, and some additional measures such as lighting tuning. When the results of this package was compared to the higher requirements in Appendix CF, it was determined that a higher carryover allowance of excess renewable and load management credits to be applied to the energy efficiency requirement with the following limits:

1. For use groups R-2, R-4, I-1 and E, up to 70% of carryover credits would be allowed.
2. For other use groups, up to 50% of carryover credits would be allowed.

Appendix CD provides for a glide path that increases the energy efficiency credit requirements to be 150% of the base code C406.1.1 requirements. This level is between the base and advanced Appendix CF requirements, and similar exceptions are added to Appendix CD to provide for renewable and load management carryover to energy efficiency credits.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The suggested changes relate to optional measures that can be selected in building design. Since there is no specific requirement for a particular measure, there is no impact on the cost of construction. There could be a reduction in cost from this particular proposal, as more flexibility in measure selection is provided, allowing possibly more cost effective renewable and load management measures to replace energy efficiency measures.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal allows for excess renewable and load management credits to be applied to the energy efficiency requirements. A workgroup was formed that modified the original proposal to ensure that compliance can be achieved without relying on measures for equipment efficiency in excess of EPACT requirements.

Final Hearing Results

CED1-190-22 AM

CED1-192-22

Original Proposal

IECC: C406.1.2, TABLE C406.1.2

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov); Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C406.1.2 Additional renewable and load management credit requirements. Buildings shall comply with measures from C406.3 to achieve not less than the number of required renewable and load management credits from Table C406.1.2 based on building occupancy group and climate zone. Where a project contains multiple occupancies, credits in Table C406.1.2 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.**Exception.** Where a building achieves more energy efficiency credits in Section C406.2 than are required in Section C406.1.1, the renewable and load management credits required in Table C406.1.2 shall be reduced by the amount of ~~the excess~~surplusenergy efficiency credits, not to exceed a 30 percent reduction.

Delete and substitute as follows:

~~TABLE C406.1.2 RENEWABLE AND LOAD MANAGEMENT CREDIT REQUIREMENTS BY BUILDING OCCUPANCY GROUP~~

Building Occupancy Group	**Climate Zone**																		
	0A	**0B**	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
R-2, R-4, and I-1	64	59	70	69	73	89	72	90	90	63	90	70	51	75	66	48	48	50	42
I-2	31	32	33	32	33	36	31	40	34	32	43	32	29	37	33	34	34	27	23
R-1	41	40	48	44	48	58	54	61	63	50	61	47	42	55	50	41	41	40	32
~~B~~	63	64	74	75	78	89	83	90	90	77	90	86	68	90	83	72	72	68	58
A-2	12	12	13	13	12	17	13	17	17	12	17	13	12	12	12	12	12	~~8~~	~~7~~
M	71	70	84	84	90	90	90	90	90	81	90	90	77	90	90	76	76	71	58
~~E~~	49	55	64	61	69	83	73	90	90	67	90	75	61	86	74	66	66	60	47
S-1 and S-2	90	90	90	90	90	90	90	90	90	90	90	90	70	90	90	61	61	61	53
All Other	56	55	66	63	69	80	69	87	88	59	86	68	51	72	66	51	51	48	40

TABLE C406.1.2 RENEWABLE AND LOAD MANAGEMENT CREDIT REQUIREMENTS BY BUILDING OCCUPANCY GROUP

Building Occupancy Group	**Climate Zone**																		
	0A	**0B**	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
R-2, R-4, and I-1	34	37	31	46	48	56	49	56	38	31	42	32	26	33	34	23	27	25	25
I-2	23	24	25	25	25	28	26	30	22	25	32	24	25	28	29	26	28	22	20
R-1	30	28	35	30	34	36	34	37	41	32	37	27	28	33	32	25	29	22	18

B	38	39	45	42	45	49	47	56	57	44	55	42	38	47	46	38	45	38	31
A-2	8	8	9	9	8	9	9	11	13	8	11	9	8	10	9	8	9	8	3
M	32	32	42	37	39	47	44	58	57	42	54	46	38	48	5	42	45	38	34
E	27	34	38	37	39	47	44	58	57	42	54	46	38	48	50	42	45	38	34
S-1 and S-2	89	90	90	90	90	90	90	90	90	90	90	90	90	90	90	84	86	71	54
All Other	35	39	46	42	46	52	49	56	56	40	52	42	37	44	44	36	39	32	28

Reason: The requirements for renewable and load management credits were generally reduced to better align with other code changes for the reasons listed below. The average of all individual building type and climate zone requirements drops from 60 to 40 points or to 4% cost savings.

- In the as modified May 2022 version of CEPI-193, a new analysis of the renewable & load management credits available was conducted; however the requirements were not updated pending review of the other base code changes that were still pending. This new analysis expanded the analysis from selected prototypes to all PNNL prototype buildings and then weighted results based on the individual prototype construction weights in each use group. As a result, the available credits better reflect annual savings under a time of use electric pricing schedule.
- The base code added a renewable requirement for installation of 0.75 watts per square foot of solar generation or acquisition of equivalent off site power.
- A base code requirement for the capability of lighting load management, HVAC load management, and service water heating load management were required. These base requirements get controls in place to acheive these credits in larger buildings, but do not require the controls be activated. Where these controls are required, the related energy credits are reduced in a separate public comment.
- The revised table requirements proposed here are based on the available credits for 0.2 W/square foot of solar generation (R01) plus the lighting load management credit (G01). To acknowlege the base code addition of a solar requirement, this is reduced from the original proposed requirement based on the original available credits and 0.4 W/square foot of solar generation (R01) plus the lighting load management credit (G01). In both cases the credits for an individual building type and climate zone were limited to 90 points or 9% energy cost reduction. In the new schema, this limit only impacted the warehouse (s-1/S-2) use group.

Where site-based solar generation or lighting load management is not practical, or has reduced credits due to base requirements, off-site solar, or other load management measures can be implemented to achieve the required credits.

In addition, to enhance flexibility, allow credit for all measures implemented, and better align with the way energy efficiency and load management credits interact in ASHRAE Standard 90.1, an exception is added that allows the renewable and load management credits to be reduced by as much as 30% when the building achieves energy efficiency credits that are greater than the requirement.

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

The requirements for renewable and load management credits are generally lowered across the board, so the cost to implement these credits will be reduced.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The adjusted renewable and load management credits proposed in CED1-192 align with the proposed prescriptive renewable energy requirements in IECC 2024.

Final Hearing Results

CED1-192-22 AM

CED1-194-22

Original Proposal

IECC: TABLE C406.2(1), TABLE 406.2(2), TABLE 406.2(3), TABLE 406.2(4), TABLE 406.2(5), TABLE 406.2(6), TABLE 406.2(7), TABLE 406.2(8), TABLE 406.2(9)

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov); Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C406.2(1) BASE ENERGY CREDITS FOR GROUP R-2, R-4, AND I-1 OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	~~8~~	13	~~7~~	11	~~6~~	~~8~~	~~9~~	~~6~~	1	24	~~8~~	~~9~~	30	15	~~5~~	32	28	31	36
E02	UA reduction (15%)	C406.2.1.2	7	6	2	4	1	1	4	1	1	22	1	3	29	10	1	32	27	30	39

a. "x" indicates credit is not available in that climate zone for that measure.

TABLE 406.2(2) BASE ENERGY CREDITS FOR GROUP I-2 OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	~~6~~	11	~~6~~	11	~~7~~	~~9~~	~~6~~	~~6~~	~~2~~	~~3~~	3	~~3~~	~~4~~	~~3~~	~~7~~	~~5~~	~~5~~	17	~~3~~
E02	UA reduction (15%)	C406.2.1.2	1	1	1	1	2	1	1	1	3	1	3	11	27	7	10	3	3	2	10

a. "x" indicates credit is not available in that climate zone for that measure.

TABLE 406.2(3) BASE ENERGY CREDITS FOR GROUP R-1 OCCUPANICES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	~~4~~	~~7~~	~~4~~	~~7~~	~~3~~	~~4~~	~~7~~	~~2~~	~~1~~	~~7~~	~~2~~	~~3~~	10	~~6~~	~~4~~	12	~~9~~	19	11
E02	UA reduction (15%)	C406.2.1.2	2	3	1	2	1	3	3	2	1	5	2	2	7	4	2	9	7	9	11

a. "x" indicates credit is not available in that climate zone for that measure.

TABLE 406.2(4) BASE ENERGY CREDITS FOR GROUP B OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	4	~~7~~	4	~~7~~	~~3~~	4	7	~~2~~	~~0~~	~~7~~	~~2~~	~~3~~	10	~~6~~	4	12	~~9~~	19	11
E02	UA reduction (15%)	C406.2.1.2	7	8	3	6	5	3	7	3	1	13	4	8	21	15	11	13	24	37	43

a. "x" indicates measure is not available ~~for building occupancy~~ in that climate zone for that measure.

TABLE 406.2(5) BASE ENERGY CREDITS FOR GROUP A-2 OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	1	1	1	1	~~2~~	~~2~~	~~9~~	2	1	19	4	5	26	~~7~~	~~3~~	33	23	29	13
E02	UA reduction (15%)	C406.2.1.2	1	1	1	1	13	1	3	2	1	4	4	5	5	5	6	6	6	6	6

a. "x" indicates measure is not available in that climate zone for that measure.

TABLE 406.2(6) BASE ENERGY CREDITS FOR GROUP M OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	~~2~~	~~2~~	~~2~~	~~2~~	~~2~~	~~3~~	15	~~2~~	1	36	~~5~~	~~9~~	45	11	~~5~~	51	36	35	15
E02	UA reduction (15%)	C406.2.1.2	14	14	8	13	7	9	20	15	1	35	18	28	41	37	40	43	44	46	31

a. "x" indicates credit is not available in that climate zone for that measure.

TABLE 406.2(7) BASE ENERGY CREDITS FOR GROUP E OCCUPANCIES[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	~~9~~	22	~~8~~	20	~~9~~	12	~~5~~	11	~~3~~	4	~~9~~	~~2~~	~~3~~	~~6~~	~~0~~	4	~~3~~	4	~~3~~
E02	UA reduction (15%)	C406.2.1.2	8	18	7	19	12	13	20	17	11	24	20	17	33	32	29	40	38	46	44

a. "x" indicates measure is not available in that climate zone for that measure.

TABLE 406.2(8) BASE ENERGY CREDITS FOR GROUP S-1 AND S-2 OCCUPANCIES[a]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	~~1~~	~~2~~	1	~~1~~	1	~~2~~	25	~~2~~	~~1~~	62	11	14	74	21	~~6~~	75	57	58	21
E02	UA reduction (15%)	C406.2.1.2	14	14	1	12	1	9	27	16	2	37	29	39	44	47	50	43	52	55	74

a. "x" indicates measure is not available ~~for building occupancy~~ in that climate zone for that measure.

TABLE 406.2(9) BASE ENERGY CREDITS FOR OTHER OCCUPANCIES[a,b]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	~~5~~	~~9~~	~~5~~	~~8~~	5	~~6~~	10	~~5~~	2	20	~~6~~	~~6~~	25	10	4	28	22	26	16
E02	UA reduction (15%)	C406.2.1.2	7	8	3	7	5	5	11	7	2	18	10	14	26	20	19	24	25	29	32

a. "x" indicates measure is not available in that climate zone for that measure.

b. Other occupancy groups include all Groups except for Groups A-2, B, E, I, M, S, and R.

Reason: After CEPI-193 received the first vote, the credits for E02, UA reduction, were reanalyzed based on feedback. The reanalysis was also undertaken so that the analysis procedure was the same as it was for the alternative discrete envelope fenestration and insulation measures.

The result was an overall increase in credits by 130% as an unweighted average. There is a great deal of variation between climate zones and between building use groups. This is due to the fact that the credits are based on a percentage of total building use and not a fixed change in energy use. Often insulation savings impacts in the same numerical climate zone are different in each humidity regime, as the total base building use can vary quite a bit based on humidity. There is also a variation in heating type between prototypes. The average credits across climate zones (before/after/New%) is shown by building use in the table below: with the percentage new vs. prior on average shown.

E02 Envelope Improvement, 15% UA reduction

Compare average credits across climate zones

Building Use	New	Prior	New
Apartment	11.6	15.1	77%
Health	4.4	6.2	72%
Hotel	3.9	9.6	40%
Office	12.2	6.4	189%
Restaurant	4.0	9.6	42%
Retail	24.4	14.7	166%
Education	23.6	7.2	327%
Warehouse	29.7	22.9	130%
Other	14.3	11.5	125%
Average	14.2	11.5	130%

The two basis of analysis were different and the new analysis is expected to both be more accurate and better match the other discrete envelope measures in the credit section.

- The original analysis for this measure was from the 2021 IECC energy credit results adjusted to the 2024 credit metric. The original analysis was based on one representative building prototype for each use group.
- The improved analysis used baseline building parameters that were more up to date. It also used an automated measure parametric replacement approach and included all the prototypes relevant to that use group. Then the results from each prototype were averaged for the group by relative national construction weight.

In addition, the table footnotes were edited to be more consistent with each other.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

As an optional credit there is no direct requirement to implement particular measures, so a change in measure credits will not impact construction cost.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: After passage of CEPI-193, the E02 Credit (15% UA reduction) was reanalyzed based on feedback. This result is a significant increase, as an unweighted average, in credits.

Final Hearing Results

CED1-194-22	AS

CED1-195-22

Original Proposal

IECC: C406.2.1.6, TABLE C406.2.1.6

Proponents: Thomas Culp, Birch Point Consulting LLC, Aluminum Extruders Council (culp@birchpointconsulting.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C406.2.1.6 E06 Improve fenestration. Energy credits for one selected fenestration energy credit ID shall be achieved for improved energy characteristics ofall vertical fenestration in the project meeting the requirements in one of the rows of Table C406.2.1.6. The area-weighted average U-factor and SHGC of all vertical fenestration shall be equal to or less than the value shown in the selected table row. Where vertical fenestration is located under a permanently attached shading projection with a projection factor PF not less than 0.2 as determined in accordance with Section C402.4.3, the SHGC for that fenestration shall be permitted to be divided by 1.2. The area-weighted average visible transmittance (VT) of allvertical fenestration shall be equal to or greater than the value shown in the selected table row.

TABLE C406.2.1.6 Vertical Fenestration Requirements for Energy Credit E06

Portions of table not shown remain unchanged.

Applicable Climate Zone	Maximum U-Factor		Maximum SHGC~~a~~	Minimum VT
	Fixed	Operable		

~~a. Where vertical fenestration is located under a permanently attached shading projection with a projection factor PF not less than 0.2 as determined in accordance with Equation 4-4, the required maximum SHGC shall be multiplied by 1.2.~~

Reason: Credit E06 adds an efficiency credit for improved vertical fenestration, listing the required maximum U-factor, maximum SHGC, and minimum VT by climate zone. We agree with the intent of this credit, but note that the SHGC requirement forgot to include the ability to account for shading projection factor like in the main Table C402.5 or in ASHRAE 90.1. This proposal adds a footnote that clarifies that the maximum SHGC requirement shall be multiplied by 1.2 when there is permanently attached shading projection with PF >= 0.2 as calculated in accordance with Equation 4-4 in Section C402.5.3. Rather than listing separate SHGC values for different projection factors like in Table C402.5, this uses the same multiplier of 1.2 consistent with what is used in Table C402.5 for the PF >= 0.2 line. (We don't feel it is necessary to include an additional multiplier from the PF >= 0.5 line; as such, this accounts for some shading but is still conservative.)

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal only makes the SHGC requirement consistent with how Table C402.1.5 accounts for shading projection factor, but does not require shading. As such, there is no cost impact.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal updates the E06 additional energy credit to account for the shading projection factor when determining the maximum SHGC requirement.

Final Hearing Results

CED1-195-22 AM

CED1-197-22

Original Proposal

IECC: TABLE C407.4.1(1), C409.6.1.4.1

Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE C407.4.1(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 C405.3.2(1) or C405.3.2(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 C402.1.2	As proposed
	Solar reflectance~~absorptance~~: 0.25~~0.75~~, except as specified in Section C402.4 and Table C402.4 for Climate Zones 0, 1, 2, and 3	As proposed
	Emittance: 0.90, except as specified in Section C402.4 and Table C402.4 for Climate Zones 0, 1, 2, and 3	As proposed
Walls, above-grade	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.2	As proposed
	Thermal bridges: Account for heat transfer consistent with compliant *psi*- and *chi*-factors from Table C402.1.4 for *thermal bridges* as identified in Section C402.7 that are present in the proposed design.	As proposed; *psi*- and *chi*-factors for proposed *thermal bridges* shall be determined in accordance with requirements in Section C402.1.4.
	Solar reflectance~~absorptance~~: 0.25~~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 C402.1.2 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 C402.1.2	As proposed
Floors, slab-on-grade	Type: unheated	As proposed
	F-factor: as specified in Table C402.1.2	As proposed
Opaque doors	Type: swinging	As proposed
	Area: Same as proposed	As proposed
	U-factor: as specified in Table C402.1.2	As proposed
Vertical fenestration other than opaque doors	Area 1. The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 40 percent of above-grade wall area. 2. 40 percent of above-grade wall area; where the proposed vertical fenestration area is 40 percent or more of the above-grade wall area.	As proposed
	U-factor: as specified in Table C402.5	As proposed
	SHGC: as specified in Table C402.5 except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	External shading and PF: none	As proposed
Skylights	Area 1. The proposed skylight area; where the proposed skylight area is less than that permitted by Section C402.1. 2. The area permitted by Section C402.1; where the proposed skylight area exceeds that permitted by Section C402.1.	As proposed
	U-factor: as specified in Table C402.5	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	SHGC: as specified in Table C402.5 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.3.2. Where the occupancy of the building is not known, the lighting power density shall be 1.0 watt per square foot 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 Tables C405.5.2(1), C405.5.2(2) and C405.5.2(3). Areas and dimensions of surfaces shall be the same as proposed.	As proposed
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. End-use load components within and associated with the building shall be modeled to include, but not be limited to, the following: exhaust fans, parking garage ventilation fans, exterior building lighting, swimming pool heaters and pumps, elevators, escalators, refrigeration equipment and cooking equipment.
Schedules	Same as proposed **Exception:** Thermostat settings and schedules for HVAC systems that utilize radiant heating, radiant cooling and elevated air speed, provided that equivalent levels of occupant thermal comfort are demonstrated by means of equal Standard Effective Temperature as calculated in Normative Appendix B of ASHRAE Standard 55.	Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays and any seasonal operation. Schedules shall model the time-dependent variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads. The schedules shall be typical of the proposed building type as determined by the designer and approved by the jurisdiction.
Outdoor airflow	Where the proposed design specifies mechanical ventilation: 1. For systems 1-4 as specified in Tables C407.4.1(2) and C407.4.1(3), the outdoor airflow rate shall be determined in accordance with Section C403.7 and *International Mechanical Code* Section 403.3.1.1.2.3.4 Equation 4-8, using a system ventilation efficiency (Ey) of 0.75. 2. For systems 5-11 as specified in Tables C407.4.1(2) and C407.4.1(3), the outdoor airflow rate shall be determined in accordance with Section C403.7 and *International Mechanical Code* Section 403.3. Where the proposed design specifies natural ventilation, as proposed.	As proposed, in accordance with Section C403.2.2.
Heating systems	Fuel type: same as proposed design	As proposed
	Equipment type[a]: as specified in Tables C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in the tables in Section C403.3.2.	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 C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in Tables C403.3.2(1), C403.3.2(2) and C403.3.2(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 C403.5.	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.	
Energy Recovery	Where the proposed design specifies mechanical ventilation, as specified in Section C403.7.4 based on the *standard reference design* airflows. Where the proposed design specifies natural ventilation, as proposed.	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Fan power	As specified in Section C403.8 for the proposed design. **Exceptions:** 1. Where the fan power of the proposed design is exempted from the requirements of Section C403.8, as proposed. 2. Fan systems addressed by Section C403.8.1: Fan system BHP power shall be as proposed or to the limits specified in Section C403.8.1, whichever is smaller. If the limit is reached, the power or each fan shall be reduced proportionally until the limit is met. 3. Fan systems serving areas where the mechanical ventilation is provided in accordance with an engineered ventilation system design of Section 403.2 of the *International Mechanical Code* shall not use the particulate filtration or air cleaner pressure drop adjustment available in Table C403.8(1) when calculating the fan system BHP limit for the portion of the airflow being treated to comply with the engineered ventilation system design.	As proposed
On-site Renewable Energy	Where a system providing on-site renewable energy has been modeled in the proposed design the same system shall be modeled identically in the *standard reference design* except the rated capacity shall meet the requirements of Section C405.15.1 Where no system is designed or included in the proposed design, model an unshaded photovoltaic system with the following characteristics: **Size:** Rated capacity per Section C405.15.1 **Module Type**: Crystalline Silicone Panel with glass cover, 19.1% nominal efficiency and temperature coefficient of -0.35%/°C, Performance shall be based on a reference temperature of 77°F (25°C), airmass of 1.5 atmosphere and irradiance of 317 Btu/h x ft^2 (1000 W/m^2). **Array Type:** Rack mounted array with installed nominal operating cell temperature (INOCT) of 103°F (45°C). Total System Losses (DC output to AC output): 11.3%. **Tilt:** 0-degrees (mounted horizontally). **Azimuth:** 180 degrees.	As proposed

For SI: 1 watt per square foot = 10.7 w/m^2.

SWHF = Service Water Heat Recovery factor, DWHR = Drain Water Heat Recovery.

a. Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.

b. The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.

c. Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.

d. If an economizer is required in accordance with Table C403.5(1) and where no economizer exists or is specified in the proposed design, then a supply-air economizer shall be provided in the standard reference design in accordance with Section C403.5.

e. The SWHF shall be applied as follows:

1. Where potable water from the DWHR unit supplies not less than one shower and not greater than two showers, of which the drain water from the same showers flows through the DWHR unit then SWHF = [1 – (DWHR 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.

C409.6.1.4.1 Roofs. Roofs will be modeled with insulation above a steel roof deck. The roof U-factor and area shall be modeled as in the proposed design. If different roof thermal properties are present in a single block, an area weighted U-factor shall be used. Roof solar reflectance~~absorptance~~ shall be modeled at 0.30~~0.70~~ and emittance at 0.90.

Reason: Within the IECC commercial provisions of the 1st Public Comment Draft, there are only three instances where "solar absorptance" is used. In contrast, there are eighteen uses of "solar reflectance." This comment changes those three instances, and the associated values, to make all uses consistent throughout the commercial provisions. The end result will be less confusion in understanding roof and wall radiative property requirements in different sections of the IECC.

ARMA submitted a separate comment that changes the solar absorptance value in Section C409.6.1.4.1. If both comments are accepted, the value of solar reflectance in C409.6.1.4.1 will need to be updated to properly correlate the two comments.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The changes proposed in this comment align language across sections of the code without making technical modifications. Therefore, there is no impact on cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: correlate use of solar reflectance with other parts of the code.

Final Hearing Results

CED1-197-22 AS

CED1-198-22

Original Proposal

IECC: C403.1, C406.2.2.1, SECTION 409, C409.1, C409.2, C403.1.3, C403.1.3.1, C403.1.3.2, C403.1.3.3, C409.4, TABLE C409.4, C409.4.1, C409.5, C409.5.1, C409.5.2, C409.5.3, C409.5.3.1, C409.6, C409.6.1, C409.6.1.1, C409.6.1.1.1, C409.6.1.2, C409.3, C409.6.1.3, C409.6.1.3.1, C409.6.1.3.2, C409.6.1.4.1, C409.6.1.4.2, C409.6.1.4.3, C409.6.1.4.4, C409.6.1.4.5, C409.6.1.4.6, C409.6.1.4.7, C409.6.1.4, C409.6.1.4.8, C409.6.1.5, C409.6.1.6, C409.6.1.7, C409.6.1.8, C409.6.1.9, C409.6.1.10, C409.6.1.10.1

Proponents: Reid Hart, PowerWise Consulting, LLC, Pacific Northwest National Laboratory (reid.hart@pnnl.gov); Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Laboratory (michael.tillou@pnnl.gov)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C403.1 General. Mechanical systems and equipment serving the building heating, cooling, ventilating or refrigerating needs shall comply with one of the following:

1. Sections C403.1.1 and Sections C403.2 through Section C403.14
2. Data Centers shall comply with Section C403.1.1, Section C403.1.2 and Section C403.6 through Section C403.14
3. Section C409 ~~C403.1.3 and sections within Section C403 that are listed in Table C407.2(1~~).

C406.2.2.1 H01 HVAC Performance (TSPR). H01 energy credits shall be achieved ~~for~~ where systems are permitted ~~allowed~~ to use Section C409 ~~C403.1.3, HVAC total system performance ratio,~~ and where the proposed TSPR exceeds the minimum TSPR requirement by 5 percent or more. If improvement is greater than 5 percent, ~~base energy credits from Table C406.2(1) through C406.2(9) are permitted to be prorated up to a 20 percent improvement~~ determine H01 achieved credits using Equation 4-17. Energy credits for H01 ~~may~~ shall not be combined with energy credits from HVAC measures H02, H03 ~~and~~ or H05.

(Equation 4-17)

H01 energy credit = H01 base energy credit x TSPRs / 0.05

where:TSPRs = TSPRa x [the lessor of 0.20 and (1-(TSPRp/TSPRt))]

where:
TSPRa = [floor area served by systems permitted to use TSPR] / [total building conditioned floor area]
~~TSPRt = TSPRr / MPF~~
TSPRp = HVAC TSPR of the proposed design calculated in accordance with Sections C409.4, C409.5 and C409.6.
TSPRt = TSPRr / MPF
where:

TSPRr = HVAC TSPR of the reference building design calculated in accordance with Sections C409.4, C409.5 and C409.6.
MPF = Mechanical Performance Factor from Table C409.4 based on climate zone and building use type
Where a building has multiple building use types, MPF shall be area weighted in accordance with Section C409.4

SECTION 409
CALCULATION OF HVAC TOTAL SYSTEM PERFORMANCE RATIO

Revise as follows:

C409.1 Applicability ~~Purpose.~~ ~~Section 409 establishes criteria for demonstrating compliance with the requirements of C403.1.1,~~ Use of the HVAC Total System Performance Ratio ~~total system performance ratio~~ (~~HVAC~~ TSPR) method shall comply with this section.

C409.2 ~~Scope~~ Permitted Uses. ~~Section C409 applies to new~~ Only HVAC systems that serve building~~s~~ occupancies and uses in ~~Section C403.1.3.1 and are not excluded from using HVAC TSPR by Section C403.1.3. All applicable HVAC systems shall comply with Section C409.~~ Table C409.4 and not excluded by Section C409.2.1 shall be permitted to use the TSPR method.

Delete without substitution:

~~**C403.1.3 HVAC total system performance ratio (HVAC TSPR).** HVAC systems serving buildings or portions of buildings listed in Section C403.1.3.1 that are not served by systems listed in Section C403.1.3.2 shall have an HVAC total system performance ratio (HVAC TSPR) of the proposed design HVAC systems that is greater than or equal to the HVAC TSPR of the standard reference design divided by the applicable mechanical performance factor (MPF) from Table C409.4. HVAC TSPR shall be calculated in accordance with Section C409, Calculation of HVAC Total System Performance Ratio. Systems using the HVAC TSPR method shall also meet requirements in Section C403.1.3.3.~~

~~**C403.1.3.1 Included Building Types.** Only HVAC systems that serve the following building use types are allowed to use the TSPR Method:~~

1. ~~Office (including medical office) (occupancy group B)~~
2. ~~Retail (occupancy group M),~~
3. ~~Library (occupancy group A-3),~~
4. ~~Education (occupancy group E),~~
5. ~~Hotel/motel occupancies (occupancy group R-1),~~
6. ~~The *dwelling units* and *common areas* within occupancy group R-2 multifamily buildings.~~

Revise as follows:

C409.2.1 ~~C403.1.3.2 Excluded~~ Systems Not Permitted. The following HVAC systems are not permitted to use Section C403.1(3): ~~excluded from using the TSPR Method~~:

1. HVAC Systems using
   1.1 District heating water, chilled water or steam
   1.2 Small duct high velocity air cooled, space constrained air cooled, single package vertical air conditioner, single package vertical heat pump, or double-duct air conditioner or double-duct heat pump as defined in subpart F to 10CFR part 431
   1.3 Packaged terminal air conditioners and packaged terminal heat pumps that have cooling capacity greater than 12,000 Btu/hr (3500 kW)
   1.4 A common heating source serving both HVAC and service water heating equipmen~~, t or~~
2. HVAC systems that provide recovered heat for service water heating
3. HVAC systems not specified ~~included~~ in Table C409.6.1.10.1
4. HVAC systems specified ~~included~~ in Table C409.6.1.10.1 with characteristics or parameters in Table C409.6.1.10.2(1), not identified as applicable to that HVAC system type.
5. HVAC systems with chilled water supplied by absorption chillers, heat recovery chillers, water to water heat pumps, air to water heat pumps, or a combination of air- and water-cooled chillers on the same chilled water loop.
6. HVAC systems served by heating water plants that include air to water or water to water heat pumps.

7. Underfloor air distribution and displacement ventilation HVAC systems.
8. Space conditioning systems that do not include mechanical cooling.
9. HVAC systems serving laundry rooms, elevator rooms, mechanical rooms, electrical rooms, data centers, and computer rooms.
10. *Buildings* or areas of medical office buildings~~that comply fully with~~ required to use ASHRAE Standard 170. ~~, including but not limited to surgical centers, or~~
11. *Buildings* or areas that are required by ~~other applicable codes or standards~~ regulation to ~~provide 24/7~~ have continuous air handling unit operation
12. HVAC systems serving laboratories with fume hoods
13. Locker rooms with more than 2 showers
14. Natatoriums and rooms with saunas
15. Restaurants and commercial kitchens with total cooking capacity greater than 100,000 Btu/h(29 kW)
16. Areas of *buildings* with commercial refrigeration equipment exceeding 100 kW of power input.
17. Cafeterias and dining rooms

C409.3 ~~C403.1.3.3~~ HVAC TSPR Compliance ~~Method Partial Prescriptive Requirements.~~ HVAC systems permitted to use TSPR shall comply with Section C409.4 and the following:~~HVAC systems using the HVAC Performance Rating Method shall meet relevant prescriptive requirements in Section C403 as follows:~~

1. HVAC systems shall comply with the applicable requiremts of Section C403 as follows:

1.1. Air economizers shall meet the requirements of Section C403.5.3.4 Relief of excess outdoor air and Section C403.5.5 Economizer fault detection and diagnostics.

1.2. Variable-air-volume system systems shall meet requirements of Sections C403.6.5, C403.6.6, and C403.6.9.

1.3. Hydronic systems shall meet the requirements of Section C403.4.4.

1.4. Plants with multiple chillers or boilers shall meet the requirements of Section C403.4.5.

1.5. Hydronic (Water Loop) Heat Pumps and Water-Cooled Unitary Air Conditioners shall meet the requirements of Section C403.4.3.3.

1.6. Cooling tower turndown shall meet requirements of Section C403.11.4.

1.7. Heating of unenclosed spaces shall meet the requirements of Section C403.14.1.

1.8. Hot-gas bypass shall meet the requirements of Section C403.3.3.

1.9. Systems shall meet the operable openings interlock requirements of Section C402.5.11.10 (*staff note Section C402.5.11.10 removed by CECPI-3-21 and CEPI-65-21*). Refrigeration systems shall meet the requirements of Section C403.12.

2. Systems shall comply with the applicable provisions of Sections of Section C403 required by Table C407.2

C409.4 Performance Target ~~HVAC TSPR Compliance.~~ For HVAC Systems serving uses or portions of uses listed in Section C409.2 that are not served by systems listed in Section C409.2.1, the ~~allowed to use HVAC TSPR in accordance with Section C403.1.3 shall comply with all of the following:~~

1.	Systems shall meet the applicable provisions of Section C403.1.3.3 and Sections within Section C403 that are listed in Table C407.2

~~The~~ HVAC TSPR of the proposed design shall be greater than or equal to the HVAC TSPR of the standard reference design divided by the mechanical performance factor (MPF)using Equation 4-33.

(Equation 4-33)

$$TSPRp > TSPRr / MPF$$

where: TSPRp = HVAC TSPR of the proposed design calculated in accordance with Sections C409.4, C409.5 and C409.6.
TSPRr = HVAC TSPR of the reference building design calculated in accordance with Sections C409.4, C409.5 and C409.6.
MPF = Mechanical Performance Factor from Table C409.4~~based on climate zone and building use type~~
Where a building has multiple building use types, MPF shall be area weighted using Equation 4-34

$$MPF = (A1 \times MPF1 + A2 \times MPF2 + ... + An \times MPFn)/(A1 + A2 + ... + An)$$

(Equation 4-34)

where: MPF1, MPF2 through MPFn= Mechanical Performance Factors from Table C409.4 based on~~climate zone and~~ building use types 1,2, through n
A1, A2 through An= Conditioned floor areas for building use types 1, 2, through n

TABLE C409.4 Mechanical Performance Factors

Climate Zone: Building type Use	Occupancy Group	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Office (small and medium)~~[a]~~	~~B~~	0.72	0.715	0.70	0.705	0.685	0.65	0.71	0.68	0.645	0.805	0.70	0.78	0.845	0.765	0.805	0.865	0.835	0.875	0.895
Office (Large)[a]	B	0.83	0.83	0.84	0.84	0.79	0.82	0.72	0.81	0.77	0.67	0.76	0.63	0.71	0.72	0.63	0.73	0.71	0.71	0.71
Office (all others)[a]	B	0.72	0.715	0.70	0.705	0.685	0.65	0.71	0.68	0.645	0.805	0.70	0.78	0.845	0.765	0.805	0.865	0.835	0.875	0.895
Retail	M	0.60	0.57	0.50	0.55	0.46	0.46	0.43	0.51	0.40	0.45	0.57	0.68	0.46	0.68	0.67	0.50	0.45	0.44	0.38
Hotel/Motel	R-1	0.62	0.62	0.63	0.63	0.62	0.68	0.61	0.71	0.73	0.45	0.59	0.52	0.38	0.47	0.51	0.35	0.38	0.31	0.26
Multi-family/Dormitory	R-2	0.64	0.63	0.67	0.63	0.65	0.64	0.59	0.72	0.55	0.53	0.50	0.44	0.54	0.47	0.38	0.55	0.50	0.51	0.47
School/Education and Libraries	E (A-3)	0.82	0.81	0.80	0.79	0.75	0.72	0.71	0.72	0.67	0.73	0.72	0.68	0.82	0.73	0.61	0.89	0.80	0.83	0.77

a. Large office ~~gross~~ conditioned floor area ~~>~~ more than 150,000 ft^2 (14,000 m^2) or ~~>~~ more than 5 stories ~~floors; all other offices are small or medium~~

C409.4.1 HVAC TSPR. HVAC TSPR is calculated according to Equation 4-35.

$$HVAC\ TSPR = Heating\ and\ cooling\ load/Building\ HVAC\ system\ energy$$

(Equation 4-35)

where: Building HVAC system energy = Sum of the annual site energy consumption for heating, cooling, fans, energy recovery, pumps, and heat rejection in thousands of Btus (kWh)

Heating and cooling load = Sum of the annual heating and cooling loads met by the building HVAC system in thousands of Btus(kWh)

C409.5 General. Projects shall ~~comply with the requirements~~ use the procedures of this Section when calculating compliance using HVAC Total System Performance Ratio.

C409.5.1 Simulation Program. Simulation tools used to calculate HVAC TSPR of the Standard Reference Design shall comply with the following:

1. The simulation program shall calculate the HVAC TSPR based only on the input for the proposed design and the requirements of Section 409. The calculation procedure shall not allow the user to directly modify the building component characteristics of the standard reference design.
2. Performance analysis tools shall meet ~~ing~~ the applicable subsections of Section 409 and be tested ~~according to~~ in accordance with ASHRAE Standard 140, except for Sections 7 and 8 of Standard 140 ~~, shall be permitted to be approved~~. The required tests shall include building thermal envelope and fabric load test (Sections 5.2.1, 5.2.2, and 5.2.3), ground coupled slab-on-grade analytical verification tests (Section 5.2.4), space-cooling equipment performance tests (Section 5.3), space-heating equipment performance tests (Section 5.4), and air-side HVAC equipment analytical verifi-cation test (Section 5.5), along with the associated reporting (Section 6). ~~Tools are permitted to be approved based on meeting a specified threshold for a jurisdiction. The code official shall be permitted to approve tools for a specified application or limited scope.~~
3. The test results and modeler reports shall be~~posted on a~~ publicly available ~~website~~ and shall include the test re-sults of the simulation programs and input files used for generating the results along with the results of the other simulation programs included in ASHRAE Standard 140 Annexes B8 and B16. The modeler report in Standard 140 Annex A2 Attachment A2.7 shall be completed for results exceeding the maximum or falling below the minimum of the reference values and for omitted results.
4. The simulation program shall have the ability to ~~explicitly~~ model part-load performance curves or other part-load adjustment methods based on manufacturer's part-load performance data for mechanical equipment.
5. The *code official* shall be permitted to approve specific software deemed to meet these requirements in accordance with Section C101.5.1.

C409.5.2 Climatic Data. C409.5.2 The simulation program shall perform the simulation using hourly values of climatic data for a full calendar year (8,760 hours) and shall reflect approved coincident hourly data for temperature, solar radiation, humidity and wind speed for the building location. ~~, such as temperature and humidity, using TMY3 data for the site as specified here: https://buildingenergyscore.energy.gov/resources~~

C409.5.3 Documentation. Documentation or web links to documentation conforming to the provisions of this section shall be provided to the *code official*.

C409.5.3.1 Compliance Report. Building permit submittals shall include:

1. A report produced by the simulation software that includes the following:
   - 1.1 Address of the building.
   - 1.2 Name of individual completing the compliance report.
   - 1.3 Name and version of the compliance software tool
   - 1.4 The dimensions, floor heights and number of floors for each block.
   - 1.5 By block, the U-factor, C-factor, or F-factor for each simulated opaque envelope component and the U-factor and SHGC for each fenestration component.
   - 1.6 By block or by surface for each block, the fenestration area.
   - 1.7 By block, a list of the HVAC equipment simulated in the proposed design including the equipment type, fuel type, equipment efficiencies and system controls.
   - 1.8 Annual site HVAC energy use by end use for the proposed and baseline building.
   - 1.9 Annual sum of heating and cooling loads for the baseline building.
   - 1.10 The HVAC ~~total system performance ratio~~ TSPR for both the standard reference design and the proposed design.

2. A mapping of the actual building HVAC component characteristics and those simulated in the proposed design showing how individual pieces of HVAC equipment identified above have been combined into average inputs as required by Section C409.6.1.10 including:
   2.1 Fans
   2.2 Hydronic pumps
   2.3 Air handlers
   2.4 Packaged cooling equipment
   2.5 Furnaces
   2.6 Heat pumps
   2.7 Boilers
   2.8 Chillers
   2.9 Heat rejection equipment (open and closed-circuit cooling towers; dry coolers)
   2.10 Electric resistance coils
   2.11 Condensing units
   2.12 Motors for fans and pumps
   2.13 Energy recovery devices
3. For each piece of equipment identified above include the following as applicable:
   3.1 Equipment name or tag consistent with that found on the design documents.
   3.2 Rated Efficiency level.
   3.3 Rated Capacity.
   3.4 Where not provided by the simulation program report in item a, documention of the calculation of any weighted equipment efficiencies input into the program.
   3.5 Electrical input power for fans and pumps (before any speed or frequency control device) at design condition and calculation of input value (W/cfm(W/Lps) or W/gpm (W/Lps)).
4. Floor plan of the building identifying:
   4.1 How portions of the buildings are assigned to the simulated blocks.
   4.2 Areas of the building that are not covered under the requirements of Section C403.1.1.

C409.6 Calculation Procedures. Except as specified by this Section, the standard reference design and proposed design shall be configured and analyzed using identical methods and techniques

C409.6.1 Simulation of the proposed building design. The proposed design shall be configured and analyzed as specified in this section.

C409.6.1.1 Block Geometry. The geometry of buildings shall be configured using one or more blocks. Each block shall define attributes including block dimensions, number of floors, floor to floor height and floor to ceiling height. Simulation software may allow the use of simplified shapes (such as rectangle, L shape, H Shape, U shape or T shape) to represent blocks. Where actual building shape does not match these pre-defined shapes, simplifications are permitted providing the following requirements are met:

1. The conditioned floor area and volume of each block shall match the proposed design within 10 percent.
2. The area of each exterior envelope component from Table C402.1.4 is accounted for within 10 percent of the actual design.
3. The area of vertical fenestration and skylights is accounted for within 10 percent of the actual design.

4. The orientation of each component in 2 and 3 above is accounted for within 45 degrees of the actual design.

The creation of additional blocks may be necessary to meet these requirements. A more complex zoning of the building shall be allowed where all thermal zones in the reference and proposed model are the same and rules related to block geometry and HVAC system assignment to blocks are met with appropriate assignment to thermal zones.

Exception: Portions of the building that are unconditioned or served by systems not covered by the requirements of Section C403.1.1 shall be omitted.

Revise as follows:

C409.6.1.1.1 Number of Blocks. One or more blocks may be required per building based on the following restrictions:

1. Each *block* ~~can~~ shall have ~~only~~ no more than one building use ~~occupancy type (multifamily *dwelling unit*, multifamily common area, office, library, education, hotel/motel or retail). Therefore, at least one single *block* shall be created for each unique use type~~.
2. Each block ~~can~~ shall be served by ~~only~~ no more than one type of HVAC system. ~~Therefore, a~~ A single block shall be created for each unique HVAC system and building use ~~type~~ combination and ~~. Multiple HVAC units of the same type may be represented in one block. Table D601.10.2 provides directions for combining~~ multiple HVAC units or components of the same type shall be combined in accordance withSection C409.6.1.10.2 . ~~of the same type into a single block~~.
3. Each block ~~can~~ shall have no more than a single defined ~~ition of~~ floor~~-to-~~ -to-floor or floor ~~-to-~~ -to-ceiling height ~~s~~. Where floor heights differ by more than two feet, ~~unique~~ separate blocks ~~should~~ shall be created f ~~or the floors with varying heights~~.
4. Each block ~~can~~ shall include either above grade or below grade stories ~~floors~~. For buildings with both above grade and below grade stories ~~floors~~, separate blocks ~~should~~ shall be created for each. Where blocks have exterior walls partially below grade, if greater than 50 percent of the exterior wall surface is below grade, then simulate the block as below grade;otherwise simulate as above grade . ~~For buildings with stories floors partially above grade and partially below grade, if the total wall area of the floor(s) in consideration is greater than or equal to 50 percent above grade, then it should be simulated as a completely above grade block, otherwise it should be simulated as a below grade block.~~
5. ~~Each wall on a façade of a block shall have similar vertical fenestration.~~Where a block includes multiple stories, separate blocks shall be created, if needed, to comply with both the following fenestration modeling requirements:
   5.1. The product of the proposed design U-factor times the area of windows (U•A) on a given story of each façade ~~of a given~~ shall not ~~floor cannot~~ differ by more than 15 percent of the average U •A for that modeled façade in each block.
   5.2 The product of the proposed design SHGC times the area of windows (SHGC•A) on a given story of each façade ~~of a given~~ shall not ~~floor cannot~~ differ by more than 15 percent of the average SHGC •A for that modeled façade in each block.

   ~~If either of these conditions are not met, additional blocks shall be created consisting of floors with similar fenestration~~.
6. For a building model with multiple blocks, the blocks~~should~~ shall be configured together to have the same adjacencies as the actual building design.

C409.6.1.2 Thermal Zoning. Each ~~floor~~ story in a block shall be modeled ~~a single thermal zone or as five thermal zones consisting of four perimeter zones and a core zone.~~ as follows:

1. Below grade ~~floor~~ stories shall be modeled as a single thermalzone ~~block~~.
2. Where ~~If~~ any façade in the block is less than 45 feet in length, it shall be modeled as ~~there shall only be~~ a single thermal zone per ~~floor~~ story.
3. Otherwise, each ~~floor~~ story shall be modeled with five thermal zones. A perimeter zone shall be created extending from each façade to a depth of 15 feet. Where facades intersect, the zone boundary shall be formed by a 45 degree angle with the two facades. The remaining area or each ~~floor~~ story shall be modeled as a core zone with no exterior walls.

C409.6.1.2.1 ~~C409.3~~ Core & Shell, ~~/ Initial~~ Build-Out, and Future System Construction Analysis. Where the building permit applies to only a portion of the HVAC system in a *building* and the remaining components will be designed under a future building permit or were previously installed, ~~the future or previously installed~~ such components shall be modeled as follows:

1. ~~Where the HVAC zones that do not include~~ Blocks including existing or future HVAC zones ~~systems in the current permit will be or are~~ served by independent systems and not part of the construction project shall not be modeled ~~, then the block including those zones shall not be included in the model~~.
2. Where the HVAC zones that do not include complete HVAC systems in the permit are intended to receive HVAC services from systems that are part of the construction project ~~in the permit~~, their proposed zonal systems shall be modeled with equipment that meets, but does not exceed, the requirements of Section C403.
3. Where existing HVAC systems serve permitted ~~the~~ zone equipment ~~in the permit receives HVAC services from previously installed systems that are not in the permit,~~ the ~~previously installed~~ existing systems shall be modeled with equipment matching the manufacturer's stated efficiency for the ~~certified value of what is~~ installed equipment or equipment that meets, but does not exceed the requirements of complying with Section C403.
4. Where the central plant heating and cooling equipment is completely replaced and HVAC zones with existing systems receive HVAC services from systems in the permit, their proposed zonal systems shall be modeled with equipment that meets, but does not exceed, the requirements of Section C403.

C409.6.1.3 Occupancy. Building occupancies modeled in the standard reference design and the proposed design shall comply with the following requirements.

Revise as follows:

C409.6.1.3.1 Occupancy Type. The occupancy type for each block shall be consistent with the building occupancy and uses specified in Table C409.4 ~~area type as determined in accordance with Section C405.4.2.1.~~ Portions of the building that are building occupancy and uses other than those specified in Table C409.4 ~~area types multifamily dwelling unit, multifamily common area, office, school (education), library, or retail~~ shall not be included in the simulation. Surfaces adjacent to such excluded building portions shall be modeled as adiabatic in the simulation program.

C409.6.1.3.2 Occupancy schedule, density, and heat gain. The occupant density, heat gain, and schedule shall be for multifamily, office, retail, library, hotel/motel or school as specified by ASHRAE Standard 90.1 Normative Appendix C.

C409.6.1.4.1 Roofs. ~~Roofs will be modeled with insulation above a steel roof deck.~~ The roof U-factor and area shall be modeled as in the proposed design. If different roof thermal properties are present in a single block, an area weighted U-factor shall be used. Roofs shall be modeled with insulation above a steel roof deck, with ~~Roof~~ solar absorptance ~~shall be modeled at~~ of 0.70 and emittance ~~at~~ of 0.90.

C409.6.1.4.2 Above grade walls. ~~Walls will be modeled as steel frame construction.~~ The U-factor and area of above grade walls shall be modeled as in the proposed design. If different wall constructions exist on the façade of a block an area-weighted U-factor shall be used. Walls shall be modeled as steel frame construction.

C409.6.1.4.3 Below grade walls. The C-factor and area of below grade walls shall be modeled as in the proposed design. If different ~~slab on grade floor~~ below grade wall constructions exist in a block, an area-weighted C- factor shall be used.

C409.6.1.4.4 Above grade exterior floors. ~~Exterior floors shall be modeled as steel frame.~~ The U-factor and area of floors shall be modeled as in the proposed design. If different ~~wall~~ floor constructions exist in the block an area-weighted U-factor shall be used. Exterior floors shall be modeled as steel frame.

C409.6.1.4.5 Slab on grade floors. The F-factor and ~~area~~ perimeter of slab on grade floors shall be modeled as in the proposed design. If different ~~below grade wall~~ slab on grade floor constructions exist in a *block*, a~~n area~~ perimeter-weighted F- factor shall be used.

C409.6.1.4.6 Vertical Fenestration. The window area and area weighted U-factor and SHGC shall be modeled for each façade based on the proposed design. Each exterior surface in a block must comply with Section C409.6.1.1.1 item 5. Windows ~~will~~ shall be combined into a single window centered on each façade based on the area and sill height input by the user. When different U values, SHGC or sill heights exist on a single facade in a block, the area weighted average for each shall be input by the user.

C409.6.1.4.7 Skylights. The skylight area and area weighted U-factor and SHGC shall be modeled for each roof ~~floor~~ based on the proposed design. Skylights ~~will~~ shall be combined into a single skylight centered on the roof of each zone based on the area input by the user.

C409.6.1.4 Envelope Components. Building envelope components modeled in the standard reference design and the proposed design shall comply with the requirements of this Section.

C409.6.1.4.8 Exterior Shading. Permanent window overhangs shall be modeled. When windows with and without overhangs or windows with different overhang projection factors exist on a façade, window width weighted projection factors shall be input by the user as follows:

$$P_{avg} = (A1 \times L_{o1} + A2 \times L_{o2} \ldots + An \times L_{on})/(Lw_1 + Lw_2 \ldots + L_{wn})$$

C409.6.1.5 Lighting. Interior lighting power density shall be equal to the allowance in Table C405.4.2(1) for multifamily, office, retail, library, or school. The lighting schedule shall be for multifamily, office, retail, library, or school as specified by ASHRAE Standard 90.1 Normative Appendix C. The impact of lighting controls is assumed to be captured by the lighting schedule and no explicit controls shall be modeled. Exterior lighting shall not be modeled.

C409.6.1.6 Miscellaneous equipment. The miscellaneous equipment schedule and power shall be for multifamily, office, retail, library, or school as specified by ASHRAE Standard 90.1 Normative Appendix C. The impact of miscellaneous equipment controls is assumed to be captured by the equipment schedule and no explicit controls shall be modeled.

Exceptions:

1. Multifamily dwelling units shall have a miscellaneous load density of 0.42 W/ft^2
2. Multifamily common areas shall have a miscellaneous load density of 0 W/ft^2

C409.6.1.7 Elevators. Elevators shall not be modeled.

C409.6.1.8 Service water heating equipment. Service water heating shall not be modeled.

C409.6.1.9 On-site renewable energy systems. On-site Renewable Energy Systems shall not be modeled.

Revise as follows:

C409.6.1.10 HVAC equipment. Where proposed or reference system parameters are not specified in Section C409, HVAC systems shall be modeled to meet the minimum requirements of Section C403 Mechanical Systems.

C409.6.1.10.1 Supported HVAC systems. At a minimum, the HVAC systems shown in Table C409.6.1.10.1 ~~CD105.2.10~~.1 shall be supported by the simulation program.

Reason: The changes here are the result of several SEHPCAC meetings with the CEPI-76 proponents to improve clarity of the new section.

There are no changes in intended requirements as a result of these changes.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Proposed changes are clarification and editorial only.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal is based on several SEHPCAC meetings with CEPI-76 to clarify the section. There are no changes to the section requirements. The modeling SC unanimously approved the proposal with no comment.

Final Hearing Results

CED1-198-22	AS

CED1-203-22

Original Proposal

IECC: SECTION 202 (New), C406.1.3, C503.6

Proponents: Jack Bailey, ONE LUX STUDIO, INTERNATIONAL ASSOCIATION OF LIGHTING DESIGNERS (jbailey@oneluxstudio.com)

2024 International Energy Conservation Code [CE Project]

Add new definition as follows:

SUBSTANTIAL IMPROVEMENT. Any *repair,* reconstruction, rehabilitation, *alteration, addition* or other improvement of a building or structure, the cost of which equals or is more than 50 percent of the market value of the structure before the improvement. Where the structure has sustained substantial damage, as defined in the *International Building Code*, any repairs are considered substantial improvement regardless of the actual *repair* work performed. Substantial improvement does not include the following:
1. Improvement of a *building* required to correct health, sanitary or safety code violations ordered by the*code official*. 2. Alteration of a *historic building* where the *alteration* will not affect the designation as a historic building.

Revise as follows:

~~**C406.1.3 Substantial Alterations to Existing Buildings.** The *building envelope*, *equipment*, and *systems* in *alterations* to *buildings* exceeding 5000 square feet (46.5 m^2) of *gross conditioned floor area* shall comply with the requirements of Section C406.1.1 and C406.1.2 where the alteration includes replacementof two or more of the following:~~

1. ~~HVAC unitary systems or HVAC central heating or cooling equipment serving the alteration area, not including ductwork or*piping*.~~
2. ~~80% or more of the lighting fixtures in the *alteration* area.~~
3. ~~Building envelope components in the *alteration* area including new exterior cladding, fenestration, or insulation.~~

C503.6 Additional energy efficiency credits. ~~*Alterations* shall comply with measures from Sections C406.2 and C406.3 to achieve not less than 10 percent the number of required efficiency credits from Table C406.1.1 based on building occupancy group and *climate zone*. Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of this section.~~Alterations that are substantial improvements shall comply with measures from Sections C406.2, Section C406.3, or both to earn the number of required credits specified in Table C406.1.1 based on building occupancy group and climate zone. Where a project contains multiple occupancies, credits specified in Table C406.1.1 for each building occupancy shall be weighted by the gross conditioned floor area to determine the weighted average credits required. Accessory occupancies, other than Groups F or H, shall be included with the primary occupancy group for the purposes of this section.

Exceptions:

1. ~~*Alterations* that include replacement of no more than one of the following~~:
   - ~~1.1 HVAC unitary systems or HVAC central heating or cooling equipment serving the*work area* of the *alteration*.~~
   - ~~1.2 Water heating equipment serving the *work area* of the alteration.~~
   - ~~1.3 50 percent or more of the lighting fixtures in the*work area* of the alteration.~~
   - ~~1.4 50 percent or more of the area of interior surfaces of the thermal envelope in the*work area* of the alteration.~~
   - ~~1.5 50 percent or more of the building's *exterior wall envelope*, including fenestration~~.
2. ~~*Alterations* to *buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, High-Hazard Group H~~.

1. *Alterations* that do not contain conditioned space.
2. Portions of *buildings* devoted to manufacturing or industrial use.

3. *Alterations* to *buildings* where the building after the *alteration* complies with Section C407.

~~4. *Buildings* in Climate Zone 0A.~~

4. *Alterations* that are permitted with an*addition* complying with Section C502.3.7.

~~6. *Alterations* that comply with Section C407~~.

Reason: To ensure that this section of the code is usable and enforceable.

There are several problems which are fixed by this proposed revision:

1. This proposal assumes that compliance is not required unless the specified conditions are met. This limits the risk of unusual project types not being able to comply with the code just because the authors of the code didn't think of them when a list of exceptions was created.

2. This proposal requires that only substantial alterations will be required to achieve efficiency credits. This is important because the vast majority of alterations are truly small-scale projects without sophisticated design teams to wade through the compliance requirements.

3. This proposal specifies that credits are achieved only from work being done as part of the alteration. This allows projects to be completed that upgrade only part of inefficient buildings without adding to the scope of the project, and also requires that alterations of inefficient parts of otherwise efficient buildings will have to do more.

4. This proposal specifies which credits are achievable for each type of alteration. Some credits (for example L04 increase daylight area, or E03 envelop leak reduction) really should not be allowed unless the entire building is being modified.

5. This proposal indicates that the restrictions on credit combinations identified in C406.2.1, C406.2.2, C406.2.3, and C406.2.5 will apply to alterations as well.

6. This proposal deletes C406.1.3, which is redundant.

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

This proposal will significantly reduce the burden of cost and complexity for small alterations.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal clarifies the scope threshold where alteration projects are subject to obtaining C406 credits.

Final Hearing Results

CED1-203-22 AM

CED1-204-22

Original Proposal

IECC: CC101.1, SECTION 202, CC103.1, CC103.2 (New), CC103.2.1, CC103.3.1, CC103.3.2, CC103.3.3, CC103.3.3.1, CC103.2

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

CC101.1 Purpose. The purpose of this appendix is to supplement the *International Energy Conservation Code* and require renewable energy systems of adequate capacity to achieve net zero operational energy.

GREEN RETAIL PRICING. A program by the retail electricity provider to provide 100-percent renewable energy to the building project owner.

Revise as follows:

OFF-SITE RENEWABLE ENERGY SYSTEM. Renewable energy system which serves the building project and is not an on-site renewable energy system, including contracted purchases of renewable energy and renewable energy certificates.

ON-SITE RENEWABLE ENERGY SYSTEM.
Renewable energy systems located on any of the following:
1. The *building*.
2. The property upon which the *building* is located.
3. A property that shares a boundary with and is under the same ownership or control as the property on which the *building* is located, or
4. A property that is under the same ownership or control as the property on which the *building* is located and is separated only by a public right-of way ~~on which the *building* is located~~ from the building being served by the renewable energy system.

RENEWABLE ENERGY SYSTEM. Photovoltaic, solar thermal, geothermal energy extracted from hot fluid or steam, wind, or other approved ~~renewable energy production~~ systems used to generate renewable energy.

CC103.1 Renewable energy. On-site renewable energy systems shall be installed, or adjusted off-site renewable energy shall be procured to ~~offset the building energy as calculated in Equation CC-1~~ meet the minimum renewable energy requirement in accordance with Section CC103.1.1.

$$RE_{onsite} + RE_{offsite} \geq RE_{min}$$

where: **(Equation CC-1)**

RE_{onsite} = Annual site energy production from on-site renewable energy systems ~~(see Section CC103.2~~), including installed on-site renewable energy systems used for compliance with C405.13.1 and C406.5.

$RE_{offsite}$ = Adjusted annual energy production from off-site renewable energy systems that ~~may~~ is permitted to be credited against the minimum renewable energy requirement ~~(see Section CC103.3).~~ This includes ~~including~~ off-site renewable energy purchased for compliance with C405.13.2.

RE_{min} = Minimum renewable energy requirement.

When Section C401.2.1(1) is used for compliance with the *International Energy Conservation Code*, the minimum renewable energy requirement shall be determined by multiplying the gross *conditioned floor area* plus the gross semiheated floor area of the proposed building by the prescriptive renewable energy requirement from Table CC103.1. An area weighted average shall be used for mixed-use buildings.When Section C401.2.1, Item 2 or Section C401.2.2 is used for compliance with the*International Energy Conservation Code*, the minimum renewable energy requirement shall be equal to the building energy as determined from energy simulations.

Add new text as follows:

CC103.2 Procurement Factors for Renewable Energy System Compliance Alternatives

Renewable Energy Systems	Procurement Factors
Onsite renewable energy with a capacity of not less than 7.5 W/f^2 ~~:~~	1.0
Offsite renewable energy complying with Section CC103.3.1	0.90
Unbundled renewable energy certificates	0.75
Offsite renewable energy systems used to comply where the building site is located where an unshaded flat plate collector oriented toward the equator and tilted at an angle from horizontal equal to the latitude receives an annual daily average incident solar radiation less than 1.1 kBtu/ft^2 - day (3.5 kWh/m^2 - day).	1.0
Offsite renewable energy systems used to comply where more than 80 percent of the roof area is covered by any combination of permanent obstructions such as, but not limited to, mechanical equipment, vegetated space, access, pathways, or occupied roof terrace.	1.0
Offsite renewable energy systems used to comply where more than 50 percent of the roof area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the building more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.	1.0

Revise as follows:

CC103.2.1 Renewable energy certificates. ~~r~~*Renewable energy certificates (RECs)* ~~and other environmental attributes~~ associated with the *on-site renewable energy system* shall be assigned to the initial and subsequent building owner(s) for acumulative period of not less than 15 years. The building owner(s) ~~may~~ are permitted to transfer ~~*renewable energy certificates*~~ *RECs* to building tenants ~~while they are~~ occupying the building.

CC103.3.1 ~~Qualifying off-site~~ Offsite procurement methods.. ~~The following are considered qualifying off-site~~ Offsite renewable energy systems used to comply with Section CC103.1 shall be one or more of the following~~procurement methods~~:

1. *Community renewables energy facility*
2. *Renewable energy investment fund*
3. *Financial renewable energy power purchase agreement*
4. *Direct ownership*
5. *Direct access to wholesale market*
6. *Green retail pricing*
7. Unbundled *Renewable Energy Certificates (RECs*)
8. *Physical renewable energy power purchase agreement.*

CC103.3.2 Requirements for all procurement methods. ~~The following requirements shall apply to all *off-site renewable energy* procurement methods:~~ Offsite renewable enregy systems used to comply with Section CC103.1 shall comply with one or more of the following:

~~1. The building owner shall sign a legally binding contract or other approved agreement to procure qualifying off-site renewable energy.~~

~~2~~ 1. The procurement contract shall have duration of not less than 15 years and shall be structured to survive a partial or full transfer of ownership of the property.

~~3~~ 2. RECs ~~and other environmental attributes~~ associated with the procured ~~*off-site*~~ offsite *renewable energy* shall ~~meet all of~~ comply with the following requirements:

  ~~3~~ 2.1 The RECs shall be ~~Are~~ retained or retired by or on behalf of the property owner or tenant for a period of not less than 15 years.

  ~~3~~ 2.2 The RECs shall be ~~Are~~ created within a 12-month period of use of the REC; and

  ~~3~~ 2.3 The RECs shall be ~~Are~~ from a generating asset constructed no more than 5 years before the issuance of the certificate of occupancy.

~~4~~ 3. The generating source shall be a renewable energy system.

~~5~~ 4. The generation source shall be located where the energy can be delivered to the building site by any of the following:

  ~~5~~ 4.1 Direct ~~By direct~~ connection to the *off-site renewable energy facility*.

  ~~5~~ 4.2 The ~~By the~~ local utility or distribution entity.

  ~~5~~ 4.3 An By an interconnected electrical network where energy delivery capacity between the generator and the building site is available.

~~6~~ 5. Records on power sent to or purchased by the building shall be retained by the building owner and made available for inspection by the code official upon request.

CC103.3.3 Adjusted off-site renewable energy. The ~~process for calculating the~~ adjusted *off-site renewable energy* ~~is shown in~~ shall be calculated in accordance with Equation CC-2.

$$RE_{offsite} = \sum_{i=1}^{n} PF_i \times RE_i = PF_1 \times RE_1 + PF_2 \times RE_2 + \ldots + PF_n \times RE_n$$ **(Equation CC-2)**

where:

$RE_{offsite}$ = Adjusted off-site renewable energy.
PF_i = Procurement factor for the i^{th} renewable energy procurement method perspecified by Table CC103.2 ~~Section CC103.3.3.1.~~
RE_i = Annual energy production for the i^{th} renewable energy procurement method .
n = The number of renewable energy procurement methods~~considered~~ used for compliance with Section CC103.1.

CC103.3.3.1 Procurement factors. ~~When installed on-site renewable energy capacity is 7.5 W/ft² (80.7 W/m²) of roof area or greater, the procurement factor is 1.00, otherwise, the procurement factor is 0.75, except for unbundled *renewable energy certificates* which shall have a procurement factor of 0.20. A procurement factor of 1.0 may also be used when the conditions of exceptions 1, 2, or 3 to Section C405.13.1 are satisfied.~~
The procurement factors for renewable energy system compliance alternatives shall be as specified in Table CC103.2 .

Exception: The procurement factor for R-2 occupancies shall be 1.0.

CC103.2 Calculation of on-site renewable energy. The annual energy production from on-site renewable energy systems shall be determined using approved software approved ~~by the code official~~.

Reason: An exception permitting a procurement factor of 1 for R-2 occupancies is provided. R-2 occupancies need the flexibility provided with procurement of offsite renewable energy generation, including compliance through the purchase of renewable energy certificates, without the ‘location’ penalties. This incentivizes 'more sustainable building locations (urban areas) where renewable onsite options are limited.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Eliminates the renewable energy location penalty for R-2 occupancies.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal makes several editorial changes to the Net Zero Appendix, Appendix CC.

Final Hearing Results	
CED1-204-22	AM

CED1-208-22

Original Proposal

IECC: CD101.4.1, SECTION 202 (New)

Proponents: Charles Eley, Eley Consulting, Architecture 2030 (charles@eley.com)

2024 International Energy Conservation Code [CE Project]

Update standard(s) as follows:

CD101.4.1 Off-site procurement. The *building owner* shall procure and be credited for the total amount of off-site renewable energy required by Equation CD-4. Procured off-site renewable energy shall comply with the requirements applicable to not less than one of the following:

1. *Community renewables energy facility.*
2. *Financial renewable energy power purchase agreement.*
3. *Physical renewable energy power purchase agreement.*
4. *Direct ownership.*
5. *Renewable Energy Investment Fund.*
6. <u>*Green retail tariff*</u>

Add new definition as follows:

<u>**GREEN RETAIL TARIFF.** An electricity-rate structure qualified under applicable statutes or rules contracted by an electricity service provider to the *building project* owner to provide electricity generated with 100% *renewable energy resources.*</u>

Reason: A green retail tariff is a special program offered by electric service providers (utilities) whereby they acquire 100% renewable energy to meet the electricity demands of a participating customer. The customer typically pays a premium in the range of one to two cents per kilowatt-hour (similar to participation in a community solar program). The delivered renewable energy is in addition to that required to meet applicable renewable portfolio standards and the RECs associated with the renewable energy are retired on behalf of the participating customer (as required by C405.15.3).

Section C405.15.2.2 would apply to green retail tariffs as it does to all off-site procurement options. A contract is required: (1) with a duration of at least 10 years, (2) that is structured to survive a transfer of ownership, and (3) and that acquires renewable energy in concert with energy consumption.

Retail green pricing is the most common method for procuring off-site renewable energy and the only option available to many building owners/managers. This is the option most widely used in Boston, San Francisco and other cities where the purchase of off-site renewable energy is already required for some building types and sizes.

Off-site renewable energy purchases are recognized in three places in the standard and this code change proposal strives to make the methods more consistent in section C405.15, Appendix CC and Appendix CD.

Not including this option will limit the ability of building owners to purchase off-site renewable energy and undermine the effectiveness of the Glide Path.

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

Increasing the number of options will create more competition and reduce compliance cost.

Public Hearing Results

Committee Action **As Submitted**

Final Hearing Results

CED1-208-22	AS

CED1-209-22

Original Proposal

IECC: C409.6.1.4.1

Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C409.6.1.4.1 Roofs. Roofs will be modeled with insulation above a steel roof deck. The roof U-factor and area shall be modeled as in the proposed design. If different roof thermal properties are present in a single block, an area weighted U-factor shall be used. Roof solar reflectance~~absorptance~~ shall be modeled at 0.25 ~~0.70~~ and emittance at 0.90.

Exception: For Climate Zones 0, 1, 2, and 3, solar reflectance and emittance shall be as specified in Section C402.4 and Table C402.4.

Reason: Roof solar absorptance in section C409.6.1.4.1 is adjusted from 0.70 to 0.75 to align with the roof solar absorptance of the Standard Reference Design in the Simulated Building Performance provisions as shown in Table C407.4.1(1). The exception recognizes new provisions in Table C407.4.1(1) that are specific to Climate Zones 0, 1, 2, and 3. By reference to Section C402.4, those new provisions require solar reflectance of 0.55 (solar absorptance of 0.45) and thermal emittance of 0.75 for Climate Zones 0 to 3. In communications during the initial phase of deliberations, the proponents of CEPI-76 (which added section C409.6.1.4.1) indicated their intention was to have the HVAC Total System Performance Ratio standard design roof solar absorptance match the value in C407. Acceptance of this minor modification will establish equivalent parameters between C407 and C409.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed change creates consistency between different options. It is not expected to increase or decrease the cost of construction because parity between alternatives is the intent.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposed change align the requirements in C409 with changes in C402.

Final Hearing Results

CED1-209-22 AM

CEPI-7-21

Original Proposal

IECC®: SECTION 202 (New), C103.2, C105.2.5, C405.15 (New), C405.15.1 (New), C405.15.2 (New), C405.15.2.1 (New), C405.15.2.2 (New), C405.15.2.3 (New), UL Chapter 06 (New), CB103.6, CB103.7, CB103.8, CB103.9

Proponents: Kim Cheslak, NBI, NBI (kim@newbuildings.org); Bryan Bomer, Department of Permitting Services, Montgomery County MD, Department of Permitting Services (bryan.bomer@montgomerycountymd.gov); Lauren Urbanek, Natural Resources Defense Council (lurbanek@nrdc.org); Ben Rabe, Fresh Energy (rabe@fresh-energy.org); Kim Burke, State of Colorado, Colorado Energy Office (kim.burke@state.co.us); Howard Calvert Wiig, Hawaii State Energy Office, Hawaii State Energy Office (howard.c.wiig@hawaii.gov); Chris Castro, City of Orlando, City of Orlando (chris.castro@orlando.gov); Brad Smith, City of Fort Collins (brsmith@fcgov.com); Amber Wood, ACEEE, ACEEE (awood@aceee.org)

2021 International Energy Conservation Code

Add new definition as follows:

<u>**ENERGY STORAGE SYSTEM (ESS).**</u> <u>One or more devices, assembled together, capable of storing energy in order to supply electrical energy at a future time.</u>

Revise as follows:

C103.2 Information on construction documents. Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted where *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

1. Energy compliance path.
2. Insulation materials and their *R*-values.
3. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
4. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Economizer description.
8. Equipment and system controls.
9. Fan motor horsepower (hp) and controls.
10. Duct sealing, duct and pipe insulation and location.
11. Lighting fixture schedule with wattage and control narrative.
12. Location of *daylight* zones on floor plans.
13. Air barrier and air sealing details, including the location of the air barrier.
14. <u>Location reserved for inverters, metering equipment, ESS, and a pathway reserved for routing of raceways or conduit from the renewable energy system to the point of interconnection with the electrical service and the ESS.</u>
15. <u>Location and layout of a designated area for ESS</u>.
16. <u>Rated energy capacity and rated power capacity of the installed or planned ESS</u>.

C105.2.5 Electrical system. Inspections shall verify lighting system controls, components and meters as required by the code, *approved* plans and specifications. Where an electrical energy storage system area is required, inspections shall verify space availability and pathways to electrical service.

Add new text as follows:

C405.15 Electrical energy storage system. Buildings shall comply with the one of C405.15.1 or C405.15.2.

C405.15.1 Electrical energy storage energy capacity. Each building shall have one or more ESS with a total rated energy capcity and rated power capacity as follows:

1. ESS rated energy capacity (kWh)≥1.0 x Installed PV System Rated Power (kW_{DC})
2. ESS rated power capacity (kW)≥0.25 x Installed PV System Rated Power (kW_{DC})

Where installed, DC coupled battery systems shall meet the requirements for rated energy capacity alone.

C405.15.2 Electrical energy storage system ready. Each building shall have one or more reserved ESS-ready areas to accomododate future electrical storage complying with the following:

1. Energy storage system rated energy capacity (kWH) ≥ Conditioned floor area of the three largest stories (f^2~~t)~~) x 0.0008 kWh/ft^2
2. Energy storage system rated power capacity (kW) ≥ Conditioned floor area of three largest stories (f^2~~t)~~) x 0.0002 kWh/ft^2

C405.15.2.1 ESS-ready location. Each ESS-ready area shall be located in accordance with Section 1207 of the*International Fire Code*.

C405.15.2.2 ESS-ready minimum area requirements. Each ESS-ready area shall be sized in accordance with the spacing requirements of Section 1207 of the *International Fire Code* and the UL9540 or UL9540A designated rating of the planned system. Where rated to UL9540A, the shall be in accordance with the manufacturer's instructions.

C405.15.2.3 Electrical distribution equipment. The onsite electrical distribution equipment shall have sufficient capacity, rating, and space to allow installation of overcurrent devices and circuit wiring in accordance with NFPA 70 for future electrical ESS installation complying with the criteria of Section C405.15.2.

Add new standard(s) as follows:

UL

UL LLC
333 Pfingsten Road
Northbrook, IL 60062

9540-2020	Standard for Energy Storage Systems and Equipment
9540A-2019	Standard for Safety Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

Revise as follows:

CB103.6 Interconnection pathway. Construction documents shall indicate pathways for routing of conduit or piping from the solar-ready zone to the electrical service panel ~~and electrical energy storage system area~~ or service hot water system.

~~**CB103.7 Electrical energy storage system-ready area.** The floor area of the electrical energy storage system-ready area shall be not less than 2 feet (610 mm) in one dimension and 4 feet (1219 mm) in another dimension, and located in accordance with Section 1207 of the *International Fire Code*. The location and layout diagram of the electrical energy storage system-ready area shall be indicated on the construction documents~~.

~~**CB103.8**~~**CB103.7 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 and ~~a dual-pole circuit breaker for future electrical energy storage system installation. These spaces~~ shall be labeled “For Future Solar Electric~~ and Storage~~.” The reserved space~~s~~ shall be positioned at the end of the panel that is opposite from the panel supply conductor connection.

~~CB103.9~~CB103.8 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: Energy storage will soon become critical to achieving President Biden’s goal of a carbon-free power sector by 2035. These systems could also bolster economy, present a cost savings opportunity for homeowners and increase resilience to power outages. In 2020, 21% of the United State’s electricity is sourced from renewable energy, primarily wind, an intermittent source of energy. As the U.S. increases the amount of electricity generated from renewables, buildings must be prepared to aid in this transition by storing energy to match grid demands.

Policies to encourage energy storage will improve the U.S. economy. Energy storage is expected to grow by over 40% each year until 2025 and the U.S., because of its manufacturing background and experience in battery-storage technology for cars is becoming a clear leader in this market.

Energy storage will also present a cost-saving opportunity. Battery prices have and will likely continue to fall in the United States, meaning that behind-the-meter storage will likely become more accessible and affordable in the short-term. More and more utilities are moving beyond voluntary programs and are expanding use of time-of-use rates for electricity as a tool for shaping demand. Ensuring buildings are energy-storage ready now will allow them to cost effectively install storage systems in the future and take advantage of these programs.

Finally, energy storage will improve resilience to power outages. In 2020, DOE found that an average household in the United States goes without power for 8 hours in a year. Because of extreme weather events caused by climate change, those outages are increasing. These outages are estimated to cost the U.S. economy between $25 billion to $70 billion annually. Requiring buildings to be storage-ready will ensure communities are more resilient by allowing buildings to cost effectively install storage which can operate for a short-period of time without relying on the electricity grid.

Bibliography: Renewables Became the Second-Most Prevalent U.S. Electricity Source in 2020 , U.S. Energy Information Administration, https://www.eia.gov/todayinenergy/detail.php?id=48896.

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Lee, Timothy. Battery Prices Have Fallen 88 Percent over the Last Decade. Ars Technica, 18 Dec. 2020, arstechnica.com/science/2020/12/battery-prices-have-fallen-88-percent-over-the-last-decade/#:~:text=The%20average%20cost%20of%20a,of%2013%20percent%20since%202019.

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Economic Benefits of Increasing Electric Grid Resilience to Weather Outages, U.S. Department of Energy and President's Council of Economic Advisors, Aug. 2013, https://www.energy.gov/sites/prod/files/2013/08/f2/Grid%20Resiliency%20Report_FINAL.pdf.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Analysis completed by NBI using RSMeans showed no incremental costs for this measure.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal will reduce the future cost of installing ESS by requiring ESS-ready criteria.

Final Hearing Results

CEPI-7-21	AM

CEPI-8-21 Part I

Original Proposal

IECC®: SECTION C104, C104.1, C104.2, C104.3 (New), C104.3, C104.4, C104.5
Proponents: Mike Nugent, Building Code Action Committee (bcac@iccsafe.org); Kris Stenger, SEHPCAC (sehpcac@iccsafe.org)

THIS IS A 2 PART PROPOSAL. PART I WILL BE HEARD BY THE IECC-COMMERCIAL COMMITTEE. PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Energy Conservation Code

SECTION C104
FEES

Revise as follows:

C104.1 Payment of Fees. A permit shall not be ~~issued~~ valid until the fees prescribed ~~in Section C104.2~~ by law have been paid~~, nor~~. Nor shall an amendment to a permit be released until the additional fee, if any, has been paid.

C104.2 Schedule of permit fees. ~~A~~ Where a permit is required, a fee for each permit shall be paid as required, in accordance with the schedule as established by the applicable governing authority.

Add new text as follows:

C104.3 Permit valuation. The applicant for a permit shall provide an estimated value of the work for which the permit is being issued at the time of application. Such estimated valuations shall include the total value of the work, including materials and labor. Where, in the opinion of the *code official*, the valuation is underestimated, the permit shall be denied, unless the applicant can show detailed estimates acceptable to the *code official*. The final valuation shall be *approved* by the *code official*.

Revise as follows:

~~**C104.3**~~ **C104.4 Work commencing before permit issuance.** Any person who commences any work before obtaining the necessary permits shall be subject to ~~an additional~~ a fee established by the *code official* that shall be in addition to the required permit fees.

~~**C104.4**~~ **C104.5 Related fees.** The payment of the fee for the construction, *alteration*, removal or demolition of work done in connection to or concurrently with the work or activity authorized by a permit shall not relieve the applicant or holder of the permit from the payment of other fees that are prescribed by law.

~~**C104.5**~~ **C104.6 Refunds.** The *code official* is authorized to establish a refund policy.

Reason: The intent is consistency in language for 'Fees' within the codes.

- Payment of fees – consistent title, always two sentences
- Schedule of permit fees – Not all projects require a fee - Commercial and Residential are currently different in this section.
- Permit valuation: This lets the jurisdiction establish fees for permits.
- Work commencing before permit issuance – remove redundant language
- Refunds – no change

The BCAC is working from the philosophy that ICC is a family of codes, so administrative requirements should be consistent across books. Most administrative and enforcement matters are the same for any code. Those matters unique for a specific code remain unchanged. This is one of a series of proposals being submitted relating to technical, editorial and organizational changes proposed for the Administrative chapters (Chapter 1) in all of the I-Codes.

This proposal is submitted by the ICC Building Code Action Committee (BCAC) and the ICC Sustainable and Energy and High Performance Code Action Committee (SEHPCAC).

BCAC was established by the ICC Board of Directors in July 2011 to pursue opportunities to improve and enhance assigned International Codes or portions thereof. In 2020 and 2021 the BCAC has held several virtual meetings open to any interested party. In addition, there were numerous virtual Working Group meetings for the current code development cycle, which included members of the committee as well as interested parties. Related documents and reports are posted on the ICC website at https://www.iccsafe.org/codes-tech-support/codes/codedevelopment-process/building-code-actioncommittee-bcac.

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

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is an administrative allowance for a building department. This will not change any construction requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: These changes bring consistency to the I codes.

Final Hearing Results

CEPI-8-21 Part I	AS

CEPI-8-21 Part II

Original Proposal

IECC®: R104.1, R104.2, R104.3 (New), R104.3, R104.4, R104.5

Proponents: Mike Nugent, Building Code Action Committee (bcac@iccsafe.org); Kris Stenger, SEHPCAC (sehpcac@iccsafe.org)

2021 International Energy Conservation Code

Revise as follows:

R104.1 Payment of Fees. A permit shall not be ~~issued~~valid until the fees prescribed ~~in Section R104.2~~ by law have been paid~~, nor~~ .Nor shall an amendment to a permit be released until the additional fee, if any, has been paid.

R104.2 Schedule of permit fees. Where a permit is required, a fee for each permit shall be paid as required, in accordance with the schedule as established by the applicable governing authority.

Add new text as follows:

R104.3 Permit valuations. The applicant for a permit shall provide an estimated value of the work for which the permit is being issued at the time of application. Such estimated valuations shall include the total value of the work, including materials and labor. Where, in the opinion of the *code official*, the valuation is underestimated, the permit shall be denied, unless the applicant can show detailed estimates acceptable to the *code official*. The final valuation shall be approved by the *code official*.

Revise as follows:

~~R104.3~~R104.4 Work commencing before permit issuance. Any person who commences any work before obtaining the necessary permits shall be subject to ~~an additional~~ a fee established by the *code official* that shall be in addition to the required permit fees.

~~R104.4~~R104.5 Related fees. The payment of the fee for the construction, *alteration*, removal or demolition of work done in connection to or concurrently with the work or activity authorized by a permit shall not relieve the applicant or holder of the permit from the payment of other fees that are prescribed by law.

~~R104.5~~R104.6 Refunds. The *code official* is authorized to establish a refund policy.

Reason: The intent is consistency in language for 'Fees' within the codes.

- Payment of fees – consistent title, always two sentences
- Schedule of permit fees - Not all projects require a fee - Commercial and Residential are currently different in this section.
- Permit valuation: This lets the jurisdiction establish fees for permits.
- Work commencing before permit issuance – remove redundant language
- Refunds – no change

The BCAC is working from the philosophy that ICC is a family of codes, so administrative requirements should be consistent across books. Most administrative and enforcement matters are the same for any code. Those matters unique for a specific code remain unchanged. This is one of a series of proposals being submitted relating to technical, editorial and organizational changes proposed for the Administrative chapters (Chapter 1) in all of the I-Codes.

This proposal is submitted by the ICC Building Code Action Committee (BCAC) and the ICC Sustainable and Energy and High Performance Code Action Committee (SEHPCAC).

BCAC was established by the ICC Board of Directors in July 2011 to pursue opportunities to improve and enhance assigned International Codes or portions thereof. In 2020 and 2021 the BCAC has held several virtual meetings open to any interested party. In addition, there were numerous virtual Working Group meetings for the current code development cycle, which included members of the committee as well as interested parties. Related documents and reports are posted on the ICC website at https://www.iccsafe.org/codes-tech-support/codes/codedevelopment-process/building-code-actioncommittee-bcac.

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

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is an administrative allowance for a building department. This will not change any construction requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Recommendation for approve proposal since this will synchronize the administrative provisions of the IECC with other I-Codes and as the IECC grows there may be a need in the future for Jurisdictions to permit energy related projects without the need for permits from other I-Codes

Final Hearing Results

CEPI-8-21 Part II	AS

CEPI-9-21

Original Proposal

IECC®: SECTION 202 (New), C403.7.5

Proponents: Nicholas O'Neil, Energy 350, NEEA (noneil@energy350.com); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new definition as follows:

DEMAND CONTROL KITCHEN VENTILATION (DCKV). A system that provides *automatic*, continuous control over exhaust hood and make-up air fan speed in response to temperature, optical, or infrared (IR) sensors that monitor cooking activity or through direct communication with cooking appliances.

Revise as follows:

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

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

Kitchen exhaust hood systems serving Type I exhaust hoods shall be provided with *demand control kitchen ventilation (DCKV)* controls w~~W~~here a kitchen or kitchen/dining facility has a total Type I kitchen hood exhaust airflow rate ~~is~~ greater than 5,000 cfm (2360 L/s).~~,~~ *DCKV* systems shall be configured to provide a minimum of 50 percent reduction in exhaust and replacement air system airflow rates. Systems shall include controls necessary to modulate exhaust and replacement air system airflows in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle operation. ~~e~~Each hood shall be a factory-built commercial exhaust hood listed by a nationally recognized testing laboratory ~~in compliance with UL 710. Each hood~~and shall have a maximum exhaust rate as specified in Table C403.7.5. ~~and shall comply with one of the following~~:

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

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

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

1. UL 710 *listed* exhaust hoods that have a design maximum exhaust flow rate not greater than 250 cfm per linear foot of hood that serve kitchen or kitchen/dining facilities with a total kitchen hood exhaust airflow rate less than 5000 cfm (2360 L/s).
2. Where allowed by the *International Mechanical Code*, an *energy recovery ventilation system* is installed on the kitchen exhaust with a sensible heat recovery effectiveness of not less than 40 percent on not less than 50 percent of the total exhaust hood airflow.

Reason: Demand control kitchen ventilation has been commonplace on make-up air hoods for years and has appeared in the IECC since 2015. This proposal clarifies the section by relocating several nested requirements to the charging language and mandating DCKV on hoods of 5000 cfm or greater unless they have an energy recovery device, or are UL-710 hoods with a maximum 250 cfm/lf flowrate or below the 5,000 cfm threshold.

This cleans up the section to make it clearer that DCKV is required on most kitchen exhaust hoods and moves less common compliance paths (such as heat recovery and UL 710 listed hoods) to exceptions rather than in the charging language making this provision easier to understand. It also removes the transfer air requirement which is not common on systems above this size threshold to utilize in real world applications.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Because the threshold for which this applies remains the same for kitchens with a total exhaust airflow of 5,000 cfm there is no expectation that costs will increase. Prior analysis for adding variable speed fans and associated controls have shown an incremental cost of $11,500 regardless of hood size. The 5,000cfm threshold was chosen as the cost-effective breakpoint given the cost and is not changing as part of this proposal.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Subcommittee referenced reason statement in proposal.

Demand control kitchen ventilation has been commonplace on make-up air hoods for years and has appeared in the IECC since 2015. This proposal clarifies the section by relocating several nested requirements to the charging language and mandating DCKV on hoods of 5000 cfm or greater unless they have an energy recovery device, or are UL-710 hoods with a maximum 250 cfm/lf flowrate or below the 5,000 cfm threshold.

This cleans up the section to make it clearer that DCKV is required on most kitchen exhaust hoods and moves less common compliance paths (such as heat recovery and UL 710 listed hoods) to exceptions rather than in the charging language making this provision easier to understand. It also removes the transfer air requirement which is not common on systems above this size threshold to utilize in real world applications.

Final Hearing Results

CEPI-9-21 AM

CEPI-12-21 Part I

Original Proposal

IECC®: SECTION 202, SECTION 202 (New)

Proponents:

Diana Burk, representing New Buildings Institute (diana@newbuildings.org)

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

THIS IS A 2 PART PROPOSAL. PART I WILL BE HEARD BY THE IECC-COMMERCIAL COMMITTEE. PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Energy Conservation Code

Delete without substitution:

~~**BIOMASS.** Nonfossilized and biodegradable organic material originating from plants, animals and/or microorganisms, including products, by-products, residues and waste from agriculture, forestry and related industries as well as the nonfossilized and biodegradable organic fractions of industrial and municipal wastes, including gases and liquids recovered from the decomposition of nonfossilized and biodegradable organic material.~~

Add new definition as follows:

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

Revise as follows:

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

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

This proposal updates the language by further refining biomass energy sources with terms that were not available at the time it was drafted in 2010. The revision also limits the biomass sources that count as renewable energy resources to those that are specified as waste products. There are many flavors of biomass energy, but this proposal ensures that virgin material of unknown origin does not count as a renewable energy resource, which in the provisions of C406 is a trade-off for energy efficiency features of the building. Without an available standard to cite in the IECC for sustainable biomass, it is critical to ensure that biomass used in compliance with the IECC is derived from waste products or byproducts. The definition of *biomass waste* is from the glossary of the Energy Information Administration. A similar amendment has been submitted to amend the residential IECC to ensure the definition of renewable energy resources is consistent between the two codes.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal clarifies the definition of renewable energy and will have no impact on construction costs.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal ensures that virgin material of unknown origin does not count as a renewable energy resource.

Final Hearing Results	
CEPI-12-21 Part I	AM

CEPI-14-21

Original Proposal

IECC®: SECTION 202 (New)

Proponents: Nicholas O'Neil, Energy 350, NEEA (noneil@energy350.com); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new definition as follows:

DEDICATED OUTDOOR AIR SYSTEM (DOAS). A *ventilation* system that supplies 100 percent outdoor air primarily for the purpose of *ventilation* and that is a separate system from the *zone* space-conditioning system.

Revise as follows:

DX-DEDICATED OUTDOOR AIR SYSTEM UNITS (DX-DOAS UNITS). A type of air-cooled, water-cooled or water source factory assembled product that dehumidifies 100 percent outdoor air to a low dew point and includes reheat that is capable of controlling the supply dry-bulb temperature of the dehumidified air to the designated supply air temperature. ~~This conditioned outdoor air is then delivered directly or indirectly to the conditioned spaces.~~ It may precondition outdoor air ~~by containing an enthalpy wheel, sensible wheel, desiccant wheel, plate heat exchanger, heat pipes, or other heat or mass transfer apparatus.~~with an *energy recovery ventilation system*.

Reason: Both DOAS and DX-DOAS terms are used in the IECC (in C403 and C406) but do not have definitions explaining what they are. These definitions are added to provide clarity when talking about DOAS and are coped from common definitions used in ASHRAE 90.1, the WA State Energy Code, and Title 24.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These are simply definitions to clarify DOAS types and do nothing to impact cost.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Both DOAS and DX-DOAS terms are used in the IECC (in C403 and C406) but do not have definitions explaining what they are. These definitions are added to provide clarity when talking about DOAS and are coped from common definitions used in ASHRAE 90.1, the WA State Energy Code, and Title 24.

Final Hearing Results

CEPI-14-21	AM

CEPI-15-21 Part I

Original Proposal

IECC®: SECTION 202 (New)

Proponents: Amanda Hickman, The Hickman Group, Reflective Insulation Manufacturers Association (RIMA) (amanda@thehickmangroup.com)

THIS IS A 3 PART PROPOSAL. PART I WILL BE HEARD BY THE IECC-COMMERCIAL COMMITTEE. PART II AND PART III WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Energy Conservation Code

Add new definition as follows:

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

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

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Adding a definition of EMITTANCE will neither increase or decrease construction costs. This is only a definition and is identical to the definition found in the 2021 IBC and existing ASHRAE and ASTM standards.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: for consistency with IECC-R admin and consistency with IECC-R consensus committee actions.

Final Hearing Results

CEPI-15-21 Part I AS

CEPI-15-21 Part II

Original Proposal

IECC®: SECTION 202 (New)

Proponents: Amanda Hickman, The Hickman Group, Reflective Insulation Manufacturers Association (RIMA) (amanda@thehickmangroup.com)

2021 International Energy Conservation Code

Add new definition as follows:

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

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

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Adding a definition of EMITTANCE will neither increase or decrease construction costs. This is only a definition and is identical to the definition found in the 2021 IBC and existing ASHRAE and ASTM standards.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This definition will be helpful to have to account for new technology coming into the field. This definition is consistent with ASHRAE and ASTM.

Final Hearing Results

CEPI-15-21 Part II AS

CEPI-15-21 Part III

Original Proposal

IRC: N1101.6, SECTION 202 (New)

Proponents: Amanda Hickman, The Hickman Group, Reflective Insulation Manufacturers Association (RIMA) (amanda@thehickmangroup.com)

2021 International Residential Code

N1101.6 Defined terms. The following words and terms shall, for the purposes of this chapter, have the meanings shown herein.

Add new definition as follows:

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

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

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Adding a definition of EMITTANCE will neither increase or decrease construction costs. This is only a definition and is identical to the definition found in the 2021 IBC and existing ASHRAE and ASTM standards.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This definition will be helpful to have to account for new technology coming into the field. This definition is consistent with ASHRAE and ASTM.

Final Hearing Results

CEPI-15-21 Part III	AS

CEPI-16-21 Part I

Original Proposal

IECC®: C402.5.4, IECC2021P1E_CE_Ch02_SecC202_DefFENESTRATION, SECTION 202
Proponents: Kris Stenger, SEHPCAC (sehpcac@iccsafe.org)

THIS IS A 2 PART PROPOSAL. PART I WILL BE HEARD BY THE IECC-COMMERCIAL COMMITTEE. PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Energy Conservation Code

Revise as follows:

C402.5.4 Air leakage of fenestration and opaque doors. The air leakage of fenestration and opaque door assemblies shall meet the provisions of Table C402.5.4. Testing shall be in accordance with the applicable reference test standard in Table C402.5.4 by an accredited, independent testing laboratory and *labeled* by the manufacturer.

Exceptions:

1. Field-fabricated fenestration assemblies that are sealed in accordance with Section C402.5.1.
2. Fenestration in buildings that comply with the testing alternative of Section C402.5 are not required to meet the air leakage requirements in Table C402.5.4.

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

FENESTRATION. Products classified as either skylights or vertical fenestration.

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

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

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

Revise as follows:

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

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

Revise as follows:

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

Vertical fenestration. Windows that are fixed or operable, ~~opaque doors, glazed~~ doors that are more than half glazed, glazed block and combination opaque and glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of

not less than 60 degrees (1.05 rad) from horizontal.

Reason: · **Revise the definition of vertical fenestration** in the IECC to resolve a conflict between the IECC and ASHRAE 90.1. By making this change, only doors that are more than one half glazed will be defined as fenestrations in both the IECC and ASHRAE 90.1. thereby clarifying the application of the IECC by more clearly stating that doors that are more than half glazed are included in the definition of vertical glazing. Having technically synonymous definitions will facilitate consistency of requirements going forward and help avoid confusion for designers who work with both the standard and the code.

· **Revise Sec. R402.3** to clarify that opaque doors (by definition*"A door that is not less than 50-percent opaque in surface area*") must meet the fenestration requirements. Since opaque doors are currently included in the definition of fenestration, this represents no technical change.

· **Re-format Sec. R402.**5 for ease of reading and to clearly state that opaque doors must comply with maximum fenestration U-factor limitations when using weighted averages for envelope compliance. Since opaque doors are currently included in the definition of fenestration, this represents no technical change.

· **Re-title the "fenestration" column of Table R402.1.2** to include opaque doors. Since opaque doors are currently included in the definition of fenestration, this represents no technical change.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

None; no technical change to the requirements is proposed.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: To provide consistency between the definitions of fenestration used in the IECC and ASHRAE 90.1. Modification makes sure the air leakage requirement still applies to opaque doors.

Final Hearing Results

CEPI-16-21 Part I AM

CEPI-17-21 Part I

Original Proposal

IECC®: SECTION 202

Proponents: Marcin Pazera, Polyisocyanurate Insulation Manufacturers Association, Polyisocyanurate Insulation Manufacturers Association (mpazera@pima.org); Justin Koscher, Polyisocyanurate Insulation Manufacturers Association, Polyisocyanurate Insulation Manufacturers Association (jkoscher@pima.org)

THIS IS A 2 PART PROPOSAL. PART I WILL BE HEARD BY THE IECC-COMMERCIAL COMMITTEE. PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Energy Conservation Code

Revise as follows:

ROOF REPLACEMENT. ~~The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.~~An alteration that includes the removal of all existing layers of *roof assembly* materials down to the roof deck and installing replacement materials above the existing roof deck.

Reason: This proposal revises the definition for roof replacement to reflect the intent and the scope of the roof replacement activity that takes place, which includes removal of all existing materials installed above the roof deck, removing those materials down to the roof deck, and installing a new roof assembly above the roof deck. The definition more explicitly states that roof replacement is an alteration as indicated in Section C503 of the IECC. The revised language in the definition more appropriately aligns with the requirements in Chapter 15 (Section 1512) of the IBC. The term “roof assembly” is already defined in the IECC and in the IBC (for use in Chapter 15). Furthermore, PIMA will submit a code change proposal for the Group B development cycle to explicitly reflect that existing roof insulation that is in good repair may be reused as part of a roof replacement (Section 1512.4).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change proposal will have no impact on the cost of construction. The proposal does not impose new requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: clarification was needed that replacement was down to the roof deck and it is also clarifying to bring in the definition of roof assembly. It also uses terminology more consistent with IBC.

Final Hearing Results

CEPI-17-21 Part I AS

CEPI-19-21 Part I

Original Proposal

IECC®: C303.1.1, C303.1.2

Proponents: Darren Meyers, P.E., International Energy Conservation Consultants LLC, International Energy Conservation Consultants LLC (dmeyers@ieccode.com); Mark Graham, National Roofing Contractors Association, National Roofing Contractors Association (mgraham@nrca.net)

THIS IS A 2 PART PROPOSAL. PART I WILL BE HEARD BY THE IECC-COMMERCIAL COMMITTEE. PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Energy Conservation Code

Revise as follows:

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

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

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

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

Reason: The National Roofing Contractors Association authored identical exceptions to C303.1.1 and R303.1.1 several cycles ago. Our proposal here, is intent on averting similar confusion relative to field inspection observations. Rigid board insulation intended for above-deck installation is package-labeled. Once the package covering is removed, no permanent marking remains, as these respective sections imply. It is common for inspectors to perform their field inspection duties by collecting or observing unopened or pre-opened packaging materials while on site.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action	**As Modified**

Committee Reason: Clarification; the code requires labeling; the standard specifies how the product is to be labeled

Final Hearing Results

CEPI-19-21 Part I AM

CEPI-19-21 Part II

Original Proposal

IECC®: R303.1.1, R303.1.2

Proponents: Darren Meyers, P.E., International Energy Conservation Consultants LLC, International Energy Conservation Consultants LLC (dmeyers@ieccode.com); Mark Graham, National Roofing Contractors Association, National Roofing Contractors Association (mgraham@nrca.net)

2021 International Energy Conservation Code

Revise as follows:

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

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

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

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

Reason: The National Roofing Contractors Association authored identical exceptions to C303.1.1 and R303.1.1 several cycles ago. Our proposal here, is intent on averting similar confusion relative to field inspection observations. Rigid board insulation intended for above-deck installation is package-labeled. Once the package covering is removed, no permanent marking remains, as these respective sections imply. It is common for inspectors to perform their field inspection duties by collecting or observing unopened or pre-opened packaging materials while on site.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

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Public Hearing Results

Committee Action **As Modified**

Committee Reason: simply a clarification that R value should be visible

Final Hearing Results

CEPI-23-21

Original Proposal

IECC®: C401.2.1

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gayathri@swinter.com)

2021 International Energy Conservation Code

Revise as follows:

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

1. **Prescriptive Compliance.** The Prescriptive Compliance option requires compliance with Sections C402 through C406 and Section C408. Dwelling units and sleeping units in Group R-2 buildings ~~without systems serving multiple units~~ shall be deemed to be in compliance with this chapter, provided that they comply with Section R406.
2. **Total Building Performance.** The Total Building Performance option requires compliance with Section C407.

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

Reason: In the prior code cycle, there were objections to allowing R406 (ERI) for dwelling / sleeping units in high-rise buildings subject to the Commercial provisions. This was mostly due to a lack of familiarity with the energy rating process and modeling protocols of ANSI/RESNET/ICC 301. As the Chair of the Standards Development Committee that oversees that Standard, it includes calculations that allow shared systems (HVAC and SHW) to be modeled in the energy rating of a dwelling or sleeping unit. A 3 story building with systems that serve multiple units currently is permitted to show compliance using R406 so there is no reason to disallow it for taller buildings.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There is no specific increase in the cost of construction associated with choosing this compliance path.

For some buildings with systems serving multiple units, R406 may be a less expensive option with respect to the energy modeling costs, but might be more expensive with regard to the specific building systems that would then be needed to meet the current ERI targets. These targets were likely developed with single family homes and low-rise multifamily in mind, without shared systems. The energy rating index uses a baseline where dwelling units and sleeping units have their own HVAC and DHW system. Where the actual design has shared systems, the additional energy associated with distribution is an energy 'penalty' to overcome (which is non-existent in units with their own systems).

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: revises the R-2 definition to include dwelling units with systems that serve multiple units

Final Hearing Results

CEPI-23-21 AS

CEPI-24-21 Part I

Original Proposal

IECC®: SECTION 202, SECTION 202 (New), C401.2.1, SECTION C407, C407.1, C407.2, TABLE C407.2, C407.5.3, C502.2, C505.1
Proponents: Amy Boyce, Institute for Market Transformation, Institute for Market Transformation

THIS IS A 2 PART PROPOSAL. PART I WILL BE HEARD BY THE IECC-COMMERCIAL COMMITTEE. PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Energy Conservation Code

Revise as follows:

PROPOSED DESIGN. A description of the proposed building used to estimate annual energy use for determining compliance based on ~~total~~ simulated building performance.

STANDARD REFERENCE DESIGN. A version of the *proposed design* that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement for compliance based on ~~total~~ simulated building performance.

Add new definition as follows:

SIMULATED BUILDING PERFORMANCE. A process in which the proposed building design is compared to a standard reference design for the purposes of estimating relative energy use against a baseline to determine code compliance.

Revise as follows:

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

1. **Prescriptive Compliance.** The Prescriptive Compliance option requires compliance with Sections C402 through C406 and Section C408. Dwelling units and sleeping units in Group R-2 buildings without systems serving multiple units shall be deemed to be in compliance with this chapter, provided that they comply with Section R406.
2. **~~Total~~ Simulated Building Performance.** The ~~Total~~ Simulated Building Performance option requires compliance with Section C407.

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

SECTION C407
~~TOTAL~~ SIMULATED BUILDING PERFORMANCE

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

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

C407.2 Mandatory requirements. Compliance based on ~~total~~simulated building performance requires that a proposed design meet all of the following:

1. The requirements of the sections indicated within Table C407.2.

2. An annual energy cost that is less than or equal to 80 percent of the annual energy cost of the*standard reference design*. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's *State Energy Data System Prices and Expenditures*reports. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

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

TABLE C407.2 REQUIREMENTS FOR ~~TOTAL~~ SIMULATED BUILDING PERFORMANCE

SECTION [a]	TITLE
Envelope	
C402.5	Air leakage—thermal envelope
Mechanical	
C403.1.1	Calculation of heating and cooling loads
C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies
C403.4, except C403.4.3, C403.4.4 and C403.4.5	Heating and cooling system controls
C403.5.5	Economizer fault detection and diagnostics
C403.7, except C403.7.4.1	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.11, except C403.11.3	Refrigeration equipment performance
C403.12	Construction of HVAC system elements
C403.13	Mechanical systems located outside of the building thermal envelope
C404	Service water heating
C405, except C405.3	Electrical power and lighting systems
C408	Maintenance information and system commisioning

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

C407.5.3 Exceptional calculation methods. Where the simulation program does not model a design, material or device of the *proposed design*, an exceptional calculation method shall be used where approved by the*code official*. Where there are multiple designs, materials or devices that the simulation program does not model, each shall be calculated separately and exceptional savings determined for each. The total exceptional savings shall not constitute more than half of the difference between the baseline simulated building performance and the proposed simulated building performance. Applications for approval of an exceptional method shall include all of the following:

1. Step-by-step documentation of the exceptional calculation method performed, detailed enough to reproduce the results.
2. Copies of all spreadsheets used to perform the calculations.
3. A sensitivity analysis of energy consumption where each of the input parameters is varied from half to double the value assumed.
4. The calculations shall be performed on a time step basis consistent with the simulation program used.

5. The performance rating calculated with and without the exceptional calculation method.

C502.2 Change in space conditioning. Any nonconditioned or low-energy space that is altered to become *conditioned space* shall be required to comply with Section C502.

Exceptions:

1. Where the component performance alternative in Section C402.1.5 is used to comply with this section, the proposed UA shall be not greater than 110 percent of the target UA.
2. Where the ~~total~~ simulated building performance option in Section C407 is used to comply with this section, the annual energy cost of the proposed design shall be not greater than 110 percent of the annual energy cost otherwise permitted by Section C407.2.

C505.1 General. Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code. Where the use in a space changes from one use in Table C405.3.2(1) or C405.3.2(2) to another use in Table C405.3.2(1) or C405.3.2(2), the installed lighting wattage shall comply with Section C405.3. Where the space undergoing a change in occupancy or use is in a building with a fenestration area that exceeds the limitations of Section C402.4.1, the space is exempt from Section C402.4.1 provided that there is not an increase in fenestration area.

Exceptions:

1. Where the component performance alternative in Section C402.1.5 is used to comply with this section, the proposed UA shall not be greater than 110 percent of the target UA.
2. Where the ~~total~~ simulated building performance option in Section C407 is used to comply with this section, the annual energy cost of the proposed design shall not be greater than 110 percent of the annual energy cost otherwise permitted by Section C407.3.

ZERO ENERGY PERFORMANCE INDEX (ZEPIPB,EE). The ratio of the proposed simulated building EUI without renewables to the baseline simulated building EUI, expressed as a percentage.

Reason: The "Total Building Performance" path, as prescribed by the IECC, uses simulation software to compare elements of the *proposed building* with that of a *baseline building*. In this simulation, many building elements are simulated using default values, as those elements do not affect the results of the comparison. The path title leads many to the false conclusion that the results of this building simulation will align with the actual building energy use – its performance – once it is built and occupied; however, that is not the intent of the simulation in this case.

While generally confusing in the past, this misconception is more critical now with the adoption of Building Performance Standards (BPS) in many jurisdictions. While BPS govern existing buildings, they will apply to newly constructed buildings once those structures have been occupied for a set number of years. The misunderstanding of the purpose and the results of the code-required proposed building model may lead owners and operators to assume that a building was designed to meet the future BPS requirements and that that design intent is backed up by the model results. Changing the language to clarify that the results of the code-required proposed building model are not necessarily aligned with future building performance will adjust expectations and potentially minimize future legal concerns.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change affects the language only.

Cost Effectiveness: While the change itself will neither increase nor decrease costs, bringing awareness to the limitations of the current total building performance path will aid owners and designers in the conversation about predicted building performance and potentially reduce costs associated with changes made later on in the process.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Reason: clarifies that the whole building modeling approach is based on simulation and not actual utility bills.

Final Hearing Results	
CEPI-24-21 Part I	AM

CEPI-24-21 Part II

Original Proposal

IECC®: SECTION 202, SECTION 202 (New), R401.2.2, R403.3.3.1, SECTION R405, R405.1, R405.2, TABLE R405.2, R405.3, R405.3.2.2, R405.4, R502.2, R505.1

Proponents: Amy Boyce, Institute for Market Transformation, Institute for Market Transformation

2021 International Energy Conservation Code

Revise as follows:

PROPOSED DESIGN. A description of the proposed *building* used to estimate annual energy use for determining compliance based on ~~total~~ simulated building performance.

STANDARD REFERENCE DESIGN. A version of the *proposed design* that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement for compliance based on ~~total~~ simulated building performance.

Add new definition as follows:

SIMULATED BUILDING PERFORMANCE. A process in which the proposed building design is compared to a standard reference design for the purposes of estimating relative energy use against a baseline to determine code compliance.

Revise as follows:

R401.2.2 ~~Total~~ Simulated Building Performance Option. The ~~Total~~ Simulated Building Performance Option requires compliance with Section R405.

R403.3.3.1 Effective R-value of deeply buried ducts. Where using the ~~Total~~ Building Simulated Performance Compliance Option in accordance with Section R401.2.2 , sections of ducts that are installed in accordance with Section R403.3.3, located directly on or within 5.5 inches (140 mm) of the ceiling, surrounded with blown-in attic insulation having an *R*-value of R-30 or greater and located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation *R*-value of R-25.

SECTION R405
~~TOTAL~~ SIMULATED BUILDING PERFORMANCE

R405.1 Scope. This section establishes criteria for compliance using ~~total~~ simulated building performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water-heating energy only.

R405.2 Simulated p~~P~~erformance-based compliance. Compliance based on ~~total~~ simulated building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.

3. An annual energy cost that is less than or equal to the annual energy cost of the *standard reference design*. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

   Exception: The energy use based on source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

TABLE R405.2 REQUIREMENTS FOR ~~TOTAL~~ SIMULATED BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

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

R405.3 Documentation. Documentation of the software used for the ~~performance~~ proposed design and the parameters for the baseline *building* shall be in accordance with Sections R405.3.2.1 through R405.3.2.2.

R405.3.2.2 Compliance report for certificate of occupancy. A compliance report submitted for obtaining the certificate of occupancy shall include the following:

1. Building street address, or other building site identification.
2. Declaration of the ~~total~~ simulated building performance path on the title page of the energy report and the title page of the building plans.
3. A statement, bearing the name of the individual performing the analysis and generating the report, indicating that the as-built building complies with Section R405.3.
4. The name and version of the compliance software tool.
5. A site-specific energy analysis report that is in compliance with Section R405.3.
6. A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the confirmed rated design of the built home complies with Section R405.3. The certificate shall report the energy features that were confirmed to be in the home, including component level insulation *R*-values or *U*-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation and service water-heating equipment installed.
7. Where on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.

R405.4 Calculation procedure. Calculations of the ~~performance~~ proposed design shall be in accordance with Sections R405.4.1 and R405.4.2.

R502.2 Change in space conditioning. Any unconditioned or low-energy space that is altered to become *conditioned space* shall be required to be brought into full compliance with this code.

Exceptions:

1. Where the simulated building performance option in Section R405 is used to comply with this section, the annual energy cost of the *proposed design* is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.2.
2. Where the Total UA, as determined in Section R402.1.5, of the existing building and the *addition*, and any *alterations* that are part of the project, is less than or equal to the Total UA generated for the existing *building*.
3. Where complying in accordance with Section R405 and the annual energy cost or energy use of the *addition* and the existing *building*, and any *alterations* that are part of the project, is less than or equal to the annual energy cost of the existing *building*. The *addition* and any *alterations* that are part of the project shall comply with Section R405 in its entirety.

R505.1 General. Any space that is converted to a dwelling unit or portion thereof from another use or occupancy shall comply with this code.

Exception: Where the simulated building performance option in Section R405 is used to comply with this section, the annual energy cost of the *proposed design* is permitted to be 110 percent of the annual energy cost allowed by Section R405.2.

Reason: The “Total Building Performance” path, as prescribed by the IECC, uses simulation software to compare elements of the *proposed building* with that of a *baseline building*. In this simulation, many building elements are simulated using default values, as those elements do not affect the results of the comparison. The path title leads many to the false conclusion that the results of this building simulation will align with the actual building energy use – its performance – once it is built and occupied; however, that is not the intent of the simulation in this case.

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Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

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Cost Effectiveness: While the change itself will neither increase nor decrease costs, bringing awareness to the limitations of the current total building performance path will aid owners and designers in the conversation about predicted building performance and potentially reduce costs associated with changes made later on in the process.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: clarifies that the whole building modeling approach is based on simulation.

Final Hearing Results

CEPI-24-21 Part II	AS

CEPI-27-21

Original Proposal

IECC®: SECTION C402, C402.1, C402.1.3, C402.1.3.1 (New), C402.1.3.2 (New), C402.1.3.3 (New), C402.1.3.4 (New), C402.1.3.5 (New), C402.1.3.6 (New), C402.1.4, C402.1.4.1, C402.1.4.1 (New), C402.1.4.1.1, C402.1.4.1.2, C402.1.4.1.3, C402.1.4.1.3 (New), C402.1.4.1.4 (New), C402.1.4.2, C402.2, C402.2.1, C402.2.1.1, C402.2.1.2, C402.2.1.3, C402.2.1.4, C402.2.1.5, C402.2.2, C402.2.3, C402.2.4, C402.2.4.1, C402.2.5, C402.2.6

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2021 International Energy Conservation Code

SECTION C402
BUILDING ENVELOPE REQUIREMENTS

Revise as follows:

C402.1 General. *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 1 of Section C401.2.1shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the *R*-value-based method ~~of~~ Section C402.1.3; the *U*-, *C*- and *F*-factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.
3. Fenestration in building envelope assemblies shall comply with Section C402.4.
4. Air leakage of building envelope assemblies shall comply with Section C402.5.
5. <u>Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.</u>

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.4, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1 or Section C401.2.2.~~Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.~~

C402.1.3 Insulation component R-value-based method. ~~*Building thermal envelope* opaque assemblies shall comply with the requirements of Sections C402.2 and C402.4 based on the *climate zone* specified in Chapter 3.~~ For opaque portions of the *building thermal envelope* intended to comply on an insulation component*R*-value basis, the *R*-values for cavity insulation and continuous insulation shall be not less than that specified in Table C402.1.3. ~~Where cavity insulation is installed in multiple layers, the cavity insulation*R*-values shall be summed to determine compliance with the cavity insulation *R*-value requirements. Where continuous insulation is installed in multiple layers, the continuous insulation *R*-values shall be summed to determine compliance with the continuous insulation*R*-value requirements. Cavity insulation *R*-values shall not be used to determine compliance with the continuous insulation*R*-value requirements in Table C402.1.3.~~ Commercial buildings or portions of commercial buildings enclosing*Group R* occupancies shall use the *R*-values from the "*Group R*" 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.

Add new text as follows:

<u>**C402.1.3.1 R-value of multi-layered insulation components.**. Where *cavity insulation* is installed in multiple layers, the*cavity insulation R*-values shall be summed to determine compliance with the*cavity insulation R*-value requirements. Where *continuous insulation* is installed in multiple layers, the *continuous insulation R*-values shall be summed to determine compliance with the*continuous insulation R*-</u>

value requirements. *Cavity insulation R*-values shall not be used to determine compliance with the *continuous insulation R*-value requirements in Table C402.1.3.

C402.1.3.2 Area-weighted averaging of R-values. Area-weighted averaging shall not be permitted for *R*-value compliance.

Exception: For tapered above-deck roof insulation, compliance with the *R*-values required in Table C402.1.3 shall be permitted to be demonstrated by multiplying the rated *R*-value per inch of the insulation material by the average thickness of the roof insulation. The average thickness of the roof insulation shall equal the total volume of the roof insulation divided by the area of the roof.

C402.1.3.3 Building materials and air spaces. Building materials that are not insulation components complying with Chapter 3 shall be excluded from demonstrating compliance with the *R*-values of Table C402.1.3. Air spaces used to demonstrate compliance with Table C402.1.3 shall comply with Section C402.2.7.

C402.1.3.4 Assembly construction. Assembly constructions used for compliance with Table C402.1.3 shall be as described in ANSI/ASHRAE/IESNA 90.1 Appendix A.

C402.1.3.5 Concrete masonry units, integral insulation. The *R*-value of integral insulation installed in concrete masonry units shall not be used in determining compliance with Table C402.1.3 except as otherwise noted.

C402.1.3.6 Mass walls and floors. Compliance with required minimum *R*-values for insulation components applied to mass walls and mass floors in accordance with Table C402.1.3 shall be permitted for assemblies complying with the following:

1. Where used as a component of the *building thermal envelope, mass walls* shall comply with one of the following:
   1.1. Weigh not less that 35 pounds per square foot (171 kg/m^2) of wall surface area.
   1.2. Weigh not less than 25 pounds per square foot (122 kg/m^2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m^3).
   1.3. Have a heat capacity exceeding 7 Btu/ft^2-F (144 kJ/m^2-K).
   1.4. 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).

2. Where used as a component of the *building thermal envelope* of a building, the minimum weight of mass floors shall comply with provide one of the following:
   2.1. 35 pounds per square foot (171 kg/m^2) of floor surface area.
   2.2. 25 pounds per square foot (122 kg/m^2) of floor surface area where the material weight is not more than 120 pcf (1900 kg/m^3).

Revise as follows:

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

Delete without substitution:

~~**C402.1.4.1 Roof/ceiling assembly.** The maximum roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4 based on construction materials used in the roof/ceiling assembly.~~

Add new text as follows:

C402.1.4.1 Methods of determining U-, C-, and F-factors. Where assembly U-factors, C-factors and F-factors and calculation procedures are established in ANSI/ASHRAE/IESNA 90.1 Appendix A for opaque assemblies, such opaque assemblies shall be a compliance alternative provided they meet the criteria of Table C402.1.4 and the construction, excluding cladding system on walls, complies with the applicable construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A. Where U-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative provided they meet the criteria of Table C402.1.4. The R-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design. Air spaces used for assembly evaluations shall comply with Section C402.2.7.

Revise as follows:

C402.1.4.1.1 Tapered, above-deck insulation based on thickness. For tapered, above-deck roof insulation, the area-weighted U-factor of non-uniform insulation thickness shall be determined by an *approved* method. ~~Where used as a component of a maximum roof/ceiling assembly *U*-factor calculation, the sloped roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) solely for *U*-factor compliance as prescribed in Section C402.1.4~~.

> **Exception:** The area-weighted U-factor shall be permitted to be determined by using the inverse of the average R-value determined in accordance with the exception to Section C402.1.3.2.

C402.1.4.1.2 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof/ceiling construction.

Delete without substitution:

~~**C402.1.4.1.3 Joints staggered.** Continuous insulation board shall be installed in not less than two layers, and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.~~

Add new text as follows:

C402.1.4.1.3 Concrete masonry units, integral insulation. Where determining compliance with Table C402.1.4, the *U*-factor of concrete masonry units with integral insulation shall be permitted to be used.

C402.1.4.1.4 Mass walls and floors. Compliance with required maximum *U*-factors for mass walls and mass floors in accordance with Table C402.1.4 shall be permitted for assemblies complying with Section C402.1.3.3.

Revise as follows:

~~**C402.1.4.2**~~ **C402.1.4.1.5 U-factor t~~T~~hermal resistance of cold-formed steel walls.** *U*-factors of walls with cold-formed steel studs shall be permitted to be determined in accordance with Equation 4-1.

$$U = 1/[R_s + (ER)] \qquad \textbf{(Equation 4-1)}$$

where:

R_S = The cumulative *R*-value of the wall components along the path of heat transfer, excluding the *cavity insulation* and steel studs. *ER* = The effective *R*-value of the *cavity insulation* with steel studs as specified in Table C402.1.4.2.

C402.2 Specific ~~building thermal envelope~~ insulation and installation requirements. Insulation in *building thermal envelope* opaque assemblies shall be installed in accordance ~~comply~~ with Section C303.2 and Sections C402.2.1 through C402.2.7, or an *approved* design ~~and Table C402.1.3~~.

C402.2.1 Roof assembly. ~~The minimum thermal resistance (*R*-value) of the insulating material~~ Roof insulation materials shall be installed

~~either~~ between the roof framing, continuously above the ceiling framing, ~~or~~ continuously on or within the roof assembly, or in any approved combination thereof. Above-deck roof insulation, shall comply with Sections C402.2.1.1 through C402.2.1.3. ~~shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly~~.

Delete without substitution:

~~**C402.2.1.1 Tapered, above-deck insulation based on thickness.** Where used as a component of a roof/ceiling assembly *R*-value calculation, the sloped roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) solely for *R*-value compliance as prescribed in Section 402.1.3.~~

Revise as follows:

C402.2.1.1 ~~**C402.2.1.2**~~ **Minimum thickness, lowest point.** The ~~minimum~~ thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be not less than 1 inch (25 mm).

Delete without substitution:

~~**C402.2.1.3 Suspended ceilings.** Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (*R*-value) of roof insulation in roof/ceiling construction~~.

Revise as follows:

C402.2.1.2 ~~**C402.2.1.4**~~ **Joints staggered.** *Continuous insulation* board located above the roof deck shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain, or scupper.

C402.2.1.3 ~~**C402.2.1.5**~~ **Skylight curbs.** Skylight curbs shall be insulated to the level ofthe above-deck roof~~s with~~ insulation ~~entirely above the deck~~ or R-5, whichever is less.

> **Exception:** Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.

C402.2.2 Above-grade walls. *Above-grade wall* insulation materials shall be installed between the wall framing, be integral to the wall assembly, be continuous on the wall assembly, or be any combination of these insulation methods. Where *continuous insulation* is layered on the exterior side of a wall assembly, the joints shall be staggered. ~~The minimum thermal resistance (*R*-value) of materials installed in the wall cavity between framing members and continuously on the walls shall be as specified in Table C402.1.3, based on framing type and construction materials used in the wall assembly. The *R*-value of integral insulation installed in concrete masonry units shall not be used in determining compliance with Table C402.1.3 except as otherwise noted in the table. In determining compliance with Table C402.1.4, the use of the *U*-factor of concrete masonry units with integral insulation shall be permitted".Mass walls" where used as a component in the thermal envelope of a building shall comply with one of the following:~~

1. ~~Weigh not less than 35 pounds per square foot (171 kg/m^2) of wall surface area~~.
2. ~~Weigh not less than 25 pounds per square foot (122 kg/m^2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m^3).~~
3. ~~Have a heat capacity exceeding 7 Btu/ft^2 × °F (144 kJ/m^2 × K).~~
4. ~~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).~~

C402.2.3 Floors over outdoor air or unconditioned space. Floor insulation shall be installed between floor framing, be integral to the floor assembly, be continuous on the floor assembly, or be any combination of these insulation methods. Where *continuous insulation* is layered on the exterior side of a floor assembly, the joints shall be staggered. ~~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 (171 kg/m^2) of floor surface area~~.
2. ~~25 pounds per square foot (122 kg/m^2) of floor surface area where the material weight is not more than 120 pounds per cubic foot (1923 kg/m^3).~~

Exceptions:

1. The floor framing *cavity insulation* or structural slab insulation shall be permitted to be<u>installed</u> in contact with the top side of sheathing or *continuous insulation* installed on the bottom side of floor assemblies<u>. Floor framing or structural slab members at the perimeter of the floor assembly shall be insulated vertically for their full depth</u> ~~where combined~~ with insulation <u>equivalent to</u> that <u>required for the above-grade wall construction.</u> ~~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*.

Delete without substitution:

~~**C402.2.4 Slabs-on-grade.** The minimum thermal resistance (*R*-value) of the insulation for unheated or heated slab-on-grade floors designed in accordance with the *R*-value method of Section C402.1.3 shall be as specified in Table C402.1.3.~~

Revise as follows:

~~**C402.2.4.1**~~ <u>**C402.2.4**</u> ~~**Insulation installation**~~ <u>**Slabs-on-grade**</u>**.** Where installed, the perimeter insulation <u>for slab-on-grade</u> shall be placed on the outside of the foundation or on the inside of the foundation wall. <u>For installations complying with Table C402.1.3, the</u> ~~The~~ perimeter insulation shall extend downward from the top of the slab for the minimum distance shown in the table or to the top of the footing, whichever is less, or downward to not less than the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. ~~Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil.~~Where installed, full slab insulation shall be continuous under the entire area of the slab-on-grade floor, except at structural column locations and service penetrations. Insulation required at the heated slab perimeter shall not be required to extend below the bottom of the heated slab and shall be continuous with the full slab insulation.

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

C402.2.5 Below-grade walls. <u>*Below-grade wall* insulation shall be installed between framing members, be integral to the wall assembly, be continuous on the wall assembly, or be any combination of these insulation methods.</u> ~~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~~ <u>For installations complying with Section C401.2.1, insulation</u> 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.

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 to an *R*-value of not less than R-3.5 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 C402.2.4 <u>and Section C402.1</u>.

Reason: Sections C402.1, C402.1.3, C402.1.4, and C402.2 are in need of improvement and better coordination to address redundancies and misplaced requirements related to R-value or U-factor compliance versus basic installation or application requirements. This proposal does not change any requirements, but places requirements in their proper location for clarity and ease of use. In addition, redundant language or restatement of requirements already established are removed.

For example, alternative means for fenestration and skylight compliance mentioned in Section C402.1 are deleted because those requirements are already established in Section C401.2 and are not relevant when choosing to comply with Section C402.1. Requirements in Section C402.2 that are related to complying with R-values (Section C402.1.3) or U/C/F-factors (Section C402.1.4) are moved into those sections respectively. Table footnotes that provide important information for compliance are moved into text of those sections and clarified (such as reference to data and requirements in ASHRAE Appendix A). In some cases, editorial errors are identified and corrected. Finally, Section C402.2 is streamlined to focus on installation and application related matters pertaining to insulation installation and, consequently, R-value and U/C/F-factor compliance requirements are moved into Sections C402.1.3 or C402.1.4.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is a formatting/clarification change and does not change requirements and should have no cost impacts. However, it could help improve efficiency and consistency of compliance and enforcement.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal reorganizes the section for better clarity.

Final Hearing Results

CEPI-27-21	AM

CEPI-28-21

Original Proposal

IECC®: SECTION C402, C402.1, C402.1.3, C402.1.4, TABLE C402.1.3, TABLE C402.1.4

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2021 International Energy Conservation Code

SECTION C402
BUILDING ENVELOPE REQUIREMENTS

Revise as follows:

C402.1 General. *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 1 of Section C401.2.1shall 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~~ U-, C- and F-factor based method ofSection C402.1.3; ~~the *U*-, *C*- and *F*-factor-based method of~~ R-value 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 Item 2 of Section C401.2.1 or Section C401.2.2.Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.

C402.1.4 ~~C402.1.3~~ Insulation component R-value alternatives ~~-based method~~. *Building thermal envelope* opaque assemblies shall comply with the requirements of Sections C402.2 and C402.4 based on the *climate zone* specified in Chapter 3. For opaque portions of the *building thermal envelope* ~~intended to comply on an insulation component*R*-value basis~~, the *R*-values for cavity insulation and continuous insulation shall be not less than that specified in Table C402.1.4 ~~C402.1.3~~. Where cavity insulation is installed in multiple layers, the cavity insulation *R*-values shall be summed to determine compliance with the cavity insulation*R*-value requirements. Where continuous insulation is installed in multiple layers, the continuous insulation *R*-values shall be summed to determine compliance with the continuous insulation *R*-value requirements. Cavity insulation *R*-values shall not be used to determine compliance with the continuous insulation*R*-value requirements in Table C402.1.4 ~~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 TableC402.1.4 ~~C402.1.3~~.

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 C402.1.3 ~~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 C402.1.3 ~~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 TableC402.1.3 ~~C402.1.4~~.

TABLE C402.1.4 ~~C402.1.3~~ OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE ALTERNATIVES ~~METHOD~~[a]

Portions of table not shown remain unchanged.

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 90.1 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 C402.1.3 ~~C402.1.4~~.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-f^2 °F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

e. “Mass floors” shall be in accordance with Section C402.2.3.

f. “Mass walls” shall be in accordance with Section C402.2.2.

g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

TABLE C402.1.3 ~~C402.1.4~~ OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, U-FACTOR METHOD[a, b]
Portions of table not shown remain unchanged.

Reason: This proposal places assembly U-factor approach as the primary approach for compliance since it is the basis for prescriptive R-value solutions. The R-value path is retained as an alternative to the U-factor approach and retains the same R-value requirements as before (consistent with the assembly U-factors). This proposal makes no criteria change but clarifies that R-values are to be derived from and be equivalent to the U-factors, C-factors, or F-factors. This proposal also makes the IECC consistent with similar action taken for the 2021 IRC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal does not change current criteria.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: To align with IBC with IRC and assign U-factors as the primary basis; modifications were added for increased clarity

Final Hearing Results

CEPI-28-21 AM

CEPI-29-21

Original Proposal

IECC®: C402.1, C402.1.4.3 (New)

Proponents: Duncan Brown, New York City Department of Buildings, New York City Department of Buildings

2021 International Energy Conservation Code

Revise as follows:

C402.1 General. *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 1 of Section C401.2.1shall 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. <u>Where the total area of the through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above-grade wall area, the building thermal envelope shall comply with Section C402.1.4.3.</u>
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 Item 2 of Section C401.2.1 or Section C401.2.2.Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.

Add new text as follows:

<u>**C402.1.4.3 Thermal Resistance of mechanical equipment penetrations.**</u> <u>Where the total area of through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above-grade wall area, such area shall be calculated as a separate wall assembly with a published and *approved* U-factor for that equipment or a default U-factor of 0.5</u>.

Reason: A tremendous amount of energy is lost with through-wall mechanical equipment penetrations in building envelopes. This proposal, which has been in effect in New York City since 2016, amends the code to require that these areas of lower thermal value are accounted for when demonstrating compliance.

Bibliography: Design of Experiment to Evaluate Thermal Resistance of a PTAC Unit - Leylegian, Naraghi et al., Proceedings of the 2011 International Mechanical Engineering Congress and Exposition, IMEC2011-65030

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

While there is increased construction cost compensating for the areas of lower insulation value, even with dated numbers, there is a simple payback period followed by improved overall performance.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal, which has been in effect in New York City since 2016, amends the code to require that these areas of lower thermal value are accounted for when demonstrating compliance.

Final Hearing Results	
CEPI-29-21	AM

CEPI-31-21

Original Proposal

IECC®: C402.1, C402.3 (New)

Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Revise as follows:

C402.1 General. *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 1 of Section C401.2.1shall 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. Wall solar reflectance and thermal emittance shall comply with Section C402.3.

~~2.~~ 3. Roof solar reflectance and thermal emittance shall comply with Section~~C402.3~~ C402.4.

~~3.~~ 4. Fenestration in building envelope assemblies shall comply with Section~~C402.4~~ C402.5.

~~4.~~ 5. Air leakage of building envelope assemblies shall comply with Section~~C402.5~~ C402.6.

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 Item 2 of Section C401.2.1 or Section C401.2.2.Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.

Add new text as follows:

C402.3 Above-Grade Wall Solar Reflectance. For Climate Zone 0, above-grade east-oriented, south-oriented, and west-oriented walls shall comply with either of the following:

1. Not less than 75 percent of the*above-grade wall* area shall have an area-weighted initial solar reflectance of not less than 0.30 where tested in accordance with ASTM C1549 with AM1.5GV, output or ASTM E903 with AM1.5GV output, or determined in accordance with an approved source. This *above-grade wall* area shall have an emittance or emissivity of not less than 0.75 where tested in accordance with ASTM C835, C1371, E408, or determined in accordance with an *approved source*. For the portion of the *above-grade wall* that is glass spandrel area, a solar reflectance of not less than 0.29, as determined in accordance with NFRC 300 or ISO 9050, shall be permitted. Area-weighted averaging is permitted only using south-, east-, and west-oriented walls enclosing the same occupancy classification.
2. Not less than 30 percent of the*above-grade wall* area shall be shaded by manmade structures, existing buildings, hillsides, permanent building projections, on-site renewable energy systems, or a combination of these. Shade coverage shall be calculated by projecting the shading surface downward on the *above-grade wall* at an angle of 45 degrees.

Exception: Above grade walls of low energy buildings complying with Section C402.1.1, greenhouses complying with Section C402.1.1.1, and equipment buildings complying with Section C402.1.2.

Reason: The proposal adds requirements for south-, east-, and west-facing walls to have a minimumsolar reflectance of 0.30 in Climate Zone 0. Thermal emittance values do not vary much for opaque, nonmetallic surfaces. A minimum value of 0.75 is sufficient and can be demonstrated by published values or testing. The main reason to have 0.75 backstop is to avoid shiny bare metal, which can become hot.

For solar reflectance, three options have been provided for measurement: (1) ASTM C1549 with air mass 1.5 global vertical (AM1.5GV) output (labeled “1.590” for air mass 1.5, 90 degree tilt in an upgrade to the Devices and Services Solar Spectrum Reflectometer v6, available from its manufacturer); (2) ASTM E903, using the AM1.5GV solar spectral irradiance to weight near normal-hemispherical solar spectral reflectance; or (3) the “G197GT90” output of the Surface Optics 410-Solar-i Hemispherical Reflectometer, operated following Appendix 9 of the CRRC-1 Program Manual (https://coolroofs.org/documents/CRRC-1_Program_Manual.pdf). All three options are based on the global solar spectral irradiance for a 90 degree sun-facing tilted surface specified in ASTM G197.

For emittance, ASTM C1371 is the simplest and least expensive measurement method but other options have been provided.

Initial reflectance is specified because there isn’t a fully developed measurement technique for measuring aged wall reflectance. Preliminary testing shows that walls become much less dirty than roofs because they are vertical surfaces.

Bibliography: ANSI/ASHRAE/IES Standard 90.1-2019 Energy Standard for Buildings Except Low-Rise Residential Buildings, Addendum s.
https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda/addenda-to-standard-90-1-2019

Levinson, R., et. al., “Solar Reflective “Cool” Walls: Benefits, Technologies, and Implementation,” State of California, California Energy Commission, Sacramento, CA, Report CEC-500-2019-040, April 2019.

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

For climate zone 0 the cost of construction may increase in the short term as these requirements are new and the availability of products may be limited. For all other climate zones this proposal will have no impact. However, long term the cost impact will most likely be reduced as more manufacturers produce products to meet demand, and as testing and reporting opportunities become available, such as the Cool Roof Rating Council’s new program for Cool Wall Rating Program, which is currently under construction.

However, it should be noted that there are many products on the market that currently meet these thresholds.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Agree with the proponent’s reason statement. Further, the modifications made by the IECC Commercial Envelope Subcommittee were designed to be consistent with the ICC manual of style and clarifies the text.

Final Hearing Results

CEPI-31-21 AM

CEPI-32-21
Original Proposal

IECC®: SECTION 202 (New), C402.1, C402.5, C402.5.1, C402.5.1.1, C402.5.1.2, C402.5.1.5, C402.5.3, C402.5.2, C402.5.8, C402.5.11, C406.1, TABLE C406.1(1), TABLE C406.1(2), TABLE C406.1(3), TABLE C406.1(4), TABLE C406.1(5), C406.9

Proponents: Theresa A Weston, The Holt Weston Consultancy, The Air Barrier Association of America (ABAA) (holtweston88@gmail.com)

2021 International Energy Conservation Code

Add new definition as follows:

AIR LEAKAGE. The uncontrolled air flow through the building thermal envelope caused by pressure differences across the building thermal envelope. Air leakage can be inward (infiltration) or outward (exfiltration) through the building thermal envelope.

Revise as follows:

C402.1 General. *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 1 of Section C401.2.1shall 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 the *building thermal envelope* ~~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 Item 2 of Section C401.2.1 or Section C401.2.2.Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.

C402.5 Air leakage—thermal envelope. The *building thermal envelope* shall comply with Sections C402.5.1 through Section C402.5.11.1, or the ~~building~~ *building thermal envelope* shall be tested in accordance with Section C402.5.2 or C402.5.3. Where compliance is based on such testing, the building shall also comply with Sections C402.5.7, C402.5.8 and C402.5.9.

C402.5.1 Air barriers. A continuous ~~air barrier~~ *air barrier* shall be provided throughout the *building thermal envelope*. The continuous ~~air barriers~~ *air barrier* shall be located on the inside or outside of the ~~building thermal envelope~~ *building thermal envelope*, located within the assemblies composing the ~~building thermal envelope~~ *building thermal envelope*, or any combination thereof. The ~~air barrier~~ *air barrier* shall comply with Sections C402.5.1.1, and C402.5.1.2.

Exception: ~~Air barriers~~ *Air barriers* are not required in buildings located in *Climate Zone* 2B.

C402.5.1.1 Air barrier construction. The *continuous air barrier* shall be constructed to comply with the following:

1. The ~~air barrier~~ *air barrier* shall be continuous for all assemblies that ~~are~~ comprise the ~~thermal envelope of the building~~ *building thermal envelope* 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~~ *air barrier* shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Sealing shall allow for expansion, contraction and mechanical vibration. Joints and seams associated with penetrations shall be sealed in the same manner or taped. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation. Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.
4. Recessed lighting fixtures shall comply with Section C402.5.10. Where similar objects are installed that penetrate the~~air barrier~~ *air barrier*, provisions shall be made to maintain the integrity of the~~air barrier~~ *air barrier*.

C402.5.1.2 . A continuous ~~air barrier~~ *air barrier* for the ~~opaque building envelope~~ *building thermal envelope* shall comply with the following:

1. Buildings or portions of buildings, including Group R and I occupancies, shall meet the provisions of Section C402.5.2.

   Exception: Buildings in Climate Zones 2B, 3C and 5C.

2. Buildings or portions of buildings other than Group R and I occupancies shall meet the provisions of Section C402.5.3.

   Exceptions:

   1. Buildings in Climate Zones 2B, 3B, 3C and 5C.
   2. Buildings larger than 5,000 square feet (464.5 m^2) floor area in Climate Zones 0B, 1, 2A, 4B and 4C.
   3. Buildings between 5,000 square feet (464.5 m^2) and 50,000 square feet (4645 m^2) floor area in Climate Zones 0A, 3A and 5B.

3. Buildings or portions of buildings that do not complete air barrier testing shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5.

C402.5.1.5 Building envelope performance verification. The installation of the continuous ~~air barrier~~ *air barrier* shall be verified by the *code official*, a *registered design professional* or *approved* agency in accordance with the following:

1. A review of the construction documents and other supporting data shall be conducted to assess compliance with the requirements in Section C402.5.1.
2. Inspection of continuous ~~air barrier~~ *air barrier* components and assemblies shall be conducted during construction while the ~~air barrier~~ *air barrier* is still accessible for inspection and repair to verify compliance with the requirements of Sections C402.5.1.3 and C402.5.1.4.
3. A final commissioning report shall be provided for inspections completed by the*registered design professional* or *approved* agency. The commissioning report shall be provided to the building owner or owner's authorized agent and the*code official*. The report shall identify deficiencies found during the review of the construction documents and inspection and details of corrective measures taken.

C402.5.3 Building thermal envelope testing. The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E3158 or ASTM E1827 or an equivalent method approved by the code official. The measured ~~air leakage~~ *air leakage* shall not exceed 0.40 cfm/ft^2 (2.0 L/s × m^2) of the *building thermal envelope* area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, portions of the building shall be tested and the measured ~~air leakages~~ *air leakage* shall be area weighted by the surface areas of the ~~building envelope~~ *building thermal envelope* in each portion. The weighted average test results shall not exceed the whole building *air leakage* ~~leakage~~ limit. In the alternative approach, the following portions of the building shall be tested:

1. The entire ~~envelope~~ *building thermal envelope* area of all stories that have any spaces directly under a roof.
2. The entire ~~envelope~~ *building thermal envelope* area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.

3. Representative above-grade sections of the ~~building~~ *building thermal envelope* totaling at least 25 percent of the wall area enclosing the remaining conditioned space.

Exception: Where the measured ~~air leakage~~ *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 infrared imaging shall be conducted while the building is pressurized along with a visual inspection of the ~~air barrier~~ ~~*air barrier*~~. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section.

C402.5.2 Dwelling and sleeping unit enclosure testing. The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent method approved by the *code official*. The measured ~~air leakage~~ *air leakage* shall not exceed 0.30 cfm/ft^2 (1.5 L/s m^2) of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa). Where multiple dwelling units or sleeping units or other occupiable conditioned spaces are contained within one *building thermal envelope*, each unit shall be considered an individual testing unit, and the building ~~air leakage~~ *air leakage* shall be the weighted average of all testing unit results, weighted by each testing unit's enclosure area. Units shall be tested separately with an unguarded blower door test as follows:

1. Where buildings have fewer than eight testing units, each testing unit shall be tested.
2. For buildings with eight or more testing units, the greater of seven units or 20 percent of the testing units in the building shall be tested, including a top floor unit, a ground floor unit and a unit with the largest testing unit enclosure area. For each tested unit that exceeds the maximum air leakage rate, an additional two units shall be tested, including a mixture of testing unit types and locations.

C402.5.8 Loading dock weather seals. Cargo door openings and loading door openings shall be equipped with weather seals that restrict ~~infiltration~~ *air leakage* and provide direct contact along the top and sides of vehicles that are parked in the doorway.

C402.5.11 Operable openings interlocking. Where occupancies utilize operable openings to the outdoors that are larger than 40 square feet (3.7 m^2) in area, such openings shall be interlocked with the heating and cooling system so as to raise the cooling setpoint to 90°F (32°C) and lower the heating setpoint to 55°F (13°C) whenever the operable opening is open. The change in heating and cooling setpoints shall occur within 10 minutes of opening the operable opening.

Exceptions:

1. Separately zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy.
2. Warehouses that utilize overhead doors for the function of the occupancy, where approved by the code official.
3. The first entrance doors where located in the exterior wall and are part of a vestibule system.

Revise as follows:

C406.1 Additional energy efficiency credit requirements. New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building and from credit calculations as specified in relevant subsections of Section C406. Where a building contains multiple-use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.

6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced ~~air infiltration~~ *air leakage* in accordance with Section C406.9
9. Where not required by Section C405.12, include an energy monitoring system in accordance with Section C406.10.
10. Where not required by Section C403.2.3, include a fault detection and diagnostics (FDD) system in accordance with Section C406.11.
11. Efficient kitchen equipment in accordance with Section C406.12.

TABLE C406.1(1) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP B OCCUPANCIES

Portions of table not shown remain unchanged.

SECTION	CLIMATE ZONE																
	0A & 1A	**0B & 1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% cooling efficiency improvement	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10% cooling efficiency improvement	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3: Reduced lighting power	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.4: Enhanced digital lighting controls	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5: On-site renewable energy	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6: Dedicated outdoor air	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.2: Recovered or renewable water heating	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: Efficient fossil fuel water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat pumpwater heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced envelope performance	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Reduced ~~air infiltration~~ *air leakage*	2	1	1	2	4	1	NA	8	2	3	11	4	1	15	8	11	6
C406.10: Energy monitoring	4	4	4	4	3	3	3	3	3	3	2	3	2	2	2	2	2
C406.11: Fault detection and diagnostics system	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

NA = Not Applicable.

TABLE C406.1(2) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP R AND I OCCUPANCIES

Portions of table not shown remain unchanged.

SECTION	**CLIMATE ZONE**																
	0A & 1A	**0B & 1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	NA	NA	1	NA	1	1	1	1	2	1	2	2
C406.2.2: 5% cooling efficiency improvement	3	3	2	2	1	1	1	1	1	NA	1	1	NA	1	1	1	NA
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	NA	1	NA	NA	1	1	1	2	2	1	3	2	3	4
C406.2.4: 10% cooling efficiency improvement	5	5	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1
C406.3: Reduced lighting power	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

C406.4: Enhanced digital lighting controls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.5: On-site renewable energy	8	8	8	8	7	8	8	7	7	7	7	7	7	7	7	7	7
C406.6: Dedicated outdoor air system	3	4	3	3	4	2	NA	6	3	4	8	5	5	10	7	11	12
C406.7.2: Recovered or renewable water heating	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.3: Efficient fossil fuel water heater	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.4: Heat pump water heater	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: Enhanced envelope performance	3	6	3	5	4	4	1	4	3	3	4	5	3	5	4	6	6
C406.9: Reduced ~~air infiltration~~ _air leakage_	6	5	3	11	6	4	NA	7	3	3	9	5	1	13	6	8	3
C406.10: Energy monitoring	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.11: Fault detection and diagnostics system	1	1	1	1	1	1	NA	1	1	NA	1	1	NA	1	1	1	1

NA = Not Applicable.

TABLE C406.1(3) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP E OCCUPANCIES

SECTION	CLIMATE ZONE																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	4
C406.2.2: 5% cooling efficiency improvement	4	4	3	3	2	2	2	2	1	1	1	1	NA	1	1	1	NA
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	1	1	1	1	2	3	4	3	4	3	4	3	5	7
C406.2.4: 10% cooling efficiency improvement	7	8	7	6	5	4	3	4	3	1	2	2	1	2	2	2	1
C406.3: Reduced lighting power	8	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406.4: Enhanced digital lighting controls	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
C406.5: On-site renewable energy	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
C406.6: Dedicatedoutdoor air system	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.2: Recoveredor renewable water heating[a]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.7.3: Efficient fossil fuel water heater[a]	NA	1	1	1	1	1	1	2	2	3	2	3	2	3	3	3	5
C406.7.4: Heat pump water heater[a]	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1	1	1	1
C406.8: Enhanced envelope performance	3	7	3	4	2	4	1	1	3	1	2	3	NA	4	3	6	9
C406.9: Reduced ~~air infiltration~~ _air leakage_	1	1	1	2	NA	NA	NA	NA	NA	NA	1	NA	NA	4	1	4	3
C406.10: Energy monitoring	3	3	3	3	3	3	3	3	3	2	2	3	2	2	2	2	2
C406.11: Fault detection and diagnostics system	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2

NA = Not Applicable.

a. For schools with showers or full-service kitchens.

TABLE C406.1(4) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP M OCCUPANCIES

SECTION	CLIMATE ZONE																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8

C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406.2.2: 5% cooling efficiency improvement	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406.2.4: 10% cooling efficiency improvement	9	12	9	8	6	6	3	4	4	1	2	3	NA	2	2	2	1
C406.3: Reduced lighting power	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
C406.4: Enhanced digital lighting controls	3	3	4	3	4	3	4	4	4	3	3	3	3	4	4	3	3
C406.5: On-site renewable energy	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406.6: Dedicated outdoor air system	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406.7.2: Recovered or renewable water heating	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: Efficient fossil fuel water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat pump water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced envelope performance	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406.9: Reduced ~~air infiltration~~ *air leakage*	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3
C406.10: Energy monitoring	4	5	5	5	5	4	4	4	4	3	3	4	3	4	4	4	3
C406.11: Fault detection and diagnostics system	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	2	2

NA = Not Applicable.

TABLE C406.1(5) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR OTHER[a] OCCUPANCIES

SECTION	CLIMATE ZONE																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406.2.2: 5% cooling efficiency improvement	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406.2.4: 10% cooling efficiency improvement	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406.3: Reduced lighting power	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406.4: Enhanced digital lighting controls	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406.5: On-site renewable energy	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406.6: Dedicated outdoor air system	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406.7.2: Recovered or renewable water heating [b]	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.3: Efficient fossil fuel water heater [b]	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.4: Heat pump water heater [b]	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: Enhanced envelope performance	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10
C406.9: Reduced ~~air infiltration~~ *air leakage*	3	2	2	4	4	2	NA	6	2	2	6	4	1	10	5	7	4
C406.10: Energy monitoring	3	3	3	3	3	3	3	3	3	3	2	3	2	2	2	3	2
C406.11: Fault detection and diagnostics system	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

NA = Not Applicable.

a. Other occupancy groups include all groups except Groups B, E, I, M and R.

b. For occupancy groups listed in Section C406.7.1.

C406.9 Reduced ~~air infiltration~~ air leakage. ~~Air infiltration~~ *Air leakage* 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~~ *air leakage* of the ~~building envelope~~ *building thermal envelope* shall not exceed 0.25 cfm/ft^2 (2.0 L/s × m^2) under a pressure differential of 0.3 inches water column (75 Pa), with the calculated surface area being the sum of the above- and below-grade building envelope. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner.

Exception: For buildings having over 250,000 square feet (25 000 m^2) of *conditioned floor area*, ~~air leakage~~ *air leakage* testing need not be conducted on the whole building where testing is conducted on representative above-grade sections of the building. Tested areas shall total not less than 25 percent of the conditioned floor area and shall be tested in accordance with this section.

Reason: The purpose of this proposal is to introduce correct terminology and to standardize it throughout the code:

- The current term, *air infiltration*, is replaced with *air leakage*. As noted in the proposed definition air leakage can occur either as infiltration or exfiltration and both directions have energy efficiency implications. Furthermore, the new term, *air leakage* and its definition are consistent with the ASHRAE 90.1 Addendum t and expected to be included in ASHRAE 90.1.Therefore, this terminology change will provide consistency across the key industry documents and will enable clarity of the code.
- Additionally, the code is updated to make sure the already defined terms *building thermal envelope* and *air barrier* are used consistently throughout the document.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed changes are to improve clarity of the code by making the terminology consistent throughout the document and consistent with other industry documents.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: adds definition and clarifies usage of the term "air leakage" throughout the code. Modification removes unnecessary extra language from definition.

Final Hearing Results

CEPI-32-21 AM

CEPI-34-21

Original Proposal

IECC®: C402.1.1, C402.1.1.1 (New), C402.1.1.1, TABLE C402.1.1.1, C402.1.2
Proponents: Leonard Sciarra, Sciarra Architecture & Planning, Sciarra Architecture & Planning (leonard.sciarra@gmail.com)

2021 International Energy Conservation Code

Revise as follows:

C402.1.1 Low-energy buildings and greenhouses. The following low-energy buildings, or portions thereof separated from the remainder of the building by *building thermal envelope* assemblies complying with this section, shall be exempt from the *building thermal envelope* provisions of Section C402.

1. ~~Those with a peak design rate of energy usage less than 3.4 Btu/h × f^{2}t (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*.~~

Add new text as follows:

C402.1.1.1 Low-energy buildings. Buildings that comply with either of the following:

1. Those with a peak design rate of energy usage less than 3.4 Btu/h × f^2~~t~~ (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*.

Revise as follows:

~~**C402.1.1.1**~~ **C402.1.1.2 Greenhouses.** Greenhouse structures or areas that are mechanically heated or cooled and that comply with all of the following shall be exempt from the building envelope requirements of this code:

1. Exterior opaque envelope assemblies comply with Sections C402.2 and C402.4.5.

   Exception: Low energy greenhouses that comply with Section C402.1.1.

2. Interior partition *building thermal envelope* assemblies that separate the greenhouse from *conditioned space* comply with Sections C402.2, C402.4.3 and C402.4.5.
3. Fenestration assemblies that comply with the thermal envelope requirements in Table C402.1.1.1. The *U*-factor for a roof shall be for the roof assembly or a roof that includes the assembly and an *internal curtain system*.

   Exception: Unconditioned greenhouses.

TABLE ~~C402.1.1.1~~ C402.1.1.2 FENESTRATION THERMAL ENVELOPE MAXIMUM REQUIREMENTS

COMPONENT	*U*-FACTOR (BTU/h × ft^2 × °F)
Skylight	0.5
Vertical fenestration	0.7

~~**C402.1.2**~~ **C402.1.1.3 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 1,200 square feet (110 m^2).
2. Are intended to house electric 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 setpoint that is restricted to not more than 50°F (10°C).
4. Have an average wall and roof *U*-factor less than 0.200 in *Climate Zones* 1 through 5 and less than 0.120 in *Climate Zones* 6 through 8.
5. Comply with the roof solar reflectance and thermal emittance provisions for *Climate Zone* 1.

Reason: This proposal cleans up the list of buildings that have unique envelope requirements so they all have their unique sections.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
this proposal does not change requirements

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies organization of low energy building requirements. The proposal is cleaner and easier to read than the existing language. Prefers that low energy buildings, green houses, and equipment building exemptions are presented separately.

Final Hearing Results

CEPI-34-21 AM

CEPI-35-21

Original Proposal

IECC®: TABLE C402.1.3

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2021 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3 OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a]
Portions of table not shown remain unchanged.

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 90.1 Appendix A.

b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the*U*-factor compliance method in Table C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially groutednot less than ~~at~~ 32 inches ~~or less~~ on center vertically and not less than 48 inches ~~or less~~ on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-f^2 °F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

e. “Mass floors” shall be in accordance with Section C402.2.3.

f. “Mass walls” shall be in accordance with Section C402.2.2.

g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

Reason: The spacing of grouted masonry cores should be 32"oc or 48"oc or MORE, not LESS. If less it would allow fully grouted concrete masonry with no cores available for integral insulation as addressed by footnote 'c'. This may be an editorial or inadvertent error from some time ago, but it should be corrected.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This is a correction of an obvious editorial error with technical implications. However, in my understanding folks are tending to read or apply the intent of footnote 'c' correctly even though it is written incorrectly.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: clarified text.

Final Hearing Results

CEPI-36-21

Original Proposal

IECC®: TABLE C402.1.3

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2021 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3 OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a]
Portions of table not shown remain unchanged.

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 90.1 Appendix A.

b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the*U*-factor compliance method in Table C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-f^2 °F.

d. Where heated slabs are below grade, below-grade walls shall comply with theR-value ~~exterior insulation~~ requirements for above-grade mass walls ~~heated slabs~~.

e. “Mass floors” shall be in accordance with Section C402.2.3.

f. “Mass walls” shall be in accordance with Section C402.2.2.

g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

Reason: Footnote ‘d’ in Table C402.1.3 is incorrect and also inconsistent with the same topic addressed in footnote ‘c’ of Table C402.1.4 which reads as follows: "c. Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls." Therefore, this proposal revises footnote ‘d’ of Table C402.1.4 to align with footnote ‘c’ of Table C402.1.4. The intent is that the below-grade walls be insulated in accordance with the insulation requirements for above-grade mass walls when the below-grade floor is a heated slab.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal makes the two footnotes in the R-value and U-factor tables consistent and in net effect may actually reduce cost for the case of a below-grade heated slab and walls complying with R-value requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Making correlation to R-value table.

Final Hearing Results	
CEPI-36-21	AS

CEPI-37-21

Original Proposal

IECC®: TABLE C402.1.3

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2021 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3 OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a]
Portions of table not shown remain unchanged.

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 90.1 Appendix A.

b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the*U*-factor compliance method in Table C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-f^2 °F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

e. “Mass floors” shall be in accordance with Section C402.2.3.

f. “Mass walls” shall be in accordance with Section C402.2.2.

g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation and full-slab insulation components shall be installed in accordance with Section C402.2.4.1 ~~is not required to extend below the bottom of the slab~~.

Reason: Footnote g includes installation guidance for insulating heated slabs that is incomplete and potentially conflicts with the newly added Section C402.2.4.1. The current footnote misses important information in Section C402.2.4.1 such as the requirement that the under-slab and perimeter slab insulation be continuous. Referencing Section C402.2.4.1 in footnote ‘g’ resolves this disconnect in updating the code last cycle.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This revision is a clarification to coordinate with slab insulation installation provisions revised last code cycle. It does not change requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Per the proponents reasoning statement.

Final Hearing Results

CEPI-37-21	AS

CEPI-38-21

Original Proposal

IECC®: TABLE C402.1.3

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2021 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3 OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a]
Portions of table not shown remain unchanged.

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
Walls, above grade																
Metal framed[h]	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-10ci or R-13 + R-5ci or R-20 + R-3.8ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-12.6ci or R-13 + R-7.5ci or R-20 + R-6.3ci	R-0 + R-15.2ci or R-13 + R-10ci or R-20 + R-9ci	R-0 + R-15.2ci or R-13 + R-10ci or R-20 + R-9ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-17.3ci or R-13 + R-12.5ci or R-20 + R-11ci	R-0 + R-21ci or R-13 + R-15.6ci or R-20 + R-14.3ci	R-0 + R-24ci or R-13 + R-18.8ci or R-20 + R-17.5ci	R-0 + R-24ci or R-13 + R-18.8ci or R-20 + R-17.5ci
Wood framed and other[h]	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 +R-12ci or R-13 + R-3.8ci or R-20	R-0 + R-12ci or R-13 + R-3.8ci or R-20	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 +R-16ci or R-13 + R-7.5ci or R20 + R3.8ci or R-27	R-0 + R-27.5ci or R-13 + R-18.8ci or R-20 + R-14ci	R-0 + R-27.5ci or R-13 + R-18.8ci or R-20 + R-14ci

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 90.1 Appendix A.

b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the*U*-factor compliance method in Table C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-f^2 °F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

e. “Mass floors” shall be in accordance with Section C402.2.3.

f. “Mass walls” shall be in accordance with Section C402.2.2.

g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

h. The first value is *cavity insulation*; the second value is *continuous insulation*. Therefore, "R-0+R-12ci" means R-12 *continuous insulation* and no *cavity insulation*; "R-13+R-3.8ci" means R-13 *cavity insulation* and R-3.8 *continuous insulation*; "R-20" means R-20 *cavity insulation* and no *continuous insulation*. R-13, R-20, and R-27 *cavity insulation* as used in this table apply to a nominal 4-inch (101 mm), 6-inch (152 mm), and 8-inch (203 mm) deep wood or cold-formed steel stud cavities, respectively.

Reason: This proposal does not change the stringency of the insulation requirements for walls. It provides additional equivalent prescriptive R-value options for all climate zones that address the three primary insulation strategies or locations on framed assemblies (cavity insulation only, cavity + continuous insulation, and continuous insulation only). For these common strategies for insulation, the user should not be required to do calculations or reference U-factor tables in a separate document, Appendix A of ASHRAE 90.1. Similar action was taken and is now included in 2021 IECC-R for wall R-values. The calculations and assumptions are exactly the same as used for existing values in the table and are available to the committee upon request.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal merely adds options for user without requiring calculations (which may reduce costs).

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: per the proponent's reason statement.

Final Hearing Results

CEPI-38-21 AS

CEPI-41-21

Original Proposal

IECC®: C402.1.4.1, C402.1.4.1.1, C402.1.4.1.2, C402.1.4.1.3

Proponents: Marcin Pazera, Polyisocyanurate Insulation Manufacturers Association, Polyisocyanurate Insulation Manufacturers Association (mpazera@pima.org); Justin Koscher, Polyisocyanurate Insulation Manufacturers Association, Polyisocyanurate Insulation Manufacturers Association (jkoscher@pima.org)

2021 International Energy Conservation Code

Revise as follows:

C402.1.4.1 Roof/ceiling assembly. The maximum roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4. Insulation shall be installed in accordance with Section C402.2.1.2 through Section C402.2.1.5.

C402.1.4.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a maximum roof/ceiling assembly *U*-factor calculation, the sloped roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) solely for *U*-factor compliance as prescribed in Section C402.1.4.

Delete without substitution:

~~**C402.1.4.1.2 Suspended ceilings.** Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof/ceiling construction.~~

~~**C402.1.4.1.3 Joints staggered.** Continuous insulation board shall be installed in not less than two layers, and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.~~

Reason: The IECC contains installation requirements applicable to roof insulation in various sections of the code. However, the intent of the code is for the installation requirements to be consistent regardless of the selected compliance method (i.e., R-value, U-factor). In previous code development cycles, inconsistencies were inadvertently created in Section C402 between the installation requirements applicable to the R-value method and the U-factor method. This proposal is intended to eliminate these inconsistencies by referencing a single set of installation requirements applicable to roof insulation. The general installation requirements in Section C402.1.4.1 (U-factor) are stricken and replaced with a pointer reference to the general installation requirements that currently appear in Section C402.2.1 (R-value). Including one set of general installation requirements in the IECC for roof insulation eliminates redundancy in code language and will make maintaining the requirements easier going forward while reducing the chance for inconsistencies. Note that the tapered insulation provisions are specific to either the U-factor or R-value compliance method and are not amended by this proposal.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change proposal will have no impact on the cost of construction. The proposal does not impose new requirements.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Reformatting of section removes redundancy. Change does not modify any requirements but improves clarity.

Final Hearing Results

CEPI-42-21

Original Proposal

IECC®: C402.1.4.1.3, C402.2.1.4

Proponents: Darren Meyers, P.E., International Energy Conservation Consultants LLC, International Energy Conservation Consultants LLC (dmeyers@ieccode.com); Mark Graham, National Roofing Contractors Association, National Roofing Contractors Association (mgraham@nrca.net)

2021 International Energy Conservation Code

Revise as follows:

C402.1.4.1.3 Joints staggered. Continuous insulation board located above deck shall be installed in not less than two layers, and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.

C402.2.1.4 Joints staggered. Continuous, above-deck insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.

Reason: Clarify the intent of these provisions using language already in Table C402.1.3 and Table C402.1.4.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposed language cleans up the language and clarifies the intent.

Final Hearing Results

CEPI-42-21	AM

CEPI-43-21

Original Proposal

IECC®: C402.1.4.2, TABLE C402.1.4.2, AISI (New)

Proponents: Jonathan Humble, American Iron and Steel Institute (Jhumble@steel.org)

2021 International Energy Conservation Code

Revise as follows:

C402.1.4.2 Thermal resistance of cold-formed steel ~~walls~~ assemblies. *U*-factors for building envelopes containing ~~of walls with~~ cold-formed steel framed ceilings and walls ~~studs~~ shall be permitted to be determined in accordance~~with Equation 4-1~~ with AISI S250 as modified herein.

1. Where the steel-framed wall contains no cavity insulation, and uses continuous insulation to satisfy the U-factor maximum, the steel-framed wall member spacing is permitted to be installed at any on-center spacing.
2. Where the steel-framed wall contains framing at 24 inches (610 mm) on center with a 23 percent framing factor or framing at 16 inches (400 mm) on-center with a 25 percent framing factor, the next lower framing member spacing input values shall be used when calculating using AISI S250.
3. Where the steel-framed wall contains less than 23 percent framing factors the AISI S250 shall be used without any modifications.
4. Where the steel-framed wall contains other than standard C-shape framing members the AISI S250 calculation option for other than standard C-shape framing is permitted to be used.

~~**U = 1/[Rs + (ER)] (Equation 4-1)**~~

~~where:~~

~~R_S = The cumulative *R*-value of the wall components along the path of heat transfer, excluding the *cavity insulation* and steel studs. ER = The effective *R*-value of the *cavity insulation* with steel studs as specified in Table C402.1.4.2.~~

~~**TABLE C402.1.4.2 EFFECTIVE R-VALUES FOR STEEL STUD WALL ASSEMBLIES**~~

NOMINAL STUD DEPTH (inches)	SPACING OF FRAMING (inches)	CAVITY *R*-VALUE (insulation)	CORRECTION FACTOR (F_c)	EFFECTIVE *R*-VALUE (ER) (Cavity *R*-Value × F_c)
~~$3^1/_2$~~	16	13	0.46	5.98
		15	0.43	6.45
~~$3^1/_2$~~	24	13	0.55	7.15
		15	0.52	7.80
~~6~~	16	19	0.37	7.03
		21	0.35	7.35
~~6~~	24	19	0.45	8.55
		21	0.43	9.03
~~8~~	16	25	0.31	7.75
	24	25	0.38	9.50

~~For SI: 1 inch = 25.4 mm.~~

Add new standard(s) as follows:

AISI AISI S250 - 21. North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing

Reason: The purpose of this proposal is to address the issue of having to submit to the code official a request to use the alternative means and methods provisions for cold-formed steel framing designs that are not shown in the IECC. For example, Section C402.1.4.2 addresses only wall framing spacing for 16 and 24 inch on center spacing and is limited to cavity plus continuous insulation options only, whereas, in the market there are many more framing spacing and insulation options used.

This proposal recommends that the Section be modified to recognize the ANSI/AISI/COFS S250 standard. This standard covers cold-formed steel wall framing spacings from 6 inches to 24 inches on center, covers member sizes from 3.5 inches to 12 inches wide, and covers member thicknesses from 0.033 inches thick to 0.064 inches thick. This standard will provide greater latitude for the user of the IECC by mitigating the necessity of having to submit for approval under alternate means and methods provisions. Further, this standard also includes provisions for evaluation of wall assemblies where all the insulation is located outside the wall cavity, which is an option the IECC does not cover.

This standard also contains provisions for calculating ceiling assemblies constructed of cold-formed steel framing with either conventional c-shape framing members, or truss construction with insulation in the attic and with additional continuous insulation below the truss framing. Previous to this proposal we found users applying the 2003 IECC provisions, which contained the calculation procedures, as part of the alternative means and methods submission process to demonstrate compliance. This proposal is intended to mitigate that additional step.

The ANSI/AISI/COFS S250 was approved and published in September 2021.

As part of AISI's effort to make this document user friendly, an excel spread sheet containing all the necessary equations and back-ground data was generated so that users would merely input the basic assembly materials data (e.g. R-values of insulations, sheathings, etc.) and allow the spread sheet to calculate within seconds the result. This excel spread sheet is available at no cost to any potential user (e.g. code official, design professional, building owner, etc.)

The proponent wishes to schedule time to present to the IECC Commercial Committee this proposal, discuss, and to take questions from the Committee.

Bibliography: AISI, "Development of a U-Factor Calculation Procedure for Cold-Formed Steel C-Shaped Clear Wall Assemblies," American Iron and Steel Institute, Washington, DC. Research Report RP20-2, April 2020.

AISI, "North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing," American Iron and Steel Institute, Washington, DC, AISI S250-21.

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

This proposed change we expect will decease the cost of construction by eliminating the need to prepare an application to the alternative means and methods process. This is because of the standards wider range of envelope assembly options that the user is permitted to calculate in order to demonstrate compliance.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Agree with proponent's reason statement that this proposal will be beneficial in standardizing the procedures for calculating building envelopes containing cold-formed steel framing. Also, agree that the amended portions do enhance, and are within the scope of, this proposal that are designed to provide greater clarity through instructions for the four different wall design configurations that could occur in building construction.

Final Hearing Results

CEPI-43-21	AM

CEPI-44-21

Original Proposal

IECC®: C402.1.4.3 (New), TABLE C402.1.4.3 (New)

Proponents: Duncan Brown, New York City Department of Buildings, New York City Department of Buildings

2021 International Energy Conservation Code

Add new text as follows:

C402.1.4.3 Thermal Resistance of Spandrel Panels. U-factors of opaque assemblies within fenestration framing systems shall be determined in accordance with the default values in Table C402.1.4.3, ASTM C1363, or ANSI/NFRC 100.

TABLE C402.1.4.3 EFFECTIVE *U*-FACTORS FOR SPANDREL PANELS[a]

Rated R-value of Insulation between Framing Members		R-4	R-7	R-10	R-15	R-20	R-25	R-30
Frame Type	Spandrel Panel	Default U-factor						
Aluminum without Thermal Break[b]	Single glass pane, stone, or metal panel	0.285	0.259	0.247	0.236	0.230	0.226	0.224
	Double glazing with no low-e coatings	0.273	0.254	0.244	0.234	0.229	0.226	0.223
	Triple glazing or double glazing with low-e glass	0.263	0.249	0.241	0.233	0.228	0.225	0.223
Aluminum with Thermal Break[c]	Single glass pane, stone, or metal panel	0.243	0.212	0.197	0.184	0.176	0.172	0.169
	Double glazing with no low-e coatings	0.228	0.205	0.193	0.182	0.175	0.171	0.168
	Triple glazing or double glazing with low-e glass	0.217	0.199	0.189	0.180	0.174	0.170	0.167
Structural Glazing[d]	Single glass pane, stone, or metal panel	0.217	0.180	0.161	0.145	0.136	0.130	0.126
	Double glazing with no low-e coatings	0.199	0.172	0.157	0.143	0.135	0.129	0.126
	Triple glazing or double glazing with low-e glass	0.186	0.165	0.152	0.140	0.133	0.128	0.125
No framing or Insulation is Continuous[e]	Single glass pane, stone, or metal panel	0.160	0.108	0.082	0.058	0.045	0.037	0.031
	Double glazing with no low-e coatings	0.147	0.102	0.078	0.056	0.044	0.036	0.030
	Triple glazing or double glazing with low-e glass	0.139	0.098	0.076	0.055	0.043	0.035	0.030

a. Extrapolation outside of the table shall not be permitted. Assemblies with distance between framing less than 30 inches (762 mm), or not included in the default table, shall have a *U-factor* determined by testing in compliance with ASTM C1363 or modeling in compliance with ANSI/NFRC 100. Spandrel panel assemblies in the table do not include metal backpans. For designs with metal backpans, multiply the U-factor by 1.20.

b. This frame type shall be used for systems that do not contain a non-metallic element that separates the metal exposed to the exterior from the metal that is exposed to the interior condition.

c. This frame type chall be used for systems where a urethan or other non-metallic element separates the metal exposed to the exterior from the metal that is exposed to the interior condition.

d. This frame type shall be used for systems that have no exposed mullion on the exterior.

e. This frame types shall be used for systems where there is no framing or the insulation is continuous and uninterrupted between framing.

Reason: Considerable review time is spent in debating the appropriate classification and thermal properties of spandrel wall types. Not to mention energy lost through the misrepresentation of U-factors. The new table, derived from Title 24 Appendix Table 4.3.8 and, a variant in effect in NYCECC since 2020, provides clear direction as to how the differently insulated types for a proposed design should be entered.

Table 4.3.8 – U-factors for Spandrel Panels and Curtain Walls

			Rated R-value of Insulation between Framing Members							
			None	R-4	R-7	R-10	R-15	R-20	R-25	R-30
Frame Type	Spandrel Panel		A	B	C	D	E	F	G	H
Aluminum without Thermal Break	Single glass pane, stone, or metal panel	1	0.4[illegible]5	0.285	0.259	0.247	0.236	0.230	0.226	0.224
	Double glass with no low-e coatings	2	0.[illegible]56	0.273	0.254	0.244	0.234	0.229	0.226	0.223
	Triple or low-e glass	3	0.[illegible]13	0.263	0.249	0.241	0.233	0.228	0.225	0.223
Aluminum with Thermal Break	Single glass pane, stone, or metal panel	4	0.4[illegible]9	0.243	0.212	0.197	0.184	0.176	0.172	0.169
	Double glass with no low-e coatings		0.[illegible]28	0.228	0.205	0.193	0.182	0.175	0.171	0.168
	Triple or low-e glass		0.[illegible]77	0.217	0.199	0.189	0.180	0.174	0.170	0.167
Structural Glazing	Single glass pane, stone, or metal panel	7	0.4[illegible]8	0.217	0.180	0.161	0.145	0.136	0.130	0.126
	Double glass with no low-e coatings		0.3[illegible]6	0.199	0.172	0.157	0.143	0.135	0.129	0.126
	Triple or low-e glass	9	0.[illegible]57	0.186	0.165	0.152	0.140	0.133	0.128	0.125
No framing or Insulation is Continuous	Single glass pane, stone, or metal panel	10	0.4[illegible]5	0.160	0.108	0.082	0.058	0.045	0.037	0.031
	Double glass with no low-e coatings	11	0.[illegible]56	0.147	0.102	0.078	0.056	0.044	0.036	0.030
	Triple or low-e glass	12	0.3[illegible]3	0.139	0.098	0.076	0.055	0.043	0.035	0.030
Frame Type	**Curtain Wall**									
Aluminum without Thermal Break	Single glass pane, stone, or metal panel	13	1.224	0.929	0.427	0.372	0.347	0.326	0.315	0.308
	Double glass with no low-e coatings	14	0.727	0.611	0.400	0.361	0.341	0.323	0.313	0.307
	Triple or low-e glass	15	0.567	0.494	0.380	0.351	0.335	0.320	0.311	0.306
Aluminum with Thermal Break	Single glass pane, stone, or metal panel	16	1.110	0.862	0.339	0.282	0.256	0.234	0.222	0.215
	Double glass with no low-e coatings	17	0.617	0.531	0.311	0.270	0.249	0.230	0.220	0.214
	Triple or low-e glass	18	0.458	0.409	0.290	0.260	0.243	0.227	0.218	0.212
Structural Glazing	Single glass pane, stone, or metal panel	19	1.106	0.859	0.290	0.228	0.199	0.175	0.162	0.154
	Double glass with no low-e coatings	20	0.577	0.502	0.260	0.215	0.192	0.171	0.160	0.152
	Triple or low-e glass	21	0.407	0.368	0.237	0.204	0.185	0.168	0.158	0.151
No framing or Insulation is Continuous	Single glass pane, stone, or metal panel	22	1.224	0.929	0.197	0.124	0.090	0.062	0.047	0.038
	Double glass with no low-e coatings	23	0.727	0.611	0.177	0.116	0.086	0.060	0.046	0.038
	Triple or low-e glass	24	0.567	0.494	0.166	0.111	0.083	0.059	0.045	0.037

This table has U-factors for the spandrel section of glass and other curtain wall systems. Design factors that affect performance are the type of framing, the type of spandrel panel and the R-value of insulation.

Four framing conditions are considered in the table. The first is the common case where standard aluminum mullions are used. Standard mullions provide a thermal bridge through the insulation, reducing its effectiveness. The second case is for metal framing members that have a thermal break. A thermal break frame uses a urethane or other non-metallic element to separate the metal exposed to outside conditions from the metal that is exposed to interior conditions. The third case is for structural glazing or systems where there is no exposed mullion on the interior. The fourth case is for the condition where there is no framing or the insulation is continuous and uninterrupted by framing. The columns in the table can be used for any specified level of insulation between framing members installed in framed curtain walls or spandrel panels.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The intent of the proposal is to aid in compliance review and does not affect the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: It provides reasonable guidance on how to assess the thermal performance of spandrel assemblies that is not previously available and can cause problems with consistency.

Final Hearing Results

CEPI-44-21	AM

CEPI-46-21

Original Proposal

IECC®: C402.1.5

Proponents: Helen Sanders, Facade Tectonics Institute/Technoform North America, The Facade Tectonics Institute

2021 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~~ the following procedure shall be an alternative to 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. *Fenestration* shall meet the applicable SHGC requirements of Section C402.4.3.

$A + B + C + D + E \leq \text{Zero}$ **(Equation 4-2)**

$A_P + B_P + C_P \leq A_T + B_T + C_T - V_F - V_S$

where:A_P = Sum of the (area x *U*-factor) for each proposed building thermal envelope assembly, other than slab-on-grade or below-grade wall assemblies.B_P = Sum of the (length x *F*-factor) for each proposed slab-on-grade edge conditionC_P = Sum of the (area x *C*-factor) for each proposed below-grade wall assemblyA_T = Sum of the (area x *U*-factor permitted by Tables C402.1.4 and C402.4) for each proposed building thermal envelope assembly, other than slab-on grade or below-grade wall assembliesB_T = Sum of the (length x *F*-factor permitted by Table C402.1.4 for each proposed slab-on-grade edge condition) C_T = Sum of the (area x *C*-factor permitted by Table C402.1.4) for each proposed below-grade wall assemblyP_F = Maximum vertical fenestration area allowable by Section C402.4.1, C402.4.1.1, or C402.4.1.2Q_F = Proposed vertical fenestration areaR_F = Q_F - P_F, but not less than zero (excess vertical fenestration area)S_F = Area-weighted average *U*-factor permitted by Table C402.4 of all vertical fenestration assembliesT_F = Area-weighted average *U*-factor permitted by Table C402.1.4 of all exterior opaque wall assembliesU_F = S_F - T_F (excess *U*-factor for excess vertical fenestration area)V_F = R_F x U_F (excess U x A due to excess vertical fenestration area)P_S = Maximum skylight area allowable by Section C402.1.4Q_S = Actual skylight areaR_S = Q_S - P_S, but not less than zero (excess skylight area)S_S = Area-weighted average *U*-factor permitted by Table C402.4 of all skylightsT_S = Area-weighted average *U*-factor permitted by Table C402.4.1 of all opaque roof assembliesU_S = S_S - T_S (excess *U*-factor for excess skylight area)V_S = R_S x U_S (excess U x A due to excess skylight area)

~~A = Sum of the (UA Dif) values for each distinct assembly type of the *building thermal envelope*, other than slabs on grade and below-grade walls.UA Dif = UA Proposed – UA Table.UA Proposed = Proposed *U*-value × Area.UA Table = (*U*-factor from Table C402.1.3, C402.1.4 or C402.4) × Area.B = Sum of the (FL Dif) values for each distinct 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.C = Sum of the (CA Dif) values for each distinct *below-grade wall* assembly type of the *building thermal envelope*.CA Dif = CA Proposed – CA Table.CA Proposed = Proposed *C*-value × Area.CA Table = (Maximum allowable *C*-factor specified in Table C402.1.4) × Area.Where the proposed vertical glazing area is less than or equal to the maximum vertical glazing area allowed by Section C402.4.1, the value of D (Excess Vertical Glazing Value) shall be zero. Otherwise:D = (DA × UV) – (DA × U Wall), but not less than zero. DA = (Proposed Vertical Glazing Area) – (Vertical Glazing Area allowed by Section C402.4.1).UA Wall = Sum of the (UA Proposed) values for each opaque assembly of the exterior wall.U Wall = Area-weighted average *U*-value of all above-grade wall assemblies.UAV = Sum of the (UA Proposed) values for each vertical glazing assembly.UV = UAV/total vertical glazing area.Where the proposed skylight area is less than or equal to the skylight area allowed by Section C402.4.1, the value of E (Excess Skylight Value) shall be zero. Otherwise:E = (EA × US) - (EA × U Roof), but not less than zero.EA = (Proposed Skylight Area) - (Allowable Skylight Area as specified in Section C402.4.1). U Roof = Area-weighted average *U*-value of all roof assemblies.UAS = Sum of the (UA Proposed) values for each skylight assembly.US = UAS/total skylight area.~~

Reason: A traditional UA calculation compares the UA of the entire proposed building to the UA of the entire prescriptive code baseline building matches the intent of the code. The above grade window-to-wall ratio for the prescriptive baseline building would be apportioned and fixed at the maximum allowable percentage to allow for trade-off of exterior wall systems against each other in the proposed building. The same applies to skylights and roofs. No trade off of façade systems against better performing building services systems is permitted anymore; the façade shall be code compliant within itself.

Equation 4-2 leads to erroneous results that allowed for excessive fenestration, which is counter to the intent of the compliance approach.

This proposal "fixes" the problem created by the existing equation and delivers on the original intent of the section. The proposed procedure accounts for the envisioned penalty for excess fenestration above and beyond the permissible window-to-wall ratio.

We recognize that this may not have exactly the right code language or formatting, but we hope that the committee will review the section and support addressing the problem with equation 4-2.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The proposed code update fixes an error with an equation and will not increase the cost of construction, as it limits excessive use of lower performance fenestration, which means that the building will be more aligned with a prescriptive building.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: this proposal clarifies the equation for component trade off eliminating some confusion that existed.

Final Hearing Results

CEPI-46-21	AM

CEPI-47-21

Original Proposal

IECC®: C402.2.1.1, C402.2.1.2

Proponents: Darren Meyers, P.E., International Energy Conservation Consultants LLC, International Energy Conservation Consultants LLC (dmeyers@ieccode.com); Mark Graham, National Roofing Contractors Association, National Roofing Contractors Association (mgraham@nrca.net)

2021 International Energy Conservation Code

Revise as follows:

C402.2.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a roof/ceiling assembly *R*-value calculation, the sloped roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) solely for *R*-value compliance as prescribed in Section 402.1.3. The thickness of tapered, above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be not less than 1 inch (25 mm).

Delete without substitution:

~~**C402.2.1.2 Minimum thickness, lowest point.** The minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be not less than 1 inch (25 mm).~~

Reason: Provisions for "Minimum thickness, lowest point," apply to tapered, above-deck installations of insulation, as intended.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action	**As Modified**

Committee Reason: This change improves the clarity of the requirement by indicating that it applies only to tapered insulation.

Final Hearing Results

CEPI-47-21	AM

CEPI-48-21

Original Proposal

IECC®: C402.2.7

Proponents: Amanda Hickman, The Hickman Group, Reflective Insulation Manufacturers Association (RIMA) (amanda@thehickmangroup.com)

2021 International Energy Conservation Code

Revise as follows:

C402.2.7 Airspaces. Where the *R*-value of an airspace is used for compliance in accordance with Section C402.1, the airspace shall be enclosed in an unventilated cavity bounded on all sides by building components andconstructed to minimize airflow into and out of the enclosed airspace. Airflow shall be deemed minimized whereone of the following conditions occur: ~~the enclosed airspace is located on the interior side of the continuous air barrier and is bounded on all sides by building components.~~

1. The enclosed airspace is unventilated.
2. The enclosed airspace is bounded on at least one side by an anchored masonry veneer, constructed in accordance with Chapter 14 of the *International Building Code*, and vented by veneer weep holes located only at the bottom of the airspace and space not less than 15 inches (381 mm) on center with top of the cavity airspace closed.

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

Reason: With the current focus by the energy building code bodies to increase energy efficiency every code cycle, it is imperative that code language be technically accurate. Unfortunately in its current state, this section of the code is not.

The current language does not evaluate the realistic stipulations as they relate to air spaces.

1. The first issue is the location of an “enclosed unventilated cavity”.
2. The second, is the specification for a test method for thermal performance of an air space on the exterior of the air barrier.

A masonry wall assembly that is built to the 2021 IBC will typically include an “enclosed airspace that is bounded on all sides by building components". This provides an “unventialled” condition as the “weep holes” provided for drainage do not promote a level of air exchange that would affect the thermal performance of the system.

An air space that is enclosed, unventilated and bounded by building components on all sides performs thermally the same regardless of location. It is not necessary to differentiate a location if the assembly meets these requirements. If an assembly has ventilation, a mechanism or design for free air exchange, then the requirements are not met, and the air space cannot be utilized as a contributor to the thermal performance of the assembly.

Free air exchange in a wall system requires “air in” and an avenue for “air out”. In order to achieve this with a masonry wall, it would require “venting” in the upper and lower half of the wall. A series of weep holes across the lower extreme of the wall do not qualify as venting which is necessary for a system to be ventilated.

The requirements related to ASTM C1363 are completely inappropriate and impossible to actually execute.

“ASTM C1363 Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus” specifies in Paragraph 1.14 “The test method does not permit intentional mass transfer of air or moisture through the specimen during measurements”.

In regard to the specified “air movement rate” of 70 mm/second, this value is arbitrary. Data to substantiate this as a “real world” rate has never been available or offered. This really is a moot point since the introduction of air movement into the apparatus is prohibited, but further exemplifies the faults with this section/exception.

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

This code change simplifies the code and eliminates unnecessary requirements, which will decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies what systems can use standard R-values.

Final Hearing Results

CEPI-48-21	AM

CEPI-58-21

Original Proposal

IECC®: C402.5, C402.5.1.2, C402.5.2, C402.5.3, C406.9, SECTION 202

Proponents: Mark Lyles, New Buildings Institute, New Buildings Institute (markl@newbuildings.org); Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com); Diana Burk, New Buildings Institute, New Buildings Institute (diana@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

C402.5 Air leakage—thermal envelope. The *building thermal envelope* shall comply with Sections C402.5.1 through Section C402.5.11.1, or the building *thermal envelope* shall be tested in accordance with Section C402.5.2 or C402.5.3. Where compliance is based on such testing, the building shall also comply with Sections C402.5.7, C402.5.8 and C402.5.9.

C402.5.1.2 Air barrier compliance. A continuous air barrier for the opaque building envelope shall comply with the following:

1. Buildings or portions of buildings, including Group R-2 and I-1 occupancies, shall meet the provisions of Section C402.5.2.

   Exception: Buildings in Climate Zones 2B, 3C and 5C.

2. Buildings or portions of buildings other than Group R-2 and I-1 occupancies shall meet the provisions of Section C402.5.3.

   Exceptions:

   1. Buildings in Climate Zones 2B, 3B, 3C and 5C.
   2. Buildings larger than 5,000 square feet (464.5 m^2) floor area in Climate Zones 0B, 1, 2A, 4B and 4C.
   3. Buildings between 5,000 square feet (464.5 m^2) and 50,000 square feet (4645 m^2) floor area in Climate Zones 0A, 3A and 5B.

3. Buildings or portions of buildings that do not complete air barrier testing shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5.

C402.5.2 Dwelling and sleeping unit enclosure testing. The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent method approved by the *code official*. The measured air leakage shall not exceed 0.30 cfm/ft^2 (1.5 L/s m^2) of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa). Where multiple dwelling units or sleeping units or other *enclosed* ~~occupiable conditioned~~ *spaces* are contained within one *building thermal envelope*, each ~~unit~~ shall be considered an individual testing unit, and the building air leakage shall be the weighted average of all tesetd~~ing~~ unit results, weighted by the ~~each testing unit's~~ enclosure area of each tested unit. Units shall be tested without simultaneously testing adjacent units and shall be separately ~~with an unguarded blower door test~~tested as follows:

1. Where buildings have fewer than eighttotal dwelling or sleeping ~~testing~~ units, each ~~testing~~ unit shall be tested.
2. For buildings with eight or moredwelling or sleeping ~~testing~~ units, the greater of seven units or 20 percent of the~~testing~~ units in the building shall be tested, including a top floor unit, a ground floor unit and a unit with the largest *testingunit enclosure area*. For each tested unit that exceeds the maximum air leakage rate, an additional two units shall be tested, including a mixture of ~~testing~~ unit types and locations.
3. *Enclosed spaces* with not less than one *exterior wall* in the *building thermal envelope* shall be tested in accordance with Section C402.5.3.

   Exception: Corridors, stairwells, and *enclosed spaces* having a *conditioned floor area* not greater than 1,500 ft^2~~-~~(139 m^2)shall be permitted to comply with Section C402.5.1.5 and either Section C402.5.1.3 or Section C402.5.1.4.

C402.5.3 Building thermal envelope testing. The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E3158 or ASTM E1827 or an equivalent method approved by the code official. The measured air leakage shall not exceed 0.40 cfm/ft^2 (2.0 L/s × m^2) of the *building thermal envelope* area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, portions of the building shall be tested and the measured air leakages shall be area weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be tested:

Exceptions:

1. The entire envelope area of all stories that have any spaces directly under a roof.
2. The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.
3. Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space.

Exception: Where the measured air leakage rate exceeds 0.40 cfm/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 infrared imaging shall be conducted while the building is pressurized along with a visual inspection of the air barrier. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section.

C406.9 Reduced air infiltration. Air infiltration shall be verified by whole-building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air-leakage rate of the building envelope shall not exceed 0.25 cfm/ft^2 (2.0 L/s × m^2) under a pressure differential of 0.3 inches water column (75 Pa), with the calculated surface area being the sum of the above- and below-grade building envelope. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner.

Exception:~~For buildings having over 250,000 square feet (25 000 m^2) of *conditioned floor area*, air leakage testing need not be conducted on the whole building where testing is shall be conducted on representative above-grade sections of the building. Tested areas shall total not less than 25 percent of the conditioned floor area and shall be tested in accordance with this section.~~*Buildings* tested in accordance with Section C402.5.2 where the weighted average of all tested unit results is not greater than 0.20 cfm/ft^2 (1.0 L/s x m^2) at a pressure differential of 0.2 inch water gauge (50 Pa).

TESTING UNIT ENCLOSURE AREA. The area sum of all the boundary surfaces that define the *dwelling unit*, *sleeping unit* or ~~occupiable~~ *conditioned enclosed space* including top/ceiling, bottom/floor and all side walls. This does not include interior partition walls within the *dwelling unit*, *sleeping unit*, or ~~occupiable~~ *conditioned enclosed space*. Wall height shall be measured from the finished floor of the *conditioned space* to the finished floor or roof/ceiling air barrier above.

Reason: Air leakage can be a significant source of energy waste in buildings, contributing to higher heating and cooling costs for building owners and occupants, and increasing risk related to comfort and durability. Air tightness testing can result in more attention to envelope assembly air barrier sealing and significantly reduced building leakage. Adequate control over air leakage can provide many benefits, including reduced HVAC equipment sizing, better building pressurization, and energy savings due to reduced heating and cooling of infiltrated outside air. In moist climates, ensuring lower air leakage through whole-building testing can also result in better humidity control and reduced risk of durability issues. While it is important that the materials and assemblies have limited leakage, that alone does not guarantee a low leakage building. Recent research shows that 40% of buildings constructed without an envelope consultant have air leakage exceeding the currently optional test standard requirements, while buildings with envelope consultants all had leakage below 0.25 cfm/ft (Wiss J. 2014).

Testing is the most reliable means of ensuring that the intent of this code section—limiting unintended energy waste in buildings due to air infiltration—will be achieved. Durston and Heron's review (2012) of the 0.25cfm/ft^2 requirement by the U.S. Department of Defense (DOD) shows that without testing, the range of building leakage can exceed the requirement by more than double (0.9 cfm/ft). However, with testing included as part of the construction process, the average leakage of buildings was determined to be below the 0.25 cfm/ft limit and in many cases lower leakage levels in the range of 0.15 cfm/ft^2 can be achieved (Durston and Heron 2012). Therefore, a test limit of 0.25 cfm/ft is considered to be both a realistic and achievable goal.

This amendment proposes exempting whole building leakage testing for buildings larger than 250,000 f^{2}t because of the technical and practical issues with testing these large buildings. This amendment also proposes different test thresholds for multifamily structures (Group R and I occupancies) that align with current industry practice in blower door testing for the multifamily market. The original air leakage testing threshold for residential buildings of 0.30 cfm/square foot tested at 50 Pascals was lowered to 0.20 cfm/square foot to align with the requirements in ASHRAE 62.2.

Additioanlly, as a result of these previous changes, the air leakage rate in Section C406.9 was reduced from 0.25 cfm/ft2 to 0.17 cfm/ft2 at 75 Pa and the specific requirements for Group R and Group I buildings were added as an exception.

Bibliography: Wiss J. 2014. *ASHRAE 1478-RP Measuring Airtightness of Mid- and High-Rise Non-Residential Buildings*. Elstner Associates, Inc. for ASHRAE. https://www.ashrae.org/resources--publications/periodicals/enewsletters/esociety/2014-12-10-articles/completed-research-december-2014.

Durston JL and M Heron. 2012. *Summary and Analysis of Large Building Air Leakage Testing for the U.S. Department of Defense*. Atlanta, GA. https://cdn.ymaws.com/www.nibs.org/resource/resmgr/BEST/best3_durston.2.9.pdf.

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

This measure will increase the cost of construction of new commercial buildings as whole building air leakage testing will be required except for primarily residential buildings (Group R and I building occupancies). Based on a survey of professional commercial building air barrier testing companies, it was determined that the cost of air leakage testing fell into three ranges:

· $350 or $0.12 to $0.07 per square foot for buildings up to 5000 square feet

· $0.50 to $0.15 per square foot for buildings between 5000 and 50,000 square feet

· $0.15 to $0.09 per square foot for buildings between 50,000 and 100,000 square feet, with decreasing costs for larger buildings.

As demand for air leakage testing in commercial buildings increases, more companies will enter the market to provide these services. Therefore, a gradual decrease in cost is expected as more companies are available to do the testing.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: CEPI-58 was modified by the proponents to remove overlapping changes with other proposals that also addressed re-structuring, test exemptions, and test stringency.

Final Hearing Results

CEPI-58-21 AM

CEPI-60-21

Original Proposal

IECC®: C402.5.1.1, C402.5.12 (New)

Proponents: Megan Hayes, NEMA, NEMA (Megan.Hayes@nema.org); Harold Jepsen, Legrand, NEMA (harold.jepsen@legrand.us)

2021 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. Sealing shall allow for expansion, contraction and mechanical vibration. Joints and seams associated with penetrations shall be sealed in the same manner or taped. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation. Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.
4. Recessed lighting fixtures shall comply with Section C402.5.10. Where similar objects are installed that penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.
5. Electrical and communication boxes shall comply with C405.5.12. Where similar objects are installed that penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.

Add new text as follows:

C402.5.12 Electrical and communication boxes. Electrical and communication boxes installed in the *building thermal envelope* shall meet one of the following:

1. Boxes that penetrates the *building thermal envelope* shall be air sealed to the subfloor, wall covering, or ceiling penetrated by the box. Spaces behind boxes penetrating the thermal envelope shall have insulation cut or blown to fit or that readily conforms to the space around the box.
2. Boxes that penetrate the *building thermal envelope* shall be the air-sealed type. Air-sealed boxes shall be tested in accordance with NEMA OS 4, Requirements for
Air-Sealed Boxes for Electrical and Communication Applications, and shall have an air leakage rate of not greater than 2.0 cfm (0.944 L/s) at a pressure differential of 1.57 psf (75 Pa). Air-sealed boxes shall be marked "NEMA OS 4" or "OS4" in accordance with NEMA OS 4. Air-Sealed boxes shall be installed per the manufacturer's instructions and with any supplied components required to achieve compliance with NEMA OS 4.

Reason: It is clear that C402.5 currently requires all building and system components that penetrate the thermal envelope to be sealed to create an air barrier and prevent air leakage. However, additional guidance is needed on how what options are available to achieve the objectives outlined in C402.5 when it comes to electrical and communication outlet boxes. This proposal corrects this gap in the code by offering a prescriptive option for conventional outlet boxes and a performance option utilizing tested air-sealed boxes. Approval of this proposal aligns the IECC-C with the IECC-R that already includes similar provisions for outlet boxes in Table R402.1.1 and R402.4.6.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There is no increase or decrease cost in construction as this proposal simply adds language specific to electrical and communication outlet boxes that penetrate the thermal envelope and already intended to be sealed against air leakage in C402.5 by mirroring the requirement in C402.5.1.1.4 and C402.5.10 for recessed lighting.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: clarifies requirements for the sealing of electrical boxes that penetrate the air barrier.

Final Hearing Results

CEPI-60-21	AM

CEPI-61-21

Original Proposal

IECC®: C402.5.1.2
Proponents: Helen Sanders, Facade Tectonics Institute/Technoform North America, Facade Tectonics Institute

2021 International Energy Conservation Code

Revise as follows:

C402.5.1.2 . A continuous air barrier for the opaque building envelope shall comply with the following:

1. Buildings or portions of buildings, including Group R and I occupancies, shall meet the provisions of Section C402.5.2.

   ~~**Exception:** Buildings in Climate Zones 2B, 3C and 5C~~.

2. Buildings or portions of buildings other than Group R and I occupancies shall meet the provisions of Section C402.5.3.

   Exceptions:

   1. Buildings in Climate Zones 2B~~, 3B, 3C and 5C~~.
   2. ~~Buildings larger than 5,000 square feet (464.5 m^2) floor area in Climate Zones 0B, 1, 2A, 4B and 4C~~.
   3. ~~3.~~ 2. Buildings ~~between 5,000~~ larger than 25,000 square feet ~~(464.5~~ 2323 m^2 ~~) and 50,000 square feet (4645 m^2)~~ floor area in Climate Zones 0 through 4 ~~0A, 3A and 5B~~.

3. Buildings or portions of buildings that do not complete air barrier testing shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5.

Reason: The members of the Façade Tectonics Institute (FTI) believe that the IECC has been moving in the right direction in terms of mandating whole building air leakage testing to improve building energy efficiency. The current 2021 version restricts the requirements to a select few climate zones though – mostly those that are heating dominated. Actual air leakage testing assures the quality of construction of the building envelope in this critical performance area. And air leakage is an energy efficiency degrader in all climate zones, whether heating dominated, mixed or cooling dominated (see references in bibliography).

In cooling dominated climate zones, air-leakage through the building envelope impacts the load on the air conditioning system (cooling of hot air infiltration), and even more so in humid climate zones where water also needs to be removed. This puts additional load on the electrical grid. As we move towards net zero buildings, and 100% electrification for decarbonization, it is becoming even more critical not just to reduce energy usage, but to free up electrical grid capacity, and manage peak demand (timing and amount) because of the increased use of renewables. This further supports the need to focus on more southern climate zones for verifying airtightness performance to reduce grid loads.

In order to achieve net zero energy and carbon emissions in buildings by 2030, the design and construction practitioners of the Façade Tectonics Institute believe we need to eliminate the exceptions to air leakage requirements so that they cover the majority of buildings as soon as possible. Previous studies have shown energy cost savings from air barriers of 2% to 36% (Emmerich et al. 2005) across all climate zones. If air-barriers are required for energy efficiency, they should be verified by testing to ensure the appropriate energy savings are captured. Verification and commissioning of building envelope systems are key tools in closing the performance gap between as-designed and as-built in building assemblies and systems.

Washington State's energy code (see reference for link) is a successful demonstration of the implementation of mandatory air-leakage testing in climate zone 4 (Maritime). Note that based on IECC 2021, only buildings less than 5,000 sq.ft. are required to do air leakage testing in this climate zone. As a result of the introduction of air leakage testing requirement, the state's construction industry has built up testing infrastructure to support meeting the requirements. The cost of fabricating an air-tight barrier is no more expensive than making a poorer one – it just requires high quality installation and quality control. Meeting the standard doesn't cost anything more, the additional cost is in the testing of the barrier's performance. Since testing is considered cost-effective in climate zone 4 (Maritime), it should be cost-effective elsewhere.

Washington's example illustrates that if air barrier testing is required, the industry will set up to do it. The fact that IECC 2021 already requires air-barrier testing in some climate zones supports the further development of testing infrastructure, as the standard is adopted by states. Expanding the climate zones in which air barrier testing is required in IECC 2024, will build on the momentum of what is already required by the 2021 version, and there should be plenty of testing capacity developed to leverage.

FTI strongly recommends removing all exceptions to air leakage testing as soon as possible, since the building envelopes constructed in the near term will be with us for the next fifty years, contributing to carbon emissions. However, an intermediate step could be to require testing for climate zones 3 and higher in the 2024 version, moving to no exceptions in 2027.

Bibliography: Steven J Emmerich et al., Investigation of the Impact of Commercial Building Envelope Airtightness on HVAC Energy Use, NIST, 2005 https://www.govinfo.gov/content/pkg/GOVPUB-C13-db70d72cbf88472707ae51276ee7e599/pdf/GOVPUB-C13-db70d72cbf88472707ae51276ee7e599.pdf

S. Emmerich and A. Persily, The air tightness of commercial buildings in the U.S.https://www.nist.gov/publications/airtightness-commercial-buildings-united-states

Washington State Energy Code 2018, https://sbcc.wa.gov/sites/default/files/2020-04/2018%20WSEC_C%202nd%20print.pdf

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

As mentioned in the reason statement, Washington State has been successful at introducing air leakage testing and an ecosystem of suppliers has been developed and is considered cost-effective in climate zone 4 Maritime. IECC 2021 also requires air leakage testing in some climate zones already and so has been considered cost-effective. Adoption of this 2021 revision should also support further development of testing infrastructure. It should not cost more to install an air barrier well, and to meet the already established standard than to install it poorly – no change in materials or process are needed. The only additional cost is the testing.

Whole building air leakage testing can run the gamut from $10k to $60k+ depending on the size and complexity of the building. The larger the building the more fans are required. The more separate zones within a building, the more individual tests are required. The more compartmentalized the interior the more extensive the required prep-work. As a result, large multi-residential projects tend to be the more expensive buildings to test. That said, even in this range of $10K to $60K, the cost of the test is a very small portion of a typical building project budget, so the fractional incremental cost is low. Blower door testing of single family residential is typically less than $1,000 (typically less than 1% of the cost of construction).

Public Hearing Results

Committee Action **As Modified**

Committee Reason: To provide for more consistency with prior actions regarding inspection versus testing options in acknowledgement of the costs of testing on smaller buildings

Final Hearing Results

CEPI-61-21 AM

CEPI-65-21

Original Proposal

IECC®: C402.5.11, C402.5.11.1, C403.14, C403.4.6 (New), TABLE C407.2

Proponents: Lisa Rosenow, Evergreen Technology Consulting, Self (lrosenow@evergreen-tech.net); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Delete without substitution:

~~**C402.5.11 Operable openings interlocking.** Where occupancies utilize operable openings to the outdoors that are larger than 40 square feet (3.7 m^2) in area, such openings shall be interlocked with the heating and cooling system so as to raise the cooling setpoint to 90°F (32°C) and lower the heating setpoint to 55°F (13°C) whenever the operable opening is open. The change in heating and cooling setpoints shall occur within 10 minutes of opening the operable opening.~~

~~**Exceptions:**~~

1. ~~Separately zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy.~~
2. ~~Warehouses that utilize overhead doors for the function of the occupancy, where approved by the code official.~~
3. ~~The first entrance doors where located in the exterior wall and are part of a vestibule system.~~

~~**C402.5.11.1 Operable controls.** Controls shall comply with Section C403.14~~.

~~**C403.14 Operable opening interlocking controls.** The heating and cooling systems shall have controls that will interlock these mechanical systems to the set temperatures of 90ºF (32ºC) for cooling and 55ºF (12.7ºC) for heating when the conditions of Section C402.5.8 exist. The controls shall configure to shut off the systems entirely when the outdoor temperatures are below 90ºF (32ºC) or above 55ºF (12.7ºC).~~

Add new text as follows:

C403.4.6 HVAC system controls for operable openings to the outdoors. All doors from a *conditioned space* to the outdoors and all other operable openings from a *conditioned space* to the outdoors that are larger than 40 square feet (3.7 m^2) when fully open, shall have *automatic* controls interlocked with the heating and cooling system. The controls shall be configured to do the following within 5 minutes of opening:

1. Disable mechanical heating to the *zone* or reset the space heating temperature setpoint to 55°F (12.7°C) or less.
2. Disable mechanical cooling to the *zone* or reset the space cooling temperature setpoint to 90°F (32°C) or more. Mechanical cooling can remain enabled if the outdoor air temperature is below the space temperature.

Exceptions:

1. *Building entrances* with *automatic* closing devices.
2. Emergency exits with an *automatic* alarm that sounds when open.
3. Operable openings and doors serving *enclosed spaces* without a *thermostat* or HVAC temperature sensor.

4. Separately zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy.
5. Warehouses that utilize operable openings for the function of the occupancy where *approved* by the *code official*.
6. The first entrance doors where located in the exterior wall and are part of a vestibule system.
7. Operable openings into spaces served by radiant heating and cooling systems.
8. *Alterations* where walls would have to be opened solely for the purpose of meeting this requirement and where *approved*.
9. Doors served by *air curtains* meeting the requirements of Section C402.5.9.

Revise as follows:

TABLE C407.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION [a]	TITLE
Envelope	
C402.5	Air leakage—thermal envelope
Mechanical	
C403.1.1	Calculation of heating and cooling loads
C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies
C403.4.1, except C403.4.3, C403.4.4 and C403.4.5	Heating and cooling system Thermostatic controls
C403.4.2	Off-hour controls
C403.4.6	HVAC system controls for operable openings to the outdoors
C403.5.5	Economizer fault detection and diagnostics
C403.7, except C403.7.4.1	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.11, except C403.11.3	Refrigeration equipment performance
C403.12	Construction of HVAC system elements
C403.13	Mechanical systems located outside of the building thermal envelope
C404	Service water heating
C405, except C405.3	Electrical power and lighting systems
C408	Maintenance information and system commissioning

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

Reason: Remove duplication, improve description of code intent and relocate mechanical controls provision to the appropriate location within the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The intent of this proposal is to improve code language clarity only.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: proposal supports increased energy efficiency around the building envelope though operable openings.

Final Hearing Results

CEPI-65-21	AM

CEPI-68-21

Original Proposal

IECC®: C402.5.2

Proponents: Aaron Gary, Tempo, Inc., Seft (aaron.gary@texenergy.org)

2021 International Energy Conservation Code

Revise as follows:

C402.5.2 Dwelling and sleeping unit enclosure testing. The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent method approved by the *code official*. The measured air leakage shall not exceed 0.30 cfm/ft^2 (1.5 L/s m^2) of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa). Where multiple dwelling units or sleeping units or other occupiable conditioned spaces are contained within one *building thermal envelope*, each unit shall be considered an individual testing unit, and the building air leakage shall be the weighted average of all testing unit results, weighted by each testing unit's enclosure area. Units shall be tested separately with an unguarded blower door test as follows:

1. Where buildings have fewer than eight testing units, each testing unit shall be tested.
2. For buildings with eight or more testing units, the greater of seven units or 20 percent of the testing units in the building shall be tested, including a top floor unit, a middle floor unit, a ground floor unit and a unit with the largest testing unit enclosure area. For each tested unit that exceeds the maximum air leakage rate, an additional ~~two~~ three units shall be tested, including a mixture of testing unit types and locations.

Reason: This amendment brings this section into closer alignment with the updated RESNET sampling guidelines for the testing of multifamily buildings.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change will only result in a change to the cost of verification if testing failures occur.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Brings the selection of dwelling units for air leakage testing more in alignment with industry standards for sampling in multifamily buildings.

Final Hearing Results

CEPI-68-21	AS

CEPI-69-21

Original Proposal

IECC®: C402.5.2, C402.5.3, ASTM Chapter 06 (New)

Proponents: Theresa A Weston, The Holt Weston Consultancy, The Air Barrier Association of America (ABAA) (holtweston88@gmail.com)

2021 International Energy Conservation Code

Revise as follows:

C402.5.2 Dwelling and sleeping unit enclosure testing. The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent method approved by the *code official*. The measured air leakage shall not exceed 0.30 cfm/ft^2 (1.5 L/s m^2) of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa).Testing shall be conducted by an *approved* third party. Where multiple dwelling units or sleeping units or other occupiable conditioned spaces are contained within one *building thermal envelope*, each unit shall be considered an individual testing unit, and the building air leakage shall be the weighted average of all testing unit results, weighted by each testing unit's enclosure area. Units shall be tested separately with an unguarded blower door test as follows:

1. Where buildings have fewer than eight testing units, each testing unit shall be tested.
2. For buildings with eight or more testing units, the greater of seven units or 20 percent of the testing units in the building shall be tested, including a top floor unit, a ground floor unit and a unit with the largest testing unit enclosure area. For each tested unit that exceeds the maximum air leakage rate, an additional two units shall be tested, including a mixture of testing unit types and locations.

C402.5.3 Building thermal envelope testing. The *building thermal envelope* shall be tested by an *approved* third party in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E3158 or ASTM E1827 or an equivalent method approved by the code official. The measured air leakage shall not exceed 0.40 cfm/ft^2 (2.0 L/s × m^2) of the *building thermal envelope* area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, portions of the building shall be tested and the measured air leakages shall be area weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be tested:

1. The entire envelope area of all stories that have any spaces directly under a roof.
2. The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.
3. Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space.

Exception: Where the measured air leakage rate exceeds 0.40 cfm/ft^2 (2.0 L/s × m^2) but does not exceed 0.60 cfm/ft^2 (3.0 L/s × m^2), an *approved* third party shall perform a diagnostic evaluation using smoke tracer or infrared imaging shall be conducted while the building is pressurized along with a visual inspection of the air barrier in accordance with ASTM E1186. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section.

Add new standard(s) as follows:

ASTM

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

E1186 - 17 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems

Reason: This proposal seeks to ensure that whole building air leakage and diagnostic test is conducted by an independent & qualified entity that is acceptable to the code official. Additionally, the proposal adds a new reference standard which provides consensus procedures for conducting the diagnostic testing specified in the code. The new reference, ASTM E1186, has the following scope:

"1. Scope

1.1 These practices cover standardized techniques for locating air leakage sites in building envelopes and air barrier systems.

1.2 These practices offer a choice of means for determining the location of air leakage sites with each offering certain advantages for specific applications.

1.3 Some of the practices require a knowledge of infrared scanning, building and test chamber pressurization and depressurization, smoke and fog generation techniques, sound generation and detection, and tracer gas concentration measurement techniques.

1.4 The practices described are of a qualitative nature in determining the air leakage sites rather than determining quantitative leakage rates.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use. For specific hazard statements, see Section 6.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee."*

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not change the technical requirements for building thermal envelope. But rather it seeks to ensure that the current code requirements are verified by qualified practitioners and in accordance with industry standard methods.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: clarify that an approved third party shall provide air leakage testing and that they can also provide diagnostic evaluation when required

Final Hearing Results

CEPI-69-21 AM

CEPI-71-21

Original Proposal

IECC®: C402.5.2, C402.5.3, C406.9

Proponents: Theresa A Weston, The Holt Weston Consultancy, The Air Barrier Association of America (ABAA) (holtweston88@gmail.com)

2021 International Energy Conservation Code

Revise as follows:

C402.5.2 Dwelling and sleeping unit enclosure testing. The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent method approved by the *code official*. The measured air leakage shall not exceed ~~0.30~~ 0.27 cfm/ft^2 (~~1.5~~ 1.4 L/s m^2) of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa). Where multiple dwelling units or sleeping units or other occupiable conditioned spaces are contained within one *building thermal envelope*, each unit shall be considered an individual testing unit, and the building air leakage shall be the weighted average of all testing unit results, weighted by each testing unit's enclosure area. Units shall be tested separately with an unguarded blower door test as follows:

1. Where buildings have fewer than eight testing units, each testing unit shall be tested.
2. For buildings with eight or more testing units, the greater of seven units or 20 percent of the testing units in the building shall be tested, including a top floor unit, a ground floor unit and a unit with the largest testing unit enclosure area. For each tested unit that exceeds the maximum air leakage rate, an additional two units shall be tested, including a mixture of testing unit types and locations.

C402.5.3 Building thermal envelope testing. The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E3158 or ASTM E1827 or an equivalent method approved by the *code official*. The measured air leakage shall not exceed ~~0.40~~ 0.35 cfm/ft^2 (~~2.0~~ 1.8 L/s × m^2) of the *building thermal envelope* area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, portions of the *building* shall be tested and the measured air leakages shall be area weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the *building* shall be tested:

1. The entire envelope area of all stories that have any spaces directly under a roof.
2. The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.
3. Representative above-grade sections of the *building* totaling at least 25 percent of the wall area enclosing the remaining conditioned space.

Exception: Where the measured air leakage rate exceeds~~0.40~~ 0.35 cfm/ft^2 (~~2.0~~ 1.8 L/s × m^2) but does not exceed ~~0.60~~ 0.45 cfm/ft^2 (~~3.0~~ 2.3 L/s × m^2), a diagnostic evaluation using smoke tracer or infrared imaging shall be conducted while the*building* is pressurized along with a visual inspection of the air barrier. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section.

C406.9 Reduced air infiltration. Air infiltration shall be verified by whole-building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air-leakage rate of the building envelope shall not exceed ~~0.25~~ 0.22 cfm/ft^2 (~~2.0~~ 1.1 L/s × m^2) under a pressure differential of 0.3 inches water column (75 Pa), with the calculated surface area being the sum of the above- and below-grade building envelope. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the *code official* and the building owner.

Exception: For buildings having over 250,000 square feet (25 000 m^2) of *conditioned floor area*, air leakage testing need not be conducted on the whole building where testing is conducted on representative above-grade sections of the building. Tested areas shall total not less than 25 percent of the conditioned floor area and shall be tested in accordance with this section.

Reason: Reducing the measured air leakage from 0.40 to 0.30 cfm/ft^2 at a pressure differential of 0.3 inch water gauge (75 Pa) recognizes the advances the industry has made in air leakage control technology and methods since whole building air leakage tested was introduced in the IECC-C in 2012 (about a decade ago). The advancement of air leakage control technology (including both materials and installation practices) during the last decade has led to increased building performance. Experiences with the air leakage testing and building performance have been recorded industry literature, some of which are listed in the bibliography.[1,2,3]

This change in the maximum air leakage requirement is consistent with industry practices and specifications which have been instituted in the industry, including:

- Seattle Energy Code 2015: .30 cfm/ft^2
- US Army Corps of Engineers (2012): .25 cfm/ft^2 (Demonstrated achievable [5])
- IgCC/ASHRAE 189.1: .25 cfm/ft^2
- Seattle Energy Code 2018: .25 cfm/ft^2
- PHIUS+ 2015: .08 cfm/ft^2 (included in incentive and tax credit programs in multiple states)

It has long been understood, deficient airtightness has negative consequences, the most important of which are:

- increased energy use
- reduced thermal comfort
- reduced air quality
- moisture damages.[6,7]

Only one of these consequences, energy use, is considered directly in the development of the IECC, but all are experienced by the building occupants.

Bibliography:

1. J. Estrada, "Building Air Leakage Testing in Seattle, Washington: What We've Learned and Where We Go from Here," in Whole Building Air Leakage: Testing and Building Performance Impacts, ed. T. Weston, K. Nelson, and K. Wissink (West Conshohocken, PA: ASTM International, 2019), 1-19. https://doi.org/10.1520/STP161520180018
2. D. Jonlin, "Rookie Mistakes: Lessons from a Decade of Mandatory Air Barrier Testing," in Whole Building Air Leakage: Testing and Building Performance Impacts, ed. T. Weston, K. Nelson, and K. Wissink (West Conshohocken, PA: ASTM International, 2019), 20-37. https://doi.org/10.1520/STP161520180025
3. K. Knight, C. Carson, and G. Proskiw, "Target Airtightness Rates for Large Buildings, What Is Possible, What Is Probable, and What Is Prophetic," in Whole Building Air Leakage: Testing and Building Performance Impacts, ed. T. Weston, K. Nelson, and K. Wissink (West Conshohocken, PA: ASTM International, 2019), 291-300. https://doi.org/10.1520/STP161520180121
4. Diana Hun, Mahabir Bhandari, Melissa Lapsa, Som Shrestha, and Simon PallinAirtightness of Commercial Building Envelopes: Where are we and where could we go? , Oak Ridge National Laboratory Caroline Hazard, CSRA https://www.osti.gov/servlets/purl/1559734
5. J.L. Durston ab\nd M. Heron, "Summary and Analysis of Large Building Air Leakage Testing for the U. S. Departmeny of Defense", https://web.archive.org/web/20190829185002/https://cdn.ymaws.com/www.nibs.org/resource/resmgr/BEST/best3_durston.2.9.pdf
6. Per Invar Sandberg, PhD, Claes Bankvall, PhD, Eva Sikander, Paula Wahlgren, PhD and Bengt Larsson, PhD. "The Effects and Cost Impact of Poor Airtightness -- Information for Developers and Clients", Buildings X Conference, ASHRAE, 2007.
7. J. S. Der Ananian, T. S. Fu, and B. A. Gabby, "Detrimental Effects of Air Leakage on Building Enclosure Performance: Energy Consumption, Occupant Comfort, and Moisture Accumulation," in Whole Building Air Leakage: Testing and Building Performance Impacts, ed. T. Weston, K. Nelson, and K. Wissink (West Conshohocken, PA: ASTM International, 2019), 38-60. https://doi.org/10.1520/STP161520180024

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

The level of air leakage control is the same as that balloted under ASHRAE 90.1 Addendum t First Public Review Draft (March 2021). In that draft it is stated "improved performance related to airtightness requirements was reviewed and found to be cost effective". The 90.1 process uses an approximately 40 year life to perform a life cycle cost assessment.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Increases stringency, reflects supported 0.35 value per subcommittee straw poll, and is consistent with ASHRAE value

Final Hearing Results	
CEPI-71-21	AM

CEPI-72-21

Original Proposal

IECC®: SECTION 202, C402.5.9, C403.4.1.4, AMCA Chapter 06, ISO Chapter 06 (New)

Proponents: Amanda Hickman, The Hickman Group, Air Movement and Control Association (AMCA) (amanda@thehickmangroup.com); Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Revise as follows:

AIR CURTAIN UNIT. A device, installed at the *building entrance* , that generates and discharges a laminar air stream intended to prevent the infiltration of external, unconditioned air into the conditioned spaces, or the loss of interior, conditioned air to the outside.

C402.5.9 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 through 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* unit with a velocity of not less than 6.56 feet per second (2 m/s) at 6.0 inches (15 cm) above the floor that ~~have~~ has been tested in accordance with ANSI/AMCA 220 or ISO 27327-1 and installed in accordance with the manufacturer's instructions. Manual or automatic controls shall be provided that will operate the *air curtain* unit with the opening and closing of the door and comply with Section C403.4.1.4. *Air curtain~~s~~* units and their controls shall comply with Section C408.2.3.

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

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

AMCA

Air Movement and Control Association Internationa
30 West University Drive
Arlington Heights, IL 60004-1806

220~~-05~~21 Laboratory Methods of Testing Air Curtain Units for Aerodynamic Performance Rating

Add new standard(s) as follows:

ISO

International Organization for Standardization
Chemin de Blandonnet 8, CP 401, 1214 Vernier
Geneva, Switzerland

ISO 27327-1(2009)　　Air Curtain Units – Laboratory Methods of Testing for Aerodynamic Performance Rating

Reason:

The primary reason for this proposal is to make clarifications regarding air curtain unit requirements, consistent with provisions for air curtain units in a parallel proposal for ASHRAE 90.1-2022 that has undergone public review without comments (ASHRAE 90.1-2019 addendum ao).

There are a few places in this proposal that add the word “unit” where appropriate to “air curtain” (including the definition), which help to clarify the difference between the air curtain (the stream of air) and the air curtain unit (the product creating the air curtain).

Under Exception 7 to Section C402.5.9, there are a few clarifications related to the use of air curtain units. Adding ISO 27327-1 as an optional test standard adds flexibility as to which standard the product can be tested to. The pointer for compliance of controls with Section C403.4.1.4 is intended to help instruct the code user with the requirements for air curtain units that have integral heating. The change to the title of Section C403.4.1.4 is intended to have the same effect.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal adds clarity to the sections on air curtain units, consistent with the parallel ASHRAE 90.1-2022 proposal mentioned in the reason statement. This proposal does not add any new requirements. Therefore, it will not increase the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The primary reason for this proposal is to make clarifications regarding air curtain unit requirements, consistent with provisions for air curtain units in a parallel proposal for ASHRAE 90.1-2022 that has undergone public review without comments (ASHRAE 90.1-2019 addendum ao).
There are a few places in this proposal that add the word "unit" where appropriate to "air curtain" (including the definition), which help to clarify the difference between the air curtain (the stream of air) and the air curtain unit (the product creating the air curtain).

Under Exception 7 to Section C402.5.9, there are a few clarifications related to the use of air curtain units. Adding ISO 27327-1 as an optional test standard adds flexibility as to which standard the product can be tested to. The pointer for compliance of controls with Section C403.4.1.4 is intended to help instruct the code user with the requirements for air curtain units that have integral heating. The change to the title of Section C403.4.1.4 is intended to have the same effect.

Final Hearing Results

CEPI-72-21　　AM

CEPI-75-21

Original Proposal

IECC®: C403.1.2, TABLE C403.1.2(1), TABLE C403.1.2(2), ASHRAE Chapter 06

Proponents: Nicholas O'Neil, Energy 350, NEEA (noneil@energy350.com); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

C403.1.2 Data centers. *Data center systems* shall comply with Sections 6 and 8 of ASHRAE 90.4~~.with the following changes:~~

~~1. Replace design mechanical load component (MLC) values specified in Table 6.2.1.1 of the ASHRAE 90.4 with the values in Table C403.1.2(1) as applicable in each climate zone.~~

~~2. Replace annualized MLC values specified in Table 6.2.1.2 of the ASHRAE 90.4 with the values in Table C403.1.2(2) as applicable in each climate zone.~~

Delete without substitution:

~~TABLE C403.1.2(1) MAXIMUM DESIGN MECHANICAL LOAD COMPONENT (DESIGN MLC~~)

CLIMATE ZONE	DESIGN MLC AT 100% AND AT 50% ITE LOAD
0A	0.24
OB	0.26
1A	0.23
2A	0.24
3A	0.23
4A	0.23
5A	0.22
6A	0.22
1B	0.28
2B	0.27
3B	0.26
4B	0.23
5B	0.23
6B	0.21
3C	0.19
4C	0.21
5C	0.19
~~7~~	0.20
~~8~~	0.19

~~TABLE C403.1.2(2) MAXIMUM ANNUALIZED MECHANICAL LOAD COMPONENT (ANNUALIZED MLC)~~

CLIMATE ZONE	HVAC MAXIMUM ANNUALIZED MLC AT 100% AND AT 50% ITE LOAD
0A	0.19
0B	0.20
1A	0.18
2A	0.19
3A	0.18
4A	0.17
5A	0.17
6A	0.17
1B	0.16
2B	0.18
3B	0.18
4B	0.18
5B	0.16
6B	0.17
3C	0.16
4C	0.16
5C	0.16
~~7~~	0.16
~~8~~	0.16

Revise as follows:

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

90.4~~–2016~~2019 Energy Standard for Data Centers - (with Addenda a, b, d, e, f)

Reason: Including references to ASHRAE 90.4-2016 and more stringent MLC values in the 2021 IECC ensured that data center systems were held to equivalent efficiency standards as other building mechanical systems. While the MLC values in ASHRAE 90.4-2016 were egregiously lenient and required individual climate zone modifications, the more recent version of 90.4-2019 corrects this issue and therefore the MLC table modifications in the IECC are no longer required.

Additionally, 90.4-2019 removed the requirement to meet a design MLC value and instead splits annualized MLC values by data centers above and below 300kW. This distinction requires more stringent MLC thresholds for larger data centers and provides more lenient MLC thresholds for smaller data centers. This aligns more closely with the built environment, where smaller data centers are limited in their ability to increase efficiency compared to larger data centers, whereas larger data centers have a variety of methods to meet MLC thresholds.

The changes to the reference section also include adopted ASHRAE Addenda that provide necessary clarifications on how to calculate the MLC value with shared data center systems and how to incorporate heat recovery into the calculations. The transition from 90.4-2016 to

90.4-2019 has made the standard more robust and is important to capture in the IECC updates.

Bibliography: ANSI/ASHRAE Standard 90.4-2019 - Energy Standard for Data Centers

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The levels specified in ASHRAE 90.1-2019 for >300kW data centers are similar to the adjusted levels published in the IECC using 90.4-2016, especially in climate zones where data centers are commonly located. For less dense data centers (<300kW) ASHRAE determined the updated MLC levels based on achievable technology from real-world projects and the MLC thresholds are more lenient in this size to better track with market practices and available efficiency improvements. Therefore costs to meet 90.4-2019 MLC levels for both data center size classes are not expected to increase on average.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Supports greater efficiency in data centers by following the latest updates in a national standard (90.4).

Final Hearing Results

CEPI-75-21	AS

CEPI-76-21

Original Proposal

IECC®: SECTION 202 (New), C403.1, C403.1.3 (New), C403.1.3.1 (New), C403.1.3.2 (New), C403.1.3.3 (New), C406.13 (New), TABLE C406.1(1), TABLE C406.1(2), TABLE C406.1(3), TABLE C406.1(4), TABLE C406.1(5), SECTION C409 (New), C409.1 (New), C409.2 (New), C409.3 (New), C409.4 (New), Table C409.4 (New), C409.4.1 (New), C409.5 (New), C409.5.1 (New), C409.5.2 (New), C409.5.3 (New), C409.5.3.1 (New), C409.6 (New), C409.6.1 (New), C409.6.1.1 (New), C409.6.1.1.1 (New), C409.6.1.2 (New), C409.6.1.3 (New), C409.6.1.3.1 (New), C409.6.1.3.2 (New), C409.6.1.4 (New), C409.6.1.4.1 (New), C409.6.1.4.2 (New), C409.6.1.4.3 (New), C409.6.1.4.4 (New), C409.6.1.4.5 (New), C409.6.1.4.6 (New), C409.6.1.4.7 (New), C409.6.1.4.8 (New), C409.6.1.5 (New), C409.6.1.6 (New), C409.6.1.7 (New), C409.6.1.8 (New), C409.6.1.9 (New), C409.6.1.10 (New), C409.6.1.10.1 (New), TABLE C409.6.1.10.1 (New), C409.6.1.10.2 (New), TABLE C409.6.1.10.2(1) (New), TABLE C409.6.1.10.2(2) (New), C409.6.1.10.3 (New), C409.6.2 (New), C409.6.2.1 (New), C409.6.2.2 (New), C409.6.2.3 (New), C409.6.2.4 (New), C409.6.2.5 (New), C409.6.2.6 (New), C409.6.2.7 (New), C409.6.2.8 (New), C409.6.2.9 (New), C409.6.2.10 (New), C409.6.2.11 (New), Table C409.6.2.11(1) (New), Table C409.6.2.11(2) (New), Table C409.6.2.11(3) (New), C409.7 (New), Table C409.7(1) (New), TABLE C409.7(2) (New), TABLE C409.7(3) (New), Appendix CD (New), CD 101 (New), (New)

Proponents: Jeremy Williams, U.S. Department of Energy, U.S. Department of Energy (jeremy.williams@ee.doe.gov)

2021 International Energy Conservation Code

Add new definition as follows:

BLOCK. A generic concept used in energy simulation. It can include one or more thermal zones. It represents a whole building or portion of a building with the same use type served by the same HVAC system type.

HVAC TOTAL SYSTEM PERFORMANCE RATIO (HVAC TSPR). The ratio of the sum of a building's annual heating and cooling load in thousands of Btus to the sum of annual site energy consumption of the building HVAC systems in BTU.

STANDARD REFERENCE DESIGN. A version of the proposed design that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement for compliance based on total building performance and *HVAC total system performance ratio*.

PROPOSED DESIGN. A description of the proposed building used to estimate annual energy use for determining compliance based on total building performance and *HVAC total system performance ratio*.

Revise as follows:

C403.1 General. Mechanical systems and equipment serving the building heating, cooling, ventilating or refrigerating needs shall comply with ~~this section~~ one of the following:

1. Sections C403.1.1 and Sections C403.2 through Section C403.14
2. Data Centers shall comply with Section C403.1.1, Section C403.1.2 and Section C403.6 through Section C403.14
3. Section C403.1.3 and sections within Section C403 that are listed in Table C407.2

~~**Exception:** Data center systems are exempt from the requirements of Sections C403.4 and C403.5~~.

Add new text as follows:

C403.1.3 HVAC total system performance ratio (*HVAC TSPR*).. HVAC systems serving buildings or portions of buildings listed in C403.1.3.1 that are not served by systems listed in C403.1.3.2 shall have an *HVAC total system performance ratio*(*HVAC TSPR*) of the *proposed design* HVAC systems that is greater than or equal to the*HVAC TSPR* of the *standard reference design* divided by the applicable mechanical performance factor (MPF) from Table C409.3.1. *HVAC TSPR* shall be calculated in accordance with Section C409, Calculation of HVAC Total System Performance Ratio. Systems using the HVAC TSPR method shall also meet requirements in C403.1.3.3.

C403.1.3.1 Included Building Types. Only HVAC systems that serve the following building use types are allowed to use the TSPR Method:

1. Office (including medical office) (occupancy group B)
2. Retail (occupancy group M),
3. Library (occupancy group A-3),
4. Education (occupancy group E),
5. Hotel/motel occupancies (occupancy group R-1),
6. the *dwelling units* and common areas within occupancy group R-2 multifamily buildings.

C403.1.3.2 Excluded Systems. The following *HVAC systems* are excluded from using the TSPR Method:

1. HVAC Systems using
   - 1.1 District heating water, chilled water or steam
   - 1.2. Small duct high velocity air cooled, space constrained air cooled, single package vertical air conditioner, single package vertical heat pump, or double-duct air conditioner or double-duct heat pump as defined in subpart F to 10CFR part 431
   - 1.3 Packaged terminal air conditioners and packaged terminal heat pumps that have cooling capacity greater than 12,000 Btu/hr (3500 kW)
   - 1.4. A common heating source serving both HVAC and service water heating equipment, or
2. HVAC systems that provide recovered heat for service water heating
3. HVAC systems not included in Table C409.5.2.10.1
4. HVAC systems included in Table C409.5.2.10.1 with parameters in Table C409.5.2.10.2, not identified as applicable to that HVAC system type.
5. HVAC systems with chilled water supplied by absorption chillers, heat recovery chillers, water to water heat pumps, air to water heat pumps, or a combination of air- and water-cooled chillers on the same chilled water loop.
6. HVAC systems served by heating water plants that include air to water or water to water heat pumps.
7. Underfloor air distribution and displacement ventilation HVAC systems.
8. Space conditioning systems that do not include mechanical cooling.
9. HVAC systems serving laundry rooms, elevator rooms, mechanical rooms, electrical rooms, data centers, and computer rooms.
10. Buildings or areas of medical office buildings that comply fully with ASHRAE Standard 170, including but not limited to surgical centers, or that are required by other applicable codes or standards to provide 24/7 air handling unit operation
11. HVAC systems serving laboratories with fume hoods
12. Locker rooms with more than 2 showers
13. Natatoriums and rooms with saunas
14. Restaurants and commercial kitchens with total cooking capacity greater than 100,000 Btu/h
15. Areas of buildings with commercial refrigeration equipment exceeding 100 kW of power input.
16. Cafeterias and dining rooms

C403.1.3.3 TSPR Method Partial Prescriptive Requirements. HVAC systems using the HVAC Performance Rating Method shall meet relevant prescriptive requirements in Section C403 as follows:

1. Air economizers shall meet the requirements of Section C403.5.3.4 Relief of excess outdoor air and Section C403.5.5 Economizer fault detection and diagnostics.
2. Variable-air-volume system systems shall meet requirements of Sections C403.6.5, C403.6.6, and C403.6.9.
3. Hydronic systems shall meet the requirements of Section C403.4.4.
4. Plants with multiple chillers or boilers shall meet the requirements of Section C403.4.5.
5. Hydronic (Water Loop) Heat Pumps and Water-Cooled Unitary Air Conditioners shall meet the requirements of Section C403.4.3.3.
6. Cooling tower turndown shall meet requirements of Section C403.10.4.
7. Heating of unenclosed spaces shall meet the requirements of Section C403.13.1.
8. Hot-gas bypass shall meet the requirements of Section C403.3.3.
9. Systems shall meet the operable openings interlock requirements of Section C402.5.11.10. Refrigeration systems shall meet the requirements of Section C403.11.

C406.13 HVAC Performance (TSPR). For systems allowed to use Section C403.1.3, the *HVAC TSPR* shall exceed the minimum requirement by 5 percent. If improvement is greater, credits in Tables C406.1(1) through C406.1(5) are permitted to be prorated up to a 20 percent improvement using Equation 4-16. Energy credits for Section C406.13 may not be combined with energy credits from any of the HVAC measures described in Section C406.2.

HVAC TSPR energy credit = base energy credit from Table 406.1 x (TSPR % / 5%) **(Equation 4-14)**

where:

TSPR% = Percentage by which TSPR of proposed design exceeds minimum TSPR requirement. The value of TSPR% cannot exceed 20% for purposes of calculating H01 energy credits.

Revise as follows:

TABLE C406.1(1) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP B OCCUPANCIES

Portions of table not shown remain unchanged.

SECTION	CLIMATE ZONE																
	0A & 1A	**0B & 1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
C406.13: *HVAC TSPR*	8	8	7	7	6	6	4	6	6	4	6	6	4	6	6	6	6

TABLE C406.1(2) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP R AND I OCCUPANCIES

Portions of table not shown remain unchanged.

SECTION	**CLIMATE ZONE**																
	0A & 1A	**0B & 1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
C406.13: *HVAC TSPR*	8	8	8	7	6	6	5	6	6	4	6	5	4	6	6	6	7

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TABLE C406.1(3) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP E OCCUPANCIES

Portions of table not shown remain unchanged.

SECTION	**CLIMATE ZONE**

	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.13: *HVAC TSPR*	11	11	10	9	8	8	6	8	7	6	7	7	6	8	7	8	8

NA = Not Applicable.

a. For schools with showers or full-service kitchens.

TABLE C406.1(4) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP M OCCUPANCIES

Portions of table not shown remain unchanged.

SECTION	CLIMATE ZONE																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.13 *HVAC TSPR*	11	11	10	9	8	8	6	8	8	7	8	8	6	9	8	9	10

NA = Not Applicable.

TABLE C406.1(5) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR OTHER[a] OCCUPANCIES

Portions of table not shown remain unchanged.

SECTION	CLIMATE ZONE																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.13: HVAC TSPR	7	8	7	6	6	5	3	6	5	4	7	6	4	8	7	8	8

Add new text as follows:

SECTION C409
CALCULATION OF HVAC TOTAL SYSTEM PERFORMANCE RATIO

C409.1 Purpose. Section 409 establishes criteria for demonstrating compliance with the requirements of C403.1.1,*HVAC total system performance ratio (HVAC TSPR)*

C409.2 Scope. Section C409 applies to new HVAC systems that serve buildings in Section C403.1.3.1 and are not excluded from using *HVAC TSPR* by Section C403.1.3. All applicable HVAC systems shall comply with Section C409.

C409.3 Core & Shell / Initial Build-Out, and Future System Construction Analysis. Where the building permit applies to only a portion of the HVAC system in a building and the remaining components will be designed under a future building permit or were previously installed, the future or previously installed components shall be modeled as follows:

1. Where the HVAC zones that do not include HVAC systems in the current permit will be or are served by independent systems, then the block including those zones shall not be included in the model.
2. Where the HVAC zones that do not include complete HVAC systems in the permit are intended to receive HVAC services from systems in the permit, their proposed zonal systems shall be modeled with equipment that meets, but does not exceed, the requirements of Section C403.
3. Where the zone equipment in the permit receives HVAC services from previously installed systems that are not in the permit, the previously installed systems shall be modeled with equipment matching the certified value of what is installed or equipment that meets the requirements of Section C403.

4. Where the central plant heating and cooling equipment is completely replaced and HVAC zones with existing systems receive HVAC services from systems in the permit, their proposed zonal systems shall be modeled with equipment that meets, but does not exceed, the requirements of Section C403.

C409.4 HVAC TSPR Compliance. Systems allowed to use *HVAC TSPR* in accordance with Section C403.1.3 shall comply with all of the following:

1. Systems shall meet the applicable provisions of Section C403.1.3.3 and Sections within Section C403 that are listed in Table C407.2
2. The *HVAC TSPR* of the *proposed design* shall be greater than or equal to the *HVAC TSPR* of the *standard reference design* divided by the mechanical performance factor (MPF) using Equation 4-16.

$$TSPRp > TSPRr / MPF \qquad \textbf{(Equation 4-16)}$$

where: TSPRp = *HVAC TSPR* of the *proposed design* calculated in accordance with Sections C409.4, C409.5 and C409.6. TSPRr = *HVAC TSPR* of the *reference building design* calculated in accordance with Sections C409.4, C409.5 and C409.6. MPF = Mechanical Performance Factor from Table C409.4 based on climate zone and building use type

Where a *building* has multiple *building* use types, MPF shall be area weighted using Equation 4-17

$$MPF = (A_1*MPF_1 + A_2*MPF_2+...+A_n*MPF_n)/(A_1+A_2+...+A_n) \qquad \textbf{(Equation 4-17)}$$

where: MPF_1, MPF_2 through MPF_n = Mechanical Performance Factors from Table C409.4 based on climate zone and *building* use types 1,2, through n A_1, A_2 through A_n = Conditioned *floor* areas for *building* use types 1, 2, through n

Table C409.4 Mechanical Performance Factors

Climate Zone: *Building* type	Ocp. Group	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Office (small and medium)[a]	B	0.72	0.715	0.7	0.705	0.685	0.65	0.71	0.68	0.645	0.805	0.70	0.78	0.845	0.765	0.805	0.865	0.835	0.875	0.895
Office (Large)[a]	B	0.83	0.83	0.84	0.84	0.79	0.82	0.72	0.81	0.77	0.67	0.76	0.63	0.71	0.72	0.63	0.73	0.71	0.71	0.71
Retail	M	0.6	0.57	0.5	0.55	0.46	0.46	0.43	0.51	0.4	0.45	0.57	0.68	0.46	0.68	0.67	0.5	0.45	0.44	0.38
Hotel/Motel	R-1	0.62	0.62	0.63	0.63	0.62	0.68	0.61	0.71	0.73	0.45	0.59	0.52	0.38	0.47	0.51	0.35	0.38	0.31	0.26
Multi-Family/ Dormitory	R-2	0.64	0.63	0.67	0.63	0.65	0.64	0.59	0.72	0.55	0.53	0.5	0.44	0.54	0.47	0.38	0.55	0.5	0.51	0.47
School/ Education and Libraries	E (A-3)	0.82	0.81	0.8	0.79	0.75	0.72	0.71	0.72	0.67	0.73	0.72	0.68	0.82	0.73	0.61	0.89	0.8	0.83	0.77

a. Large office gross conditioned floor area >150,000 ft^2 (14,000 m^2) or > 5 floors; all other offices are small or medium

C409.4.1 HVAC TSPR. *HVAC TSPR* is calculated according to Equation 4-18 .

$$HVAC\ TSPR = Heating\ and\ cooling\ load / Building\ HVAC\ system\ energy \qquad \textbf{(Equation 4-18)}$$

where:Building HVAC system energy = Sum of the annual site energy consumption for heating, cooling, fans, energy recovery, pumps, and heat rejection in thousands of BtusHeating and cooling load = Sum of the annual heating and cooling loads met by the building HVAC system in thousands of Btus

C409.5 General. Projects shall comply with the requirements of this Section when calculating compliance using*HVAC Total System Performance Ratio.*

C409.5.1 Simulation Program. Simulation tools used to calculate HVAC TSPR of the*Standard Reference Design* shall comply with the following:

1. The simulation program shall calculate the *HVAC TSPR* based only on the input for the *proposed design* and the requirements of Section 409. The calculation procedure shall not allow the user to directly modify the building component characteristics of the *standard reference design*.
2. Performance analysis tools meeting the applicable subsections of Section 409 and tested according to ASHRAE Standard 140, except for Sections 7 and 8 of Standard 140, shall be permitted to be *approved*. The required tests shall include *building thermal envelope* and fabric load test (Sections 5.2.1, 5.2.2, and 5.2.3), ground coupled slab-on-grade analytical verfication tests (Section 5.2.4), space-cooling equipment performance tests (Section 5.3), space-heating equipment performance tests (Section 5.4), and air-side HVAC equipment analytical verifiction test (Section 5.5), along with the associated reporting (Section 6). Tools are permitted to be *approved* based on meeting a specified threshold for a jurisdiction. The*code official* shall be permitted to approve tools for a specified application or limited scope.
3. The test results and modeler reports shall be posted on a publicly available website and shall include the test results of the simulation programs and input files used for generating the results along with the results of the other simulation programs included in ASHRAE Standard 140 Annexes B8 and B16. The modeler report in Standard 140 Annex A2 Attachment A2.7 shall be completed for results exceeding the maximum or falling below the minimum of the reference values and for omitted results.
4. The simulation program shall have the ability to explicitly model part-load performance curves or other part-load adjustment methods based on manufacturer's part-load performance data for mechanical equipment.

C409.5.2 Climatic Data. The simulation program shall perform the simulation using hourly values of climatic data, such as temperature and humidity, using TMY3 data for the site as specified here:https://buildingenergyscore.energy.gov/resources

C409.5.3 Documentation. Documentation conforming to the provisions of this section shall be provided to the*code official*.

C409.5.3.1 Compliance Report. Building permit submittals shall include:

1. A report produced by the simulation software that includes the following:
   1.1 Address of the building.
   1.2 Name of individual completing the compliance report.
   1.3 Name and version of the compliance software tool.
   1.4 The dimensions, floor heights and number of floors for each *block*.
   1.5 By *block*, the U-factor, C-factor, or F-factor for each simulated opaque envelope component and the U-factor and SHGC for each fenestration component.
   1.6 By *block* or by surface for each block, the fenestration area.
   1.7 By *block*, a list of the HVAC equipment simulated in the *proposed design* including the equipment type, fuel type, equipment efficiencies and system controls.
   1.8 Annual site HVAC energy use by end use for the proposed and baseline building
   1.9 Annual sum of heating and cooling loads for the baseline building.
   1.10 The HVAC total system performance ratio for both the *standard reference design* and the *proposed design*.

2. A mapping of the actual building HVAC component characteristics and those simulated in the *proposed design* showing how individual pieces of HVAC equipment identified above have been combined into average inputs as required by Section C409.6.1.10 including:
   2.1 Fans
   2.2 Hydronic pumps
   2.3 Air handlers
   2.4 Packaged cooling equipment
   2.5 Furnaces
   2.6 Heat pumps
   2.7 Boilers
   2.8 Chillers
   2.9 Heat rejection equipment (open and closed-circuit cooling towers; dry coolers)
   2.10 Electric resistance coils
   2.11 Condensing units
   2.12 Motors for fans and pumps
   2.13 Energy recovery devices

3. For each piece of equipment identified above include the following as applicable:
   3.1 Equipment name or tag consistent with that found on the design documents.
   3.2 Rated Efficiency level.
   3.3 Rated Capacity.
   3.4 Where not provided by the simulation program report in item a, documention of the calculation of any weighted equipment efficiencies input into the program.
   3.5 Electrical input power for fans and pumps (before any speed or frequency control device) at design condition and calculation of input value (W/cfm or W/gpm)

4. Floor plan of the building identifying:

    4.1 How portions of the buildings are assigned to the simulated *blocks*

    4.2 Areas of the building that are not covered under the requirements of Section C403.1.1.

C409.6 Calculation Procedures. Except as specified by this Section, the *standard reference design* and *proposed design* shall be configured and analyzed using identical methods and techniques

C409.6.1 Simulation of the proposed building design. The proposed design shall be configured and analyzed as specified in this section.

C409.6.1.1 Block Geometry. The geometry of buildings shall be configured using one or more *blocks*. Each *block* shall define attributes including *block* dimensions, number of floors, floor to floor height and floor to ceiling height. Simulation software may allow the use of simplified shapes (such as rectangle, L shape, H Shape, U shape or T shape) to represent *blocks*. Where actual building shape does not match these pre-defined shapes, simplifications are permitted providing the following requirements are met:

1. The *conditioned floor area* and volume of each *block* shall match the proposed design within 10 percent.
2. The area of each exterior envelope component from Table C402.1.4 is accounted for within 10 percent of the actual design.
3. The area of vertical fenestration and skylights is accounted for within 10 percent of the actual design.
4. The orientation of each component in 2 and 3 above is accounted for within 45 degrees of the actual design.

The creation of additional *blocks* may be necessary to meet these requirements. A more complex zoning of the building shall be allowed where all thermal zones in the reference and proposed model are the same and rules related to block geometry and HVAC system assignment to blocks are met with appropriate assignment to thermal zones.

Exception: Portions of the building that are unconditioned or served by systems not covered by the requirements of Section C403.1.1 shall be omitted.

C409.6.1.1.1 Number of Blocks. One or more *blocks* may be required per building based on the following restrictions:

1. Each *block* can have only one occupancy type (multifamily *dwelling unit*, multifamily common area, office, library, education, hotel/motel or retail). Therefore, at least one single *block* shall be created for each unique use type.
2. Each *block* can be served by only one type of HVAC system. Therefore, a single *block* shall be created for each unique HVAC system and use type combination. Multiple HVAC units of the same type may be represented in one *block*. Table D601.10.2 provides directions for combining multiple HVAC units or components of the same type into a single *block*.
3. Each *block* can have a single definition of floor to floor or floor to ceiling heights. Where floor heights differ by more than two feet, unique *blocks* should be created for the floors with varying heights.
4. Each *block* can include either above grade or below grade floors. For buildings with both above grade and below grade floors, separate *blocks* should be created for each. For buildings with floors partially above grade and partially below grade, if the total wall area of the floor(s) in consideration is greater than or equal to 50 percent above grade, then it should be simulated as a completely above grade *block*, otherwise it should be simulated as a below grade *block*.
5. Each wall on a façade of a *block* shall have similar vertical fenestration. The product of the proposed design U-factor times the area of windows (UA) on each façade of a given floor cannot differ by more than 15 percent of the average UA for that façade in each *block*. The product of the proposed design SHGC times the area of windows (SHGCA) on each façade of a given floor cannot differ by more than 15 percent of the average SHGCA for that façade in each *block*. If either of these conditions are not met, additional *blocks* shall be created consisting of floors with similar fenestration.

6. For a building model with multiple *blocks*, the *blocks* should be configured together to have the same adjacencies as the actual building design.

C409.6.1.2 Thermal Zoning. Each floor in a *block* shall be modeled as a single thermal zone or as five thermal zones consisting of four perimeter zones and a core zone. Below grade floors shall be modeled as a single thermal *block*. If any façade in the *block* is less than 45 feet in length, there shall only be a single thermal zone per floor. Otherwise each floor shall be modeled with five thermal zones. A perimeter zone shall be created extending from each façade to a depth of 15 feet. Where facades intersect, the zone boundary shall be formed by a 45 degree angle with the two facades. The remaining area or each floor shall be modeled as a core zone with no exterior walls.

C409.6.1.3 Occupancy. Building occupancies modeled in the *standard reference design* and the *proposed design* shall comply with the following requirements.

C409.6.1.3.1 Occupancy Type. The occupancy type for each *block* shall be consistent with the building area type as determined in accordance with C405.4.2.1. Portions of the building that are building area types other than multifamily *dwelling unit*, multifamily common area, office, school (education), library, or retail shall not be included in the simulation. Surfaces adjacent to such building portions shall be modeled as adiabatic in the simulation program.

C409.6.1.3.2 Occupancy schedule, density, and heat gain. The occupant density, heat gain, and schedule shall be for multifamily, office, retail, library, hotel/motel or school as specified by ASHRAE Standard 90.1 Normative Appendix C.

C409.6.1.4 Envelope Components. Building envelope components modeled in the *standard reference design* and the *proposed design* shall comply with the requirements of this Section.

C409.6.1.4.1 Roofs.. Roofs will be modeled with insulation above a steel roof deck. The roof U-factor and area shall be modeled as in the proposed design. If different roof thermal properties are present in a single *block*, an area weighted U-factor shall be used. Roof solar absorptance shall be modeled at 0.70 and emittance at 0.90.

C409.6.1.4.2 Above grade walls. Walls will be modeled as steel frame construction. The U-factor and area of above grade walls shall be modeled as in the proposed design. If different wall constructions exist on the façade of a *block* an area-weighted U-factor shall be used.

C409.6.1.4.3 Below grade walls. The C-factor and area of below grade walls shall be modeled as in the proposed design. If different slab on grade floor constructions exist in a *block*, an area-weighted C- factor shall be used.

C409.6.1.4.4 Above grade exterior floors. Exterior floors shall be modeled as steel frame. The U-factor and area of floors shall be modeled as in the proposed design. If different wall constructions exist in the *block* an area-weighted U-factor shall be used.

C409.6.1.4.5 Slab on grade floors. The F-factor and area of slab on grade floors shall be modeled as in the proposed design. If different below grade wall constructions exist in a *block*, an area-weighted F- factor shall be used.

C409.6.1.4.6 Vertical Fenestration.. The window area and area weighted U-factor and SHGC shall be modeled for each façade based on the proposed design. Each exterior surface in a *block* must comply with Section C409.6.1.1.1 item 5. Windows will be combined into a single window centered on each façade based on the area and sill height input by the user. When different U values, SHGC or sill heights exist on a single facade, area weighted average for each shall be input by the user.

C409.6.1.4.7 Skylights.. The skylight area and area weighted U-factor and SHGC shall be modeled for each floor based the proposed design. Skylights will be combined into a single skylight centered on the roof of each zone based on the area input by the user

C409.6.1.4.8 Exterior Shading.. Permanent window overhangs shall be modeled. When windows with and without overhangs or windows with different overhang projection factors exist on a façade, window width weighted projection factors shall be input by the user as follows.

$P_{avg} = (A_1 \times L_{o1} + A2 \times L_{o2} ... + An \times L_{on}) / (Lw_1 + Lw_2 ... + L_{wn})$ **(Equation 4-19)**

where: P_{avg} = Average overhang projection modeled in the simulation tool 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. L_o = Length off the overhang L_w = Length of the window

C409.6.1.5 Lighting. Interior lighting power density shall be equal to the allowance in Table C405.4.2(1) for multifamily, office, retail, library, or school. The lighting schedule shall be for multifamily, office, retail, library, or school as specified by ASHRAE Standard 90.1 Normative Appendix C. The impact of lighting controls is assumed to be captured by the lighting schedule and no explicit controls shall be modeled. Exterior lighting shall not be modeled.

C409.6.1.6 Miscellaneous equipment.. The miscellaneous equipment schedule and power shall be for multifamily, office, retail, library, or school as specified by ASHRAE Standard 90.1 Normative Appendix C. The impact of miscellaneous equipment controls is assumed to be captured by the equipment schedule and no explicit controls shall be modeled.

Exceptions:

1. Multifamily dwelling units shall have a miscellaneous load density of 0.42 W/ft^2
2. Multifamily common areas shall have a miscellaneous load density of 0 W/ft^2

C409.6.1.7 Elevators. Elevators shall not be modeled.

C409.6.1.8 Service water heating equipment.. Service water heating shall not be modeled.

C409.6.1.9 On-site renewable energy systems.. On-site Renewable Energy Systems shall not be modeled.

C409.6.1.10 HVAC equipment.. HVAC systems shall meet the requirements of Section C403 Mechanical Systems.

C409.6.1.10.1 Supported HVAC systems.. At a minimum, the HVAC systems shown in Table CD105.2.10.1 shall be supported by the simulation program.

TABLE C409.6.1.10.1 PROPOSED BUILDING HVAC SYSTEMS SUPPORTED BY HVAC TSPR SIMULATION SOFTWARE

System No.	System Name
1	Packaged Terminal Air Conditioner (with electric or hydronic heat)
2	Packaged Terminal Air Heat Pump
3	Packaged Single Zone Gas Furnace[a] and/or air-cooled Air Conditioner (includes split systems[b])
4	Packaged Single Zone Heat Pump (air to air only)(includes split systems[b] and electric or gas supplemental heat)
5	Variable Refrigerant Flow (air cooled only)
6	Four Pipe Fan Coil
7	Water Source Heat Pump (Water Loop), water-sourc *Variable-Refrigerant-Flow-System*, or water-source air conditioner
8	Ground Source Heat Pump
9	Packaged Variable Air Volume (DX cooling)[a]
10	Variable Air Volume (hydronic cooling)[a]

11	Variable Air Volume with Fan Powered Terminal Units
12	Dedicated Outdoor Air System (in conjunction with systems 1-8)

a. Reheat or primary heat may be electric, hydronic, or gas furnace

b. Condensing units with DX air handlers are modeled as package furnace with air conditioners or heat pumps

C409.6.1.10.2 Proposed building HVAC system simulation. The HVAC systems shall be modeled as in the proposed design at design conditions unless otherwise stated with clarifications and simplifications as described in Tables C409.6.1.10.2(1) and C409.6.1.10.2(2). System parameters not described in the following sections shall be simulated to meet the minimum requirements of Section C403. All zones within a *block* shall be served by the same HVAC system type as described in Section C409.6.1.1.1 item 2. Heat loss from ducts and pipes shall not be modeled. Table C409.6.1.10.2(1) Proposed Building System Parameters are based on input of full-load equipment efficiencies with adjustment using part-load curves integrated in the simulation program. Where other approaches to part-load adjustment are used, it is permitted for specific input parameter to vary. The simulation program shall model part-load HVAC equipment performance using either:

1. full-load efficiency adjusted for fan power input that is modeled separately and typical part-load performance adjustements for the proposed equipment.
2. part-load adjustments based on input of both full-load and part-load metrics, or
3. equipment-specific adjustments based on performance data provided by the equipment manufacturer for the proposed equipment.

Where multiple system components serve a *block*, average values weighed by the appropriate metric as described in this section shall be used.

1. Where multiple fan systems serve a single *block*, fan power shall be based on weighted average using the design supply air cfm
2. Where multiple cooling systems serve a single *block*, COP shall be based on a weighted average using cooling capacity. DX coils shall be entered as multi-stage if more than 50% of coil capacity serving the *block* is multi-stage with staged controls.
3. Where multiple heating systems serve a single *block*, thermal efficiency or heating COP shall be based on a weighted average using heating capacity.
4. Where multiple boilers or chillers serve a heating water or chilled water loop, efficiency shall be based on a weighted average for using heating or cooling capacity.
5. When multiple cooling towers serving a condenser water loop are combined, the cooling tower efficiency, cooling tower design approach and design range are based on a weighted average of the design water flow rate through each cooling tower.
6. Where multiple pumps serve a heating water, chilled water or condenser water loop, pump power shall be based on a weighted average for using design water flow rate.
7. When multiple system types with and without economizers are combined, the economizer maximum outside air fraction of the combined system shall be based on weighted average of 100% supply air for systems with economizers and design outdoor air for systems without economizers.
8. Multiple systems with and without ERVs cannot be combined.
9. Systems with and without supply air temperature reset cannot be combined.
10. Systems with different fan control (constant volume, multi-speed or VAV) for supply fans cannot be combined.

TABLE C409.6.1.10.2(1) PROPOSED BUILDING SYSTEM PARAMETERS

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
HVAC System Type	System Type	User Defined	Selected from Table C409.6.1.10.1	All
System Sizing	Design Day Information	Fixed	99.6% heating design and 1% dry-bulb and 1% wet-bulb cooling design	All
	Zone Coil Capacity	Fixed	Sizing factors used are 1.25 for heating equipment and 1.15 for cooling equipment	All
	Supply Airflow	Fixed	Based on a supply-air-to-room-air temperature *set-point* difference of 20°F(11.11°C) or	1-11
		Fixed	Equal to required outdoor air ventilation	12
Outdoor Ventilation Air	Portion of supply air with proposed Filter ≥MERV 13	User-defined	Percentage of supply air flow subject to higher filtration (Adjusts baseline Fan Power higher. Prorated)	All
	Outdoor Ventilation Air Flow Rate	Fixed	As specified in ASHRAE Standard 90.1 Normative Appendix C, adjusted for proposed DCV control	All
	Outdoor *Ventilation* Supply Air Flow Rate Adjustments	Fixed	Based on ASHRAE Standard 62.1 Section 6.2.4.3 System Ventilation Efficiency (Evs) is 0.75	9-11
		Fixed	System Ventilation Efficiency (Evs) is 1.0	1-8, 12
		Fixed	Basis is 1.0 Zone Air Distribution Effectiveness	All
System Operation	Space temperature Set points	Fixed	As specified in ASHRAE Standard 90.1 Normative Appendix C, except -multifamily which shall use 68°F(20°C) heating and 76°F(24.4°C) cooling setpoints. -hotel/motel that shall be 70°F(21.1°C) heating and 72°F(22.2°C) cooling	1-11
	Fan Operation - Occupied	User Defined	Runs continuously during occupied hours or cycles to meet load. Multispeed fans reduce airflow related to thermal loads.	1-11
	Fan Operation – Occupied	Fixed	Fan runs continuously during occupied hours	12
	Fan Operation - Night Cycle	Fixed	Fan cycles on to meet setback temperatures	1-11
Packaged Equipment Efficiency	DX Cooling Efficiency	User Defined	Cooling COP without fan energy calculated in accordance with Section C409.6.1.10.2	1, 2, 3, 4, 5,7, 8, 9, 11,12
	DX Coil Number of Stages	User-defined	Single Stage or Multistage	3, 4, 9, 10, 11, 12
	Heat Pump Efficiency	User Defined	Heating COP without fan energy calculated in accordance with Section C409.6.1.10.2	2, 4, 5, 7, 8, 12
	Furnace Efficiency	User Defined	Furnace thermal efficiency	3, 9, 11, 12

Heat Pump Supplemental Heat	Heat Source	User-defined	Electric resistance or gas furnace	2, 4, 7, 8, 12
	Control	Fixed	Supplemental electric heat locked out above 40°F(4°C) OAT. Runs as needed in conjunction with compressor between 40°F(4°C) and 0°F(-17.8°C). Gas heat operates in place of the heat pump when the heat pump cannot meet load.	2, 4, 7, 8, 12
System Fan Power and Controls	Part-load Fan Controls	User-defined	Static pressure reset included for VAV.	1-8 (CAV, two or three speed), 9, 10, 11 (VAV), 12 (CAV and VAV)
	-Constant Volume			
	-Two Speed or three speed			
	-VAV			
	Design Fan Power (W/cfm)	User-defined	Input electric power for all fans required to operate at fan system design conditions divided by the supply airflow rate This is a "wire to air" value including all drive, motor *efficiency* and other losses.	All

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
	Low-speed and medium speed fan power	User Defined	Low speed input electric power for all fans required to operate at low-speed conditions divided by the low speed supply airflow rate. This is a "wire to air" value including all drive, motor *efficiency* and other losses. Also provide medium speed values for three-speed fans.	1-8
Variable Air Volume Systems	Supply Air Temperature (SAT) Controls	User defined	If not SAT reset then constant at 55°F(12.8°C).	9, 10, 11
			Options for reset based on outside air temperature (OAT) or warmest zone. If warmest zone, then the user can specify the minimum and maximum temperatures. If OAT reset, SAT is reset higher to 60°F(15.6°C) at outdoor low of 50°F(10°C). SAT is 55°F(12.8°C) at outdoor high of 70°F(21.1°C).	
	Minimum Terminal Unit airflow percentage	User Defined	Average minimum terminal unit airflow percentage for*block* weighted by cfm or minimum required for outdoor air ventilation, whichever is higher.	9, 10, 11
	Terminal Unit Heating Source	User Defined	Electric or hydronic	9, 10, 11
	Dual *set point* minimum *VAV* damper position	User-defined	Heating maximum airflow fraction	9, 10
	Fan Powered Terminal Unit (FPTU) Type	User Defined	Series or parallel FPTU	11
	Parallel FPTU Fan	Fixed	Sized for 50% peak primary air at 0.35 W/cfm	11
	Series FPTU Fan	Fixed	Sized for 50% peak primary air at 0.35 W/cfm	11
Economizer	Economizer Presence	User Defined	Yes or No	3, 4, 5, 6, 9, 10, 11
	Economizer Control Type	Fixed	Lockout on Differential dry-bulb temperature (OAT>RAT) in 6A, 5A, All B & C climate zones; fixed enthalpy>28 Btu/lb (47kJ/kg) or fixed dry-bulb OAT>75°F(24°C) in 0A to 4A climate zones	3, 4, 5, 6, 9, 10, 11
Energy Recovery	Sensible Effectiveness	User Defined	Heat exchanger sensible effectiveness at design heating and cooling conditions	3, 4, 9, 10, 11, 12
	Latent Effectiveness	User Defined	Heat exchanger latent effectiveness at design heating and cooling conditions	3, 4, 9, 10, 11, 12
	Economizer Bypass	User Defined	If ERV is bypassed or wheel rotation is slowed during economizer conditions (Yes/No)	3, 4, 9, 10, 11, 12
	Economizer Bypass active	Fixed	If there is a bypass, it will be active between 45°F(7.2°C) and 75°F(23.9°C) outside air temperature.	3, 4, 9, 10, 11, 12
	Bypass SAT Setpoint	User Defined	If bypass, target supply air temperature	3, 4, 9, 10, 11, 12
	Fan Power Reduction		during Bypass (W/cfm)	User Defined

If ERV system include bypass, static pressure set point and variable speed ~~fan, fan power can be reduced during~~ economizer conditions		3, 4, 9, 10, 11, 12		
~~Demand Controlle~~d Ventilation	~~DCV Application~~ on/off	~~User~~ Defined	Percent of *block* floor area under occupied standby controls, ON/OFF only with occupancy sensor and no variable control	3, 4, 9, 10, 11, 12
	DCV Application CO2	User Defined	Percentage of *block* floor area under variable DCV control (CO2); may include both variable and ON/OFF control	3, 4, 9, 10, 11, 12
DOAS	DOAS Fan Power W/cfm	User Defined	Fan electrical input power in W/cfm of supply airflow	12

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
	DOAS Supplemental Heating and Cooling	User Defined	Heating source, cooling source, energy recovery and respective efficiencies	12
	Maximum SAT Set point (Cooling)	User-defined	SAT set point if DOAS includes supplemental cooling	12
	Minimum SAT Set point (Heating)	User-defined	SAT set point if DOAS includes supplemental heating	12
Heating Plant	Boiler Efficiency	User Defined	Boiler thermal efficiency	1, 6, 7, 9, 10, 11, 12
	Heating Water Loop Configuration	User-defined	Constant flow primary only; Variable flow primary only; Constant flow primary – variable flow secondary, Variable flow primary and secondary	1, 6, 7, 9, 10, 11, 12
	Heating Water Primary Pump Power (W/gpm)	User-defined	Heating water primary pump input W/gpm heating water flow	1, 6, 7, 9, 10, 11, 12
	Heating Water Secondary Pump Power (W/gpm)	User-defined	Heating water secondary pump input W/gpm heating water flow (if primary/secondary)	1, 6, 7, 9, 10, 11, 12
	Heating Water Loop Temperature	User-defined	Heating water supply and return temperatures, °F(°C)	1, 6, 9, 10,11
	Heating Water Loop Supply Temperature Reset	Fixed	Reset HWS by 27.3% of design delta-T (HWS-70°F(21.1°C) Space Heating temperature set point) between 20°F(-6.7°C) and 50°F(10°C) OAT	1, 6, 7, 9, 10, 11, 12
	Boiler Type	Fixed	Non-condensing boiler where input thermal efficiency is less than 86%; Condensing boiler otherwise	1, 6, 7, 9, 10, 11, 12
Chilled Water Plant	Chiller Compressor Type	User Defined	Screw/Scroll, Centrifugal or Reciprocating	6,10, 11, 12
	Chiller Condenser Type	User Defined	Air cooled or water cooled	6, 10, 11, 12
	Chiller Full Load Efficiency	User Defined	Chiller COP	6, 10, 11, 12
	Chilled Water Loop Configuration	User Defined	Variable flow primary only, constant flow primary – variable flow secondary, variable flow primary and secondary	6, 10, 11,12
	Chilled Water Primary Pump Power (W/gpm)	User-defined	Primary pump input W/gpm chilled water flow	6, 10, 11,12

	Chilled Water Secondary Pump Power (W/gpm)	User-defined	Secondary Pump input W/gpm chilled water flow (if primary/secondary)	6, 10, 11,12
	Chilled Water Temperature Reset Included	User Defined	Yes/No	6, 10, 11,12
Chilled Water Plant (cont.)	Chilled Water Temperature Reset Schedule (if included)	Fixed	Outdoor air reset: CHW supply temperature of 44°F(6.7°C) at 80°F(26.7°C) outdoor air dry bulb and above, CHW supply temperature of 54°F(12.2°C) at 60°F(15.6°C) outdoor air dry bulb temperature and below, ramped linearly between	6, 10, 11,12
	~~Condenser Water Pump Power (W/gpm)~~	~~User Defined~~	~~Pump input W/gpm condenser water flow~~	~~6, 7, 8, ,10, 11, 12~~
	~~Condenser Water Pump Control~~	~~User Defined~~	~~Constant speed or variable speed~~	~~6, 7, 8, 10~~, 11,12

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
	Heat Rejection Equipment Efficiency	User Defined	gpm/hp tower fan	6, 7, 10, 11, 12
	Heat Rejection Fan Control	User Defined	Constant or variable speed	6, 7, 10, 11, 12
	Heat Rejection Approach and Range	User Defined	Design cooling tower approach and range temperature	6, 7, 10, 11,12
Heat Pump Loop	Loop flow and Heat Pump Control Valve	Fixed	Two position Valve with VFD on Pump. Loop flow at 3 gpm/ton	7, 8
	Heat Pump Loop minimum and maximum temperature control	User-defined	User input: restrict to minimum 20°F(11.1°C) and maximum 40°F(22.2°C) temperature difference	7
GLHP Well Field		Fixed	Bore depth = 250 ft(76 m) Bore length 200 ft/ton (1.5 m/kW) for the greater of cooling or heating load Bore spacing = 15 ft(4.6 m) Bore diameter = 5 in (127 mm) ¾" (19 mm)Polyethylene pipe Ground and grout conductivity = 4.8 Btu-in/h-ft2-°F (0.69 W/(mK))	8

a. Part load fan power and pump power modified in accordance with Table C409.6.1.10.2(2)

TABLE C409.6.1.10.2(2) FAN AND PUMP POWER CURVE COEFFICIENTS

Equation Term	Fan Power Coefficients	Pump Power Coefficients	
	VSD + SP reset	Ride Pump Curve	VSD + DP/valve reset
b	0.0408	0	0
x	0.088	3.2485	0.0205
x^2	-0.0729	-4.7443	0.4101
x^3	0.9437	2.5295	0.5753

C409.6.1.10.3 Demand Control Ventilation.. Demand Controlled Ventilation (DCV) shall be modeled using a simplified approach that adjusts the design outdoor supply air flow rate based on the floor area of the building that is covered by DCV. The simplified method shall accommodate both variable DCV and on/off DCV, giving on/off DCV on third the effective floor control area of variable DCV. Outdoor air reduction coefficients shall be as stated in Table C409.6.1.10.3

Exception: On/off DCV shall receive full effective area adjustment for R-1 and R-2 occupancies.

C409.6.1.10.3 DCV OUTDOOR AIR REDUCTION CURVE COEFFICIENTS

Equation Term	DCV OSA reduction (y) as a function of effective DCV control floor area (x)			
	Office	School	Hotel; Motel; Multi-Family; Dormitory	Retail
b	0	0	0	0
x	0.4053	0.2676	0.5882	0.4623
x^2	-0.8489	0.7753	-1.0712	-0.848
x^3	1.0092	-1.5165	1.3565	1.1925
x^4	-0.4168	0.7136	-0.6379	-0.5895

C409.6.2 Simulation of the standard reference design. The standard reference design shall be configured and analyzed as specified in this section.

C409.6.2.1 Utility Rates. Same as *proposed design.*

C409.6.2.2 Blocks. Same as *proposed design.*

C409.6.2.3 Thermal zoning. Same as *proposed design.*

C409.6.2.4 Occupancy type, schedule, density, and heat gain. Same as *proposed design.*

C409.6.2.5 Envelope components.. Same as *proposed design.*

C409.6.2.6 Lighting. Same as *proposed design.*

C409.6.2.7 Miscellaneous equipment. Same as *proposed design.*

C409.6.2.8 Elevators. Not modeled. Same as *proposed design*.

C409.6.2.9 Service water heating equipment. Not modeled. Same as *proposed design*.

C409.6.2.10 On-site renewable energy systems. Not modeled. Same as *proposed design*.

C409.6.2.11 HVAC equipment. The *reference building design* HVAC equipment consists of separate space conditioning systems as described in Table C409.6.2.11(1) through Table C409.6.2.11(3) for the appropriate building use types. In these tables, 'Warm' refers to climate zones 0 to 2 and 3A and 'Cold' refers to climate zones 3B, 3C, and 4 to 8.

Table C409.6.2.11(1) Reference Building Design HVAC Complex Systems

Building Type Parameter	**Large Office (warm)**	**Large Office (cold)**	**School (warm)**	**School (cold)**
System Type	*VAV*/ RH Water-cooled Chiller/ Electric Reheat (PIU)	*VAV*/ RH Water-cooled Chiller/ Gas *Boiler*	*VAV*/ RH Water-cooled Chiller/ Electric Reheat (PIU)	*VAV*/ RH Water-cooled Chiller/ Gas *Boiler*
Fan control	VSD (No SP Reset)	VSD (No SP Reset)	VSD (No SP Reset)	VSD (No SP Reset)
Main fan power (W/CFM (W·s/L) Proposed ≥ MERV13	1.165 (2.468)	1.165 (2.468)	1.165 (2.468)	1.165 (2.468)
Main fan power (W/CFM (W·s/L) proposed < MERV13	1.066 (2.259)	1.066 (2.259)	1.066 (2.259)	1.066 (2.259)
Zonal fan power (W/CFM (W·s/L))	0.35 (0.75)	NA	0.35 (0.75)	NA
Minimum zone airflow fraction	1.5* Voz	1.5* Voz	1.2 * Voz	1.2 * Voz

Building Type Parameter	Large Office (warm)	Large Office (cold)	School (warm)	School (cold)
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Outdoor air economizer	No	Yes except 4A	No	Yes except 4A
Occupied OSA (= proposed)	Sum(Voz)/0.75	Sum(Voz)/0.75	Sum(Voz)/0.65	Sum(Voz)/0.65
Energy recovery ventilator *efficiency* ERR	NA	NA	50%	50%
(Enthalpy Recovery Ratio)			No Bypass	60°F(15.6 °C)except 4A
ERV bypass SAT *set point*				
DCV	No	No	No	No
Cooling Source	(2) Water-cooled Centrifugal Chillers	(2) Water- cooled Centrifugal Chillers	(2) Water- Cooled Screw Chillers	(2) Water- Cooled Screw Chillers
Cooling *COP* (net of fan)	Path B for profile	Path B for profile	Path B for profile	Path B for profile
Heating source (reheat)	*Electric resistance*	Gas *Boiler*	*Electric resistance*	Gas *Boiler*
Furnace or *boiler efficiency*	1.0	75% Et	1.0	80% Et
Condenser heat rejection	Axial Fan Open Circuit Cooling Tower			
Cooling tower *efficiency* (gpm/fan-hp (L/s·fan-*kW*))	38.2 (3.23)	38.2 (3.23)	38.2 (3.23)	38.2 (3.23)
Tower turndown (> 300 ton (1060*kW*))	50%	50%	50%	50%
Pump (constant flow/variable flow)	Constant Flow; 10°F (5.6°C) range	Constant Flow; 10°F (5.6°C) range	Constant Flow; 10°F (5.6°C) range	Constant Flow; 10°F (5.6°C) range
Tower approach	25.72 - (0.24 x WB), where WB WB is the 0.4% evaporation design wet-bulb temperature (°F)			
Cooling condenser *pump* power (W/gpm (W·s/L))	19 (300)	19 (300)	19 (300)	19 (300)
Cooling primary *pump* power (W/gpm (W·s/L))	9 (142)	9 (142)	9 (142)	9 (142)
Cooling secondary *pump* power (W/gpm (W·s/L))	13 (205)	13 (205)	13 (205)	13 (205)
Cooling coil chilled water delta-T, °F (°C)	12 (6.7)	12 (6.7)	12 (6.7)	12 (6.7)
Design chilled water supply temperature, °F (°C)	44 (6.7)	44 (6.7)	44 (6.7)	44 (6.7)
Chilled water supply temperature (CHWST) reset *set point* vs Outside Air Temperature OAT, °F (°C)	CHWST: 44-54/OAT 80-60 (6.7-12.2/ 26.7-15.6)	CHWST: 44-54/OAT 80-60 (6.7-12.2/ 26.7-15.6)	CHWST: 44-54/OAT 80-60 (6.7-12.2/ 26.7-15.6)	CHWST: 44-54/OAT 80-60 (6.7-12.2/ 26.7-15.6)

Building Type Parameter	Large Office (warm)	Large Office (cold)	School (warm)	School (cold)
CHW cooling loop *pump*ing control	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD
Heating *pump* power (W/gpm (W·s/L))	16.1 (254)	16.1 (254)	19	19
Heating oil HW dT. °F (°C)	50 (10)	50 (10)	50 (10)	50 (10)
Design Hot Water Supply Temperature (HWST). °F (°C)	180 (82.2)	180 (82.2)	180 (82.2)	180 (82.2)
HWST reset *set point* vs OAT, °F (°C)	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)
Heat loop *pumping* control	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD

Table C409.6.2.11(2)

TSPR Reference Building Design HVAC Simple Systems

Building Type Parameter	Building Type					
	Medium Office (warm)	Medium Office (cold)	Small Office (warm)	Small Office (cold)	Retail (warm)	Retail (cold)
System type	Package *VAV* - Electric Reheat	Package *VAV* - Hydronic Reheat	PSZ-HP	PSZ-AC	PSZ-HP	PSZ-AC
Fan control	VSD (No SP Reset)	VSD (No SP Reset)	Constant Volume	Constant Volume	Constant Volume	Constant Volume
Main fan power (W/CFM (W·s/L)) proposed ≥ MERV13	1.285 (2.723)	1.285 (2.723)	0.916 (1.941)	0.916 (1.941)	0.899 (1.905)	0.899 (1.905)
Main fan power (W/CFM (W·s/L)) proposed < MERV13	1.176 (2.492)	1.176 (2.492)	0.850 (1.808)	0.850 (1.801)	0.835 (1.801)	0.835 (1.801)
Zonal fan power (W/CFM (W·s/L))	0.35 (0.75)	NA	NA	NA	NA	NA
Minimum zone airflow fraction	30%	30%	NA	NA	NA	NA
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Supplemental heating availability	NA	NA	<40°F (<4.4°C) OAT	NA	<40°F (<4.4°C) OAT	NA
Outdoor air economizer	No	Yes except 4A	No	Yes except 4A	No	Yes except 4A
Occupied OSA source	Packaged unit, occupied damper, all *building* use types					
Energy recovery ventilator	No	No	No	No	No	No
DCV	No	No	No	No	No	No
Cooling source	DX, multi-stage	DX, multi-stage	DX, 1 stage (heat pump)	DX, single stage	DX, 1 stage (heat pump)	DX, single stage
Cooling *COP* (net of fan)	3.40	3.40	3.00	3.00	3.40	3.50
Heating source	*Electric resistance*	Gas *Boiler*	Heat Pump	Furnace	Heat Pump	Furnace
Heating *COP* (net of fan) / furnace or *boiler efficiency*	1.0	75% E_t	3.40	80% E_t	3.40	80% E_t

Table C409.6.2.11(3) TSPR Reference Building Design HVAC Simple Systems

Parameter	Building Type			
	Hotel (warm)	Hotel (cold)	Multifamily (warm)	Multifamily (cold)

Parameter	Building Type			
	Hotel (warm)	Hotel (cold)	Multifamily (warm)	Multifamily (cold)
System type	*PTHP*	*PTAC*	*PTHP*	*PTAC*
Fan control	Constant Volume	Constant Volume	Constant Volume	Constant Volume
Main fan power (W/CFM (W·s/L))	0.300 (0.636)	0.300 (0.636)	0.300 (0.636)	0.300 (0.636)
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Supplemental heating availability	<40°F (<4.4°C)	NA	<40°F (<4.4°C)	NA
Outdoor air economizer	No	No	No	No
Occupied OSA source	Packaged unit, occupied damper	Packaged unit, occupied damper	Packaged unit, occupied damper	Packaged unit, occupied damper
Energy recovery ventilator	No	No	No	No
DCV	No	No	No	No
Cooling source	DX, 1stage (heat pump)	DX, 1 stage	DX, 1 stage (heat pump)	DX, 1 stage
Cooling *COP* (net of fan)	3.10	3.20	3.10	3.20
Heating source	*PTHP*	(2) Hydronic *Boiler*	*PTHP*	(2) Hydronic *Boiler*
Heating *COP* (net of fan) / furnace or *boiler efficiency*	3.10	75% E_t	3.10	75% E_t
Heating *pump* power (W/gpm (W·s/L))	NA	19 (300)	NA	19 (300)
Heating coil heating water delta-T, °F (°C)	NA	50 (27.8)	NA	50 (27.8)
Design HWST, °F (°C)	NA	180 (82.2)	NA	180 (82.2)
HWST reset *set point* vs OAT, °F (°C)	NA	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)	NA	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)
Heat loop *pumping* control	NA	2-way Valves & ride*pump* curve	NA	2-way Valves & ride*pump* curve

C409.7 Target Design HVAC Systems. Target system descriptions described in Tables C409.7(1) through C409.7(3) are provided as reference for Section C403.1.1 Exception 10. The target systems are used for developing MPF values and do not need to be programmed into TSPR software.

Table C409.7(1)
Target Building Design Criteria HVAC Complex Systems

Parameter	**Building Type**			
	Large Office (warm)	**Large Office (cold)**	**School (warm)**	**School (cold)**
System Type	*VAV*/ RH	*VAV*/ RH	*VAV*/ RH	*VAV*/ RH
	Water-cooled Chiller/	Water-cooled Chiller/	Water-cooled Chiller/	Water-cooled Chiller/
	Electric Reheat (PIU)	Gas *Boiler*	Electric Reheat (PIU)	Gas *Boiler*

Parameter	Building Type			
	Large Office (warm)	**Large Office (cold)**	**School (warm)**	**School (cold)**
Fan control	VSD (No SP Reset)	VSD (No SP Reset)	VSD (No SP Reset)	VSD (No SP Reset)
Main fan power (W/CFM (W·s/L) Proposed ≥ MERV13	1.127 (2.388)	1.127 (2.388)	1.127 (2.388)	1.127 (2.388)
Zonal fan power (W/CFM (W·s/L))	0.35 (0.75)	NA	0.35 (0.75)	NA
Minimum zone airflow fraction	1.5* Voz	1.5* Voz	1.2 * Voz	1.2 * Voz
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Outdoor air economizer	*Yes except 0-1*	Yes	*Yes except 0-1*	Yes
Occupied OSA (= proposed)	Sum(Voz)/0.75	Sum(Voz)/0.75	Sum(Voz)/0.65	Sum(Voz)/0.65
Energy recovery ventilator *efficiency* ERR (Enthalpy Recovery Ratio)	NA	NA	50%	50%
ERV bypass SAT *set point*			No Bypass	60°F(15.6°C) except 4A
DCV	Yes	Yes	Yes	Yes
% Area Variable Control	15%	15%	70%	70%
% Area On/Off Control	65%	65%	20%	20%
Cooling Source	(2) Water-cooled Centrif Chillers	(2) Water- cooled Centrif Chillers	(2) Water- Cooled Screw Chillers	(2) Water- Cooled Screw Chillers
Cooling *COP* (net of fan)	ASHRAE 90.1 Appendix G, Table G3.5.3	ASHRAE 90.1 Appendix G, Table G3.5.3	ASHRAE 90.1 Appendix G, Table G3.5.3	ASHRAE 90.1 Appendix G, Table G3.5.3
Heating source (reheat)	*Electric resistance*	Gas *Boiler*	*Electric resistance*	Gas *Boiler*
Furnace or *boiler efficiency*	1.0	90% Et	1.0	80% Et
Condenser heat rejection	Cooling Tower	Cooling Tower	Cooling Tower	Cooling Tower
Cooling tower *efficiency* (gpm/hp (L/s·*kW*))–See G3.1.3.11	40.2 (3.40)	40.2 (3.40)	40.2 (3.40)	40.2 (3.40)

Parameter	Building Type			
Tower turndown (> 300 ton (1060*kW*))	50%	50%	50%	50%
Pump (constant flow/variable flow)	Constant Flow; 10°F (5.6°C) range	Constant Flow; 10°F (5.6°C) range	Constant Flow; 10°F (5.6°C) range	Constant Flow; 10°F (5.6°C) range
Tower approach	ASHRAE 90.1 Appendix G, Table G3.1.3.11	ASHRAE 90.1 Appendix G, Table G3.1.3.11	ASHRAE 90.1 Appendix G, Table G3.1.3.11	ASHRAE 90.1 Appendix G, Table G3.1.3.11
Cooling condenser *pump* power (W/gpm (W·s/L))	19 (300)	19 (300)	19 (300)	19 (300)
Cooling primary *pump* power (W/gpm (W·s/L))	9 (142)	9 (142)	9 (142)	9 (142)
Cooling secondary *pump* power (W/gpm (W·s/L))	13 (205)	13 (205)	13 (205)	13 (205)
Cooling coil chilled water delta-T, °F (°C)	18 (10)	18 (10)	18 (10)	18 (10)
Design chilled water supply temperature, °F (°C)	42 (5.56)	42 (5.56)	42 (5.56)	42 (5.56)
Chilled water supply temperature (CHWST)reset *set point* vs OAT, °F (°C)	CHWS 44-54/OAT 80-60 (6.7-12.2)/26.7-15.6)	CHWS 44-54/OAT 80-60 (6.7-12.2)/26.7-15.6)	CHWS 44-54/OAT 80-60 (6.7-12.2)/26.7-15.6)	CHWS 44-54/OAT 80-60 (6.7-12.2)/26.7-15.6)
CHW cooling loop *pump*ing control	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD

Parameter	Building Type			
	Large Office (warm)	Large Office (cold)	School (warm)	School (cold)
Heating *pump* power (W/gpm (W·s/L))	16.1 (254)	16.1 (254)	19 (254)	19 (254)
Heating HW dT. °F (°C)	50 (27.78)	20 (11.11)	50 (27.78)	20 (11.11)
Design HWST. °F (°C)	180 (82)	140 (60)	180 (82)	140 (60)
Hot water supply temperature (HWST) range vs outside air temperature (OAT) range	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)
Heat loop *pumping* control	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD	2-way Valves & *pump* VSD

TABLE C409.7(2) Target Building Design Criteria HVAC Simple Systems

Parameter	Building Type					
	Medium Office (warm)	Medium Office (cold)	Small Office (warm)	Small Office (cold)	Retail (warm)	Retail (cold)
System type	Package VAV - Electric Reheat	Package VAV - Hydronic Reheat	PSZ-HP	PSZ-AC	PSZ-HP	PSZ-AC
Fan control	VSD (with SP Reset)	VSD (with SP Reset)	Constant Volume	Constant Volume	2-speed	2-speed
Main fan power (W/CFM (W·s/L))proposed ≥ MERV13	0.634 (1.343)	0.634 (1.343)	0.486 (1.03)	0.486 (1.03)	0.585 (1.245)	0.585 (1.245)
Zonal fan power (W/CFM (W·s/L))	0.35 (5.53)	NA	NA	NA	NA	NA
Minimum zone airflow fraction	1.5* Voz	1.5* Voz	NA	NA	NA	NA
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Supplemental heating availability	NA	NA	<40°F (<4.4°C) OAT	NA	<40°F (<4.4°C) OAT	NA
Outdoor air economizer	Yes except 0-1	Yes	Yes except 0-1	Yes	Yes except 0-1	Yes
Occupied OSA source	Packaged unit, occupied damper, all building use types					
Energy recovery ventilator	No	No	No	No	Yes, in 0A, 1A, 2A, 3A	Yes all A, 6,7,8 CZ
ERR					50%	50%
DCV	Yes	Yes	No	No	Yes	Yes
% Area Variable Control	15%	15%			80%	80%

Parameter	Building Type					
	Medium Office (warm)	Medium Office (cold)	Small Office (warm)	Small Office (cold)	Retail (warm)	Retail (cold)
% Area On/Off Control	65%	65%			0%	0%
Cooling source	DX, multi-stage	DX, multi-stage	DX, 1 stage (heat pump)	DX, single stage	DX, 2 stage (heat pump)	DX, 2 stage
Cooling COP (net of fan)	3.83	3.83	3.82	3.8248	3.765	3.765
Heating source	Electric resistance	Gas Boiler	Heat Pump	Furnace	Heat Pump	Furnace
Heating COP (net of fan) / furnace or boiler efficiency	100%	81% E_t	3.81	81% E_t	3.536	81% E_t
Heating coil HW dT. °F (°C)	NA	20 (11.11)	NA	NA	NA	NA
Design HWST. °F (°C)	NA	140 (60)	NA	NA	NA	NA
HWST reset set point vs OAT, °F (°C)	NA	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)	NA	NA	NA	NA
Heat loop pumping control	NA	2-way Valves & ride pump curve	NA	NA	NA	NA
Heating pump power (W/gpm (W·s/L))	NA	16.1	NA	NA	NA	NA

TABLE C409.7(3) Target Building Design Criteria HVAC Simple Systems

Parameter	Building Type			
	Hotel (warm)	Hotel (cold)	Multifamily (warm)	Multifamily (cold)
System type	*PTHP*	*PTAC with Hydronic Boiler*	*Split HP*	*Split AC*
Fan control	Cycling	Cycling	Cycling	Cycling
Main fan power (W/CFM (W·s/L))	0.300 (0.638)	0.300 (0.638)	0.246 (0.523)	0.271 (0.576)
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Supplemental heating availability	<40°F (<4.4°C)	NA	<40°F (<4.4°C)	NA
Outdoor air economizer	Only CZ 2, 3	No	No	No
Occupied OSA source	DOAS	DOAS	DOAS	DOAS except 3C
Energy recovery ventilator	NA	NA	Yes	Yes except 3C
ERR	NA	NA	60%	60%

DCV	Yes	Yes	No	No
% Area Variable Control	70%	70%		
% Area On/Off Control	0%	0%		
Cooling source	DX, 1stage (heat pump)	DX, 1 stage	DX, 1 stage (heat pump)	DX, 1 stage
Cooling *COP* (net of fan)	3.83	3.83	3.823	3.6504
Heating source	*Heat Pump*	(2) Hydronic *Boiler*	*Heat Pump*	Furnace
Heating *COP* (net of fan) / furnace or *boiler efficiency*	3.44	81% E_t	3.86	80% AFUE
Heating *pump* power (W/gpm (W·s/L))	NA	16.1	NA	NA
Heating coil heating water delta-T, °F (°C)	NA	20 (11.11)	NA	NA
Design HWST, °F (°C)	NA	140 (60)	NA	NA
HWST reset *set point* vs OAT, °F (°C)	NA	HWST: 180-150/OAT 20-50 (82-65.6/ -6.7-10)	NA	NA
Heat loop *pump*ing control	NA	2-way Valves & ride*pump* curve	NA	NA

Appendix CD
REQUIRED HVAC TSPR

CD 101 Required HVAC TSPR. For jurisdictions who wish to adopt a stretch code or HVAC incentive system,make the following changes to Section C403.

Replace Section C403.1 with the following: **C403.1 General.** Mechanical systems and equipment serving the building heating, cooling, ventilating, or refrigerating needs shall comply with one of the following:

1. Sections C403.1.1 and C403.2 through C403.14 and also comply with Section C403.1.3
2. Data Centers shall comply with C403.1.1, C403.1.2 and C403.6 through C403.14

Replace Section C403.1.3 with the following. **C403.1.3 HVAC total system performance ratio (*HVAC TSPR*)**. Forsystemsservingbuildings or portions of buildings of the following types:

1. Office (including medical office) (occupancy group B),
2. Retail (occupancy group M), library (occupancy group A-3),
3. Education (occupancy group E), and
4. Hotel/motel occupancies (occupancy group R-1) and
5. The *dwelling units* and common areas within occupancy group R-2 multifamily buildings,

The *HVAC total system performance ratio*(*HVACTSPR*)ofthe *proposed design*HVACsystemsshallbegreaterthanorequaltothe *HVACTSPR*of the *standard reference design*dividedbytheapplicablemechanicalperformancefactor(MPF)fromTableC409.4. *HVACTSPR*shallbecalculatedin accordancewithSection C409,CalculationofHVACTotalSystemPerformanceRatio.

Exceptions to C403.1.3

1. Buildings with conditioned floor area less than 5,000 squarefeet.
2. Alterationsto existing buildings that do not substantially replace the entire HVAC system and are not serving initial build-out construction
3. HVAC systems using district heating water, chilled water or steam.

4. Portions of buildings served by systems using:
   4.1. Small duct high velocity air cooled, space constrained air cooled, single package vertical air conditioner, single package vertical heat pump, or
   4.2. Double-duct air conditioner or double-duct heat pump as defined in subpart F to 10CFR part 431
   4.3. Packaged terminal air conditioners and packaged terminal heat pumps that have cooling capacity greater than 12,000 Btu/hr (3500 kW)
   4.4. A common heating source serving both HVAC and service water heating equipment
   4.5. HVAC systems not included in Table C409.5.2.10.1
   4.6. HVAC systems included in table C409.5.2.10.1 with parameters in Table C409.5.2.10.2, not identified as applicable to that HVAC system type.
   4.7. Underfloor air distribution and displacement ventilation HVAC systems.
   4.8. Space conditioning systems that do not include mechanical cooling.
   4.9. HVAC systems that provide recovered heat for service water heating
   4.10. HVAC systems with chilled water supplied by absorption chillers, heat recovery chillers, water to water heat pumps, air to water heat pumps, or a combination of air and water cooled chillers on the same chilled water loop.
   4.11. HVAC system served by heating water plants that include air to water or water to water heat pumps.
   4.12. HVAC systems meeting or exceeding all the requirements of the applicable Target Design HVAC System described in Tables C409.5.4(1) through C409.5.4(3) ,
   4.13. HVAC systems serving laundry rooms, elevator rooms, mechanical rooms, electrical rooms, data centers, and computer rooms.
   4.14. Buildings or areas of medical office buildings that comply fully with ASHRAE Standard 170, including but not limited to surgical centers, or that are required by other applicable codes or standards to provide 24/7 air handling unit operation
   4.15. HVAC systems serving laboratories with fume hoods
   4.16. Locker rooms with more than 2 showers
   4.17. Natatoriums and rooms with saunas
   4.18. Restaurants and commercial kitchens with total cooking capacity greater than 100,000 Btu/h
   4.19. Cafeterias and dining rooms
   4.20. Areas of buildings with commercial refrigeration equipment exceeding 100 kW of power input.

Replace Table C409.4 with the following, this provides a 5% reduction in HVAC energy:

	Climate Zone:	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Building type	Occupancy Group																			
Office (small and medium)[a]	B	0.68	0.68	0.67	0.67	0.65	0.62	0.67	0.65	0.61	0.76	0.67	0.74	0.8	0.73	0.76	0.82	0.79	0.83	0.85
Office (Large)[a]	B	0.79	0.79	0.8	0.8	0.75	0.78	0.68	0.77	0.73	0.64	0.72	0.6	0.67	0.68	0.6	0.69	0.67	0.67	0.67
Retail	M	0.57	0.54	0.48	0.52	0.44	0.44	0.41	0.48	0.38	0.43	0.54	0.65	0.44	0.65	0.64	0.48	0.43	0.42	0.36
Hotel/Motel	R-1	0.59	0.59	0.6	0.6	0.59	0.65	0.58	0.67	0.69	0.43	0.56	0.49	0.36	0.45	0.48	0.33	0.36	0.29	0.25
Multi-Family/ Dormitory	R-2	0.61	0.6	0.64	0.6	0.62	0.61	0.56	0.68	0.52	0.5	0.48	0.42	0.51	0.45	0.36	0.52	0.48	0.48	0.45
School/ Education and Libraries	E (A-3)	0.78	0.77	0.76	0.75	0.71	0.68	0.67	0.68	0.64	0.69	0.68	0.65	0.78	0.69	0.58	0.85	0.76	0.79	0.73

a. large office (gross conditioned floor area >150,000 ft^2 (14,000 m^2) or > 5 floors); all other offices are small or medium

Reason: The prescriptive path is traditionally the most widely used approach for commercial code compliance in the United States. Though easy to implement, the prescriptive approach does not discriminate between high-performing and poorly performing heating, ventilation, air conditioning (HVAC) system configurations that are both minimally compliant. For example, a high capacity PTAC is less efficient than a packaged rooftop air conditioner, but either one can be used in the prescriptive path. The packaged rooftop unit is a better design choice, both for energy savings and reduced noise in the space. To meet aggressive energy and carbon reduction goals, energy codes will need to transition from prescriptive to performance-based approaches, a transition that has several challenges.

This proposal includes 3 features:

· An alternative path in Section C403 that can be used optionally for tradeoffs, such as a more efficient system that does not have outside air economizers. This performance path uses minimum efficiency HVAC equipment for all the target systems with a selection of a reasonable and typical system type and related fan and pumping parameters. In this case, mandatory requirements and certain prescriptive requirements are maintained, while most prescriptive requirements can be traded off for improved efficiency in other parts of the system.

· An addition to the energy credits section (C406) of the code that accounts for the total HVAC system performance, not just heating and cooling efficiency.

· An optional appendix that can be adopted for stretch codes and utility incentive certification that requires TSPR analysis where it is applicable and requires a higher level of performance, saving 5% vs. minimum efficiency systems.

HVAC System Performance is a discipline performance path and provides a simpler solution to HVAC system evaluation compared to whole building performance, while keeping tradeoffs limited to specific building systems. The Total System Performance Ratio (TSPR) is a metric for evaluation of overall system efficiency instead of individual component efficiency, a solution that could also eventually facilitate the transition to a 100% performance-based code structure. TSPR is a ratio that compares the annual heating and cooling load of a building to the annual energy consumed by the building's HVAC system.

A web-based calculation tool has been developed for determining a building's TSPR. Already incorporated into the 2018 Washington State Energy Code, this approach has also been evaluated by the ASHRAE Standard 90.1 Project Committee and has the potential to provide a comprehensive performance-based approach for HVAC system evaluation and analysis

For the stretch code option, implementing a base TSPR minimum requirement for HVAC systems in relevant buildings will result in savings when the least efficient systems allowed under the prescriptive path are required to make some change to improve efficiency in line with a reasonably good prescriptive system. Such changes might include efficiency improvements, better duct design that reduces fan power, or the inclusion of options like economizers, demand controlled ventilation, improvement in energy recovery effectiveness or addition of energy recovery that might be excepted for the particular situation. The HVAC System performance path looks at the performance of all the systems in the building, so smaller systems do not necessarily need to meet higher requirements.

Additional Commentary for Section 409.3

1. Examples of *HVAC systems* that are intended to receive HVAC services from*systems* in the permit include future zonal water source heat pumps that will receive loop water that is heated by a *boiler* or cooled by a cooling tower included in the permit, any*system* that will receive outdoor *ventilation* air from a dedicated *outdoor air system* included in the permit, and future zone terminal units that will be connected to a central *VAV system* included in the permit.

2. An initial build-out with heating coils served from a previously installed*system* with a high-*efficiency* condensing *boiler* would use the installed *efficiency* if it exceeded the current requirements. If the installed*boiler* had a lower *efficiency* than the current requirements, the current requirement would be used

3. A partial central plant upgrade (e.g. chiller, but not *boiler* replacement) cannot use this method

Coordination with Proposal CEPI-193-21

Proposal CEPI-193-21 includes the following coordinating language that adds the HVAC TSPR approach as an HVAC energy credit.

1. Section 406.2.2 numbered list items 1 and 7.

2. Section C406.2.2.1,

3. the base energy credits for H01 in Tables C406.1.4(1) through C406.1.4(9).

If this Proposal CEPI-76-21 is not approved for publication in the 2024 IECC then the coordinating language for energy credit H01 in CEPI-193-21 needs to be removed prior to publication.

Bibliography: Goel S., R Hart, M Tillou, M Rosenberg, J Gonzalez, K Devaprasad, and J Lerond. 2021. HVAC System Performance for Energy Codes. PNNL-31571. Richland, WA: Pacific Northwest National Laboratory.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
For the base proposal, there is no cost impact, as TSPR is an optional path that is not required under the prescriptive path.

For the energy credits addition, this is one of many options, and the energy credits show cost effectiveness through one cost effective path that may not include this option. Adding TSPR to energy credits just increases efficiency.

For the stretch code appendix, there may be a cost increase; however, this option is a jurisdictional adoption choice where the jurisdiction may choose to require improved efficiency performance as a matter of policy, rather than focusing on individual building cost savings, including consideration for environmental externalities and societal costs.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal provides an alternative compliance path with a focus on performance. Please also refer to the reason statement in the proposal.

Final Hearing Results

CEPI-76-21 AM

CEPI-77-21

Original Proposal

IECC®: C403.10 (New), C403.10.1 (New), C403.10.2 (New)

Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Add new text as follows:

C403.10 Buildings with High-Capacity Space-Heating Gas Boiler Systems. Gas hot-water boiler systems for space heating with system input capacity capacities of at least not less than 1,000,000 Btu/h (293 kW) but not more and not greater than 10,000,000 Btu/h (2931 kW) in new buildings shall comply with Sections C403.10.1 and C403.10.2

Exceptions:

1. Where 25 percent of the annual space heating requirement is provided by on-site renewable energy, site-recovered energy, or heat recovery chillers.
2. Space heating boilers installed in individual dwelling units.
3. Where 50 percent or more of the design heating load is served using perimeter convective heating, radiant ceiling panels, or both.
4. Individual gas boilers with input capacity less than 300,000 Btu/h (87 kW) shall not be included in the calculations of the total system input or total system efficiency.

C403.10.1 Boiler Efficiency. Gas hot-water boilers shall have a thermal efficiency (E_t) of not less than 90 percent where rated in accordance with the test procedures in Table C403.3.2(6). Systems with multiple boilers are allowed to meet this requirement where the space heating input provided by equipment with thermal efficiency (E_t) above or below 90 percent provides an input capacity-weighted average thermal efficiency of not less than 90 percent. For boilers rated only for combustion efficiency, the calculation for the input capacity-weighted average thermal efficiency shall use the combustion efficiency value.

C403.10.2 Hot-Water Distribution System Design. The hot-water distribution system shall be designed to meet the following:

1. Coils and other heat exchangers shall be selected so that at design conditions the hot water return temperature entering the boilers is 120°F (48.9 ºC) or less.
2. Under all operating conditions, the water temperature entering the boiler is not greater than 120°F (48.9 ºC), or the flow rate of supply hot water that recirculates directly into the return system, such as by three-way valves or minimum flow bypass controls, shall be no greater than 20 percent of the design flow of the boilers.

Reason: This proposal adds an implementation of condensing boilers for new construction to achieve condensing-level efficiency (i.e., 90% Et) for large boiler systems (i.e., between 1 million and 10 million Btuh), where the proper design considerations are included so that the condensing boilers will operate properly. To ensure condensing occurs, requirements are added to ensure boiler entering water temperature is designed to be low, and able to be maintained low, by minimizing recirculation of hot-water supply into the return.

The introduction of these new requirements is important because boilers represent 40% of the heating in commercial buildings and are especially prevalent in cold climates and current levels specified in Table C403.3.2(6) are not enough to achieve condensing boiler level efficiency. A challenge for condensing boilers for hot-water heating is that they require system design changes and the use of higher delta entering and leaving temperature to maintain condensing operation to ensure they operate efficiently.

The proposed text seen here was approved for publication in 90.1-2019 as addendum bc to 90.1-2016. There is a slight modification to the charging language to clarify that the capacity threshold applies to individual systems and not the total boiler capacity for the building.

This addendum was closely reviewed by designers, manufacturers, and users. The boiler working group held meetings with all stakeholders to ensure that all concerns were addressed.

Bibliography: ANSI/ASHRAE/IES Standard 90.1-2019: Energy Standard for Buildings Except Low-Rise Residential Buildings

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

First cost was determined from the 2012 GSA Condensing Boiler Study, which estimates $38.50/MBtu for noncondensing and $42.60/MBtu for condensing boilers. In addition, the study estimates an additional average annual maintenance cost of $400 for condensing boilers. Energy savings were found using energy modeling simulations run using USDOE's EnergyPlus. Three prototype buildings were used—large office, hospital, and secondary school—in various U.S. climate zones.

Using the Standard 90.1 scalar ratio, the economic analysis shows an average scalar ratio of 4.2. The maximum scalar ratio is 17.2 for boilers with a life expectancy of 25 years, so this measure is highly cost-effective. Models and estimates show that all prototypes fall within the maximum scalar ratio and are cost-effective.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal adds an implementation of condensing boilers for new construction to achieve condensing-level efficiency (i.e., 90% Et) for large boiler systems (i.e., between 1 million and 10 million Btuh), where the proper design considerations are included so that the condensing boilers will operate properly. To ensure condensing occurs, requirements are added to ensure boiler entering water temperature is designed to be low, and able to be maintained low, by minimizing recirculation of hot-water supply into the return.

The introduction of these new requirements is important because boilers represent 40% of the heating in commercial buildings and are especially prevalent in cold climates and current levels specified in Table C403.3.2(6) are not enough to achieve condensing boiler level efficiency. A challenge for condensing boilers for hot-water heating is that they require system design changes and the use of higher delta entering and leaving temperature to maintain condensing operation to ensure they operate efficiently.

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This addendum was closely reviewed by designers, manufacturers, and users. The boiler working group held meetings with all stakeholders to ensure that all concerns were addressed.

Final Hearing Results

CEPI-77-21	AM

CEPI-79-21

Original Proposal

IECC®: C403.12.3, TABLE C403.12.3, TABLE C403.12.3(2) (New)

Proponents: Howard Ahern, Airex Manufacturing Inc, Airex Manufacturing (howard.ahern@airexmfg.com)

2021 International Energy Conservation Code

Revise as follows:

C403.12.3 Piping insulation. Piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table C403.12.3(1) or Table C403.12.3(2).

Exceptions:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with a test procedure referenced by this code.
2. Factory-installed piping within room fan-coils and unit ventilators tested and rated according to AHRI 440 (except that the sampling and variation provisions of Section 6.5 shall not apply) and AHRI 840, respectively.
3. Piping that conveys fluids that have a design operating temperature range between 60°F (15°C) and 105°F (41°C).
4. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power.
5. Strainers, control valves, and balancing valves associated with piping 1 inch (25 mm) or less in diameter.
6. Direct buried piping that conveys fluids at or below 60°F (15°C).
7. In radiant heating systems, sections of piping intended by design to radiate heat.

TABLE C403.12.3 MINIMUM PIPE INSULATION THICKNESS (in inches or R Value)[a, c]

Portions of table not shown remain unchanged.

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY			NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu × in./(h × ft^2 × °F)[b]	Mean Rating Temperature, °F	Inches R Value	< 1	1 to < 1 $^1/_2$	1 $^1/_2$ to < 4	4 to < 8	~~>~~≥ 8
				Minimum Insulation Thickness (inches)				
> 350	0.32-0.34	250	Inches	4.5	5.0	5.0	5.0	5.0
			R Value	R32	R36	R34	R26	R21
251-350	0.29-0.32	200	Inches	3.0	4.0	4.5	4.5	4.5
			R Value	R20	R29	R32	R24	R20
201-250	0.27-0.30	150	Inches	2.5	2.5	2.5	3.0	3.0
			R Value	R17	R17	R17	R15	R13
141-200	0.25-0.29	125	Inches	1.5	1.5	2.0	2.0	2.0
			R Value	R9	R9	R11	R10	R9
105-140	0.21-0.28	100	Inches	1.0	1.0	1.5	1.5	1.5
			R Value	R5	R9	R8	R8	R7
40-60	0.21-0.27	75	Inches	0.5	0.5	1.0	1.0	1.0

			R Value	R2	R2	R5	R5	R4
< 40	0.20-0.26	50	Inches	0.5	1.0	1.0	1.0	1.5
			R Value	R 6	R9	R9	R8	R7

For SI: 1 inch = 25.4 mm, °C = [(°F) – 32]/1.8.

a. For piping smaller than 1 $^1/_2$ inches and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in Note b) but not to a thickness less than 1 inch.

b. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

$$T = r\,[(1 + t/r)^{K/k} - 1]$$

where:

T = Minimum insulation thickness in inches.

r = Actual outside radius of pipe in inches.

t = Insulation thickness listed in the table for applicable fluid temperature and pipe size.

K = Conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu × in/h × f^{2}t × °F).

k = The upper value of the conductivity range listed in the table for the applicable fluid temperature.

c. For direct-buried heating and hot water system piping, reduction of these thicknesses by 1 $^1/_2$ inches (38 mm) shall be permitted (before thickness adjustment required in Note b but not to thicknesses less than 1 inch.

Add new text as follows:

TABLE C403.12.3(2) MINIMUM PIPE INSULATION R-Value[a]

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	NOMINAL PIPE OR TUBE SIZE (inches)				
	≤1	1 TO <1 1/2	1 1/2 TO <4	4 TO <8	≥8
Minimum Insulation R-Value					
>350	R32	R36	R34	R26	R21
251-350	R20	R29	R32	R24	R20
201-250	R17	R17	R17	R15	R13
141-200	R9	R9	R11	R10	R9
105-140	R5	R9	R8	R8	R7
40-60	R2	R2	R5	R5	R4
<40	R6	R9	R9	R8	R7

For SI: R-1 = RSI-0.176228, °C = [(°F)-32]/1.8.

a. The *R-value* of cylindrical piping insulation shall be determined as follows:

$R=(r_o(\ln(r_o/r_i)))/k$

where:
R = The interior *R-value* of the cylindrical piping insulation in Btu x ft^2 x °F/h

r_o = The outer radius of the piping insulation in inches

r_i = The inner radius of the piping insulation in inches
k = the thermal conductivity of the insulation material in Btu x in/h x ft^2 x °F

-

Reason: All materials having the same R-value, regardless of type; thickness; or weight, are equal in insulating strength. Where a specific R-value is required all insulation materials can be compared equally.

This proposal seeks to harmonize the selection of pipe insulation requirements by allowing either thickness or R Value. The Chart has been changed to set minimum R valves required as an option to pipe insulation thickness . Optional R Values allows for materials with the same or higher R Values but lower thickness. “Since 2010, there have been a number of new mechanical insulation products and systems developed in North America. Some are modifications to previously commercially available materials, and some are completely new. Additionally, ASTM has developed several new specifications and revised a number of others.”*

New materials for Pipe insulation are readily available and comply with the minimum R values required but can have lower thicknesses. This proposal offers the option of using either R values or pipe insulation thickness to achieve desired energy savings.

2021 IECC C102.1General
The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. The code official shall have the authority to approve an alternative material, design or method of construction upon the written application of the owner or the owner's authorized agent. The *code official* shall first find that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, *fire resistance*, durability, energy conservation and safety.

The code does allow for alternative material in C102.1 however, this would prove to be impractical as the code official would not know the R Value required without having to Calculate each size of piping to find the Pipe Insulations R Value and again would restrict new material that have the same R value required but in a lower thickness.

C303.1.2 already requires Insulating materials shall be installed such that the manufacturer’s*R*-value mark is readily observable upon inspection. This also would make it easier to inspect an R Value on the insulation then to view pipe insulation to determine its thickness.

Technical Report on Calculating Pipe Insulation R-Values

Using Dimensions and Thermal Conductivity Values

In the International Energy Code (IEC)

Written by Gordon H. Hart, P.E.

October 12, 2021

Technical Problem

: The International Energy Code (IEC) includes a Table C403.12.3 that specifies minimum pipe insulation thicknesses. These can be broken into rows for different pipe temperature ranges and columns for different pipe diameter ranges. For each pipe temperature range, there is an assumed range of thermal conductivity values from which the pipe insulation thickness is calculated.

There is an inverse relationship between thermal conductivity and R-value; hence, the greater the thermal conductivity, the lower the R-value and vice-versa. The higher thermal conductivity (i.e., value of k) will give the lower R-value for each range, when R-value is calculated. In the attached table, these lower R-values should be calculated using the standard equation that uses input of inner and outer pipe insulation radii and thermal conductivity of pipe insulation, namely:

First, since there is a range of values of k applicable to each temperature range, the higher value of k should be used to calculate the lower R-value. In addition, the inner and outer pipe insulation radii (radius is half the diameter) are not equal to nominal values. Rather, their exact radii values are different and should be taken from the ASTM standard C585. Making these modifications to the input to the above equation for R-value, we arrive at new, somewhat lower R-values for each temperature range and each pipe diameter range, as shown on the attached table (note that these only show the non-residential values):

	Nominal	**Actual**	**Actual**	**Actual**		**R-value**
105-140	**Pipe Dia, NPS**	**r1 inside**	**r2 outside**	**th (inch)**	**k (max)**	**(min)**
	< 1	0.72	1.72	1	0.28	5
	1 up to 1.5	0.72	2.22	1.5	0.28	9
	1.5 up to 4	1.015	2.515	1.5	0.28	8
	4 up to 8	2.35	3.99	1.64	0.28	8
	> 8	4.41	6.05	1.64	0.28	7
141-200	< 1	0.72	2.22	1.5	0.29	9
	1 up to 1.5	0.72	2.22	1.5	0.29	9
	1.5 up to 4	1.015	3.015	2	0.29	11
	4 up to 8	2.35	4.45	2.1	0.29	10
	> 8	4.41	6.59	2.18	0.29	9
201-250	< 1	0.72	3.31	2.59	0.3	17
	1 up to 1.5	0.72	3.31	2.59	0.3	17
	1.5 up to 4	1.015	3.81	2.795	0.3	17
	4 up to 8	2.35	5.375	3.025	0.3	15
	> 8	4.41	7.5	3.09	0.3	13
251-350	< 1	0.72	3.81	3.09	0.32	20
	1 up to 1.5	0.72	4.81	4.09	0.32	29
	1.5 up to 4	1.015	5.875	4.86	0.32	32
	4 up to 8	2.35	7	4.65	0.32	24
	> 8	4.41	9	4.59	0.32	20
>350	< 1	0.72	5.375	4.655	0.34	32
	1 up to 1.5	0.72	5.875	5.155	0.34	36
	1.5 up to 4	1.015	6.375	5.36	0.34	34
	4 up to 8	2.35	7.5	5.15	0.34	26
21	21	21	21	21	21	21

Temp Ran	Nominal	Actual	Actual	Actual		R-value
<40	Pipe Dia, NPS	r1 inside	r2 outside	th (inch)	k (max)	(min)
	< 1	0.72	1.72	1	0.26	6
	1 up to 1.5	0.72	2.22	1.5	0.26	10
	1.5 up to 4	1.015	2.515	1.5	0.26	9
	4 up to 8	2.35	3.99	1.64	0.26	8
	> 8	4.41	6.05	1.64	0.26	7
40-60	0.5 (non-res)	0.5	0.935	0.435	0.27	2
	1 up to 1.5 (non-res)	0.72	1.22	0.5	0.27	2
	1.5 up to 4	1.015	2.015	1	0.27	5
	4 up to 8	2.35	3.4	1.05	0.27	5
	> 8	4.41	5.5	1.09	0.27	4

Comments

: These minimum R-values, are calculated using the maximum values of k from the appropriate temperature range in the 2021 IECC Table C403.12.3. It's particularly interesting, however, to examine the smallest pipe in the

< 40°F temperature range since that previously required a minimum of .50-inch thickness, which results in a minimum R-value of 6.

Conclusions: The 2021 IECC Table C403.12.3 gives the minimum required thickness for pipe insulation used to insulate both cold and hot pipes. It is proposed that an alternative be to list the minimum required R-value for each pipe temperature range and each pipe size range, using calculated values of R-value. The new R-value calculations have used minimum values of thermal conductivity, k, and nominal dimensions of the pipe insulation. These calculations, as described above and as shown on the attached table, show the minimum R-values.

*Recent Developments in Mechanical Insulation Technolgy_Gordon H. Hart Insulation Outlook Magazine

Bibliography: Howard Ahern

Airex Manufacturing

760-250-1625

howard.ahern@airexmfg.com

Gordon H. Hart, P.E.
Consulting Engineer
Artek Engineering, LLC
Email: gordon.hart@artekengineering.com
Phone: 913-219-7394

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code proposal does not change the current requirement for pipe insulation thickness thus not increasing cost but allows an option to comply based on R Values or thickness. As new materials can be higher R values and have lower thickness this could decrease labor and materials used.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: per the proponent's reason statement submitted.

Final Hearing Results	
CEPI-79-21	AM

CEPI-80-21
Original Proposal

IECC®: C403.12.3.1

Proponents: Howard Ahern, Airex Manufacturing, Airex Manufacturing (howard.ahern@airexmfg.com)

2021 International Energy Conservation Code

Revise as follows:

C403.12.3.1 Protection of piping insulation.
Piping insulation exposed to the weather shall be protected fromphysical damage, including that caused by sunlight, moisture, equipment maintenance and wind. Theprotection~~, and~~ shall provide shielding from solar radiation that can cause degradation of the material~~and~~. The protection shall be removable and reuseable for not less than 6 inches (150 mm) from the connection to the equipment piping for maintenance. Adhesive tape shall not be permitted as a means of insulation protection.

Reason: Purpose of code change: This proposal will clarify the intent of Section C403.12.3. The intent of these sections is not only protection of pipe insulation from weather but to insure the insulations thermal conductivity energy savings integrity lasts the life of the mechanical system asper the intent of the code. To remove the opportunity for misunderstanding so that the code has will have its intended result, the term "equipment maintenance" must be clarified that it is for physical damage.

The 2012,2015, & 2018 IECC Code and Commentary both state that Equipment maintenance is to protect from physical damage to the pipe insulation.

"The piping insulation should be protected from sunlight, moisture, wind and solar radiation but also from personal who may step on it, run in to it with equipment, etc. and cause it to be damaged.

"Protective covering must also protect from physical damage so if the protection covering does get damaged from stepping on it, dropping tools on it, birds, lawn trimmers etc.it can be repaired or replaced.

Keeping the insulations thermal conductivity integrity and insuring the insulation system last the life of the mechanical system and avoiding the costly replacement of the insulation. Repairing pipe insulation is done with adhesives and then adhesive seams are left to weather exposure leading to degradation. The seams open sun and moisture damage the insulation system. Removable protection is vital to ensure insulation can retard heat and condensation to provide energy savings and safety.

Pipe insulation is sold in minimum 6 foot sections at Contractor supply Distributors

The proposal states that protection be removable no less than 6 feet from the equipment to allow equipment maintenance without having to destroy the insulation or purchase additional pipe insulation to replace. The intent is in the original 2012 IECC code proposal, the proponent's reason statement of this requirement EC207-09/10 stated this was to Harmonize the IECC with ASHRAE 90.1 the 2012 code the reason statement also stated -"All AC units require periodic maintenance. The frequency varies with how hard the unit operates, exterior temperature, preventive maintenance program, and many others. On every occasion, every maintenance provides an excuse for the Freon line insulation to be touched and removed." The intent is clear that the protection be removable and independent of the pipe insulation for maintenance without damaging the pipe insulation. Removing protection without damaging the insulation is stated in EC207-09/10 "Adhesives Tape is not permitted as it will limit maintenance and damage insulations permeability characteristics. Removal of tape damages the integrity of the original insulation into pieces, specially, if the insulation has reached thermo set state. The main reason for pitting and corrosion of the piping in refrigerant lines is moisture intrusion into the pipe insulation from the termination point that are not protected. The gap between the piping and insulation creates a pathway for moisture to run the length and damage the system. It only takes a 1% moisture gain to equal to a 7.5 % loss in thermal efficiency. "The most likely area of intrusion is at the insulation system penetration Points, gauges, attachments etc. If the integrity or exterior of the insulation system is not installed correctly and moisture sources are present, moisture will more than likely penetrate the insulation system. Moisture intrusion can negatively affect all aspects of the insulation system such as thermal values, which can have a direct impact on process control, energy cost, condensation, control, safety, the potential of mold development etc. Not to mention the potential of corrosion under the insulation (CUI)." Insulation, the Forgotten Technology for Energy Conservation 2007 ACEE

Bibliography: Howard Ahern
Airex Manufacturing

760-250-1625

howard.ahern@airexmfg.com

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change will not increase the cost of construction as removable protection has been used before and snice the IECC2012 when protection was required. In fact this will decrease the cost of construction on future equipment replacement and maintenance by nit having to replace pipe insulation.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal will clarify the intent of Section C403.12.3. The intent of these sections is not only protection of pipe insulation from weather but to insure the insulations thermal conductivity energy savings integrity lasts the life of the mechanical system asper the intent of the code.

Final Hearing Results

CEPI-80-21 AM

CEPI-82-21 Part I

Original Proposal

IECC®: C403.13.2, C403.13.3 (New), C403.13.3
Proponents: Nick Thompson, City of Aspen, Colorado Chapter of the ICC (nick.thompson@cityofaspen.com)

THIS IS A 2 PART PROPOSAL. PART I WILL BE HEARD BY THE IECC-COMMERCIAL COMMITTEE. PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Energy Conservation Code

C403.13.2 Snow- and ice-melt system controls. Snow- and ice-melting systems shall include automatic controls configured to shut off the system when the pavement temperature is above 50°F (10°C) and precipitation is not falling, and an automatic or manual control that is configured to shut off when the outdoor temperature is above 40°F (4°C).

Add new text as follows:

C403.13.3 Roof and gutter deicing controls. Roof and gutter deicing systems, including but not limited to self-regulating cable, shall include automatic controls that are configured to shut off the system when the outdoor temperature is above 40°F (4°C) and that include one of the following:

1. A moisture sensor configured to shut off the system in the absence of moisture, or
2. A daylight sensor or other means configured to shut off the system between sunset and sunrise.

Revise as follows:

~~C403.13.3~~ C403.13.4 **Freeze protection system controls.** Freeze protection systems, such as heat tracing of outdoor piping and heat exchangers, including self-regulating heat tracing, shall include automatic controls configured to shut off the systems when outdoor air temperatures are above 40°F (4°C) or when the conditions of the protected fluid will prevent freezing.

Reason: Roof and gutter deicing, often in the form of heat tape, is used to prevent ice dams in buildings with inadequate roof insulation, air sealing, and/or attic/roof surface ventilation. These systems use energy and are often left running at times that are unnecessary for ice dam prevention. The intent is to have automatic controls limit the system from running when either of two conditions is present. The first condition is when the outdoor temperature is above 40°F (4.8°C). For the second condition, there is an option to either provide a moisture sensor or a timer. Running heat tape all day and night can lead to melt cavities with an air space that can insulate the ice from the heat tape. Shutting the system off at night or using moisture control helps alleviate this issue. Moisture control works well if done just right but can be problematic in practice on roofs. A timer provides an option to avoid this concern. A daylight sensor option was considered but deemed inappropriate for high latitudes that may be in darkness all day long.

This language applies to both self-regulating type cable and standard cable. Self-regulating cable automatically adjusts the wattage based on temperature; as temperature decreases, the heat output of the cable increases. However, controls are needed as some current will still flow through at temperatures above 40°F (4.8°C) and the moisture/timer condition is needed to avoid air cavities.

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

Upfront cost will increase but will be made up for by reducing energy bills over the useful life of the system. Electric resistant heat is very expensive to run when it is not needed. Manual controls require user interaction which is unlikely to be effective. Anecdotally, many people have systems installed without automatic controls and then wonder why their electric bills are so high until they realize their heat tape system has been running all summer long.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: To clarify the original reason statement, ice damming can occur even on new buildings built to current code provisions, such as warm roofs that are unvented.

Final Hearing Results

CEPI-82-21 Part I	AM

CEPI-82-21 Part II

Original Proposal

IECC®: R403.9, R403.10 (New)

Proponents: Nick Thompson, City of Aspen, Colorado Chapter of the ICC (nick.thompson@cityofaspen.com)

2021 International Energy Conservation Code

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

Add new text as follows:

R403.10 Roof and gutter deicing controls. Roof and gutter deicing systems, including but not limited to self-regulating cable, shall include automatic controls configured to shut off the system when the outdoor temperature is above 40°F (4.8°C) maximum and shall include one of the following:

1. A moisture sensor configured to shut off the system in the absence of moisture, or
2. A programmable timer configured to shut off the system for 8 hours minimum at night.

Reason: Roof and gutter deicing, often in the form of heat tape, is used to prevent ice dams in buildings with inadequate roof insulation, air sealing, and/or attic/roof surface ventilation. These systems use energy and are often left running at times that are unnecessary for ice dam prevention. The intent is to have automatic controls limit the system from running when either of two conditions is present. The first condition is when the outdoor temperature is above 40°F (4.8°C). For the second condition, there is an option to either provide a moisture sensor or a timer. Running heat tape all day and night can lead to melt cavities with an air space that can insulate the ice from the heat tape. Shutting the system off at night or using moisture control helps alleviate this issue. Moisture control works well if done just right but can be problematic in practice on roofs. A timer provides an option to avoid this concern. A daylight sensor option was considered but deemed inappropriate for high latitudes that may be in darkness all day long.

This language applies to both self-regulating type cable and standard cable. Self-regulating cable automatically adjusts the wattage based on temperature; as temperature decreases, the heat output of the cable increases. However, controls are needed as some current will still flow through at temperatures above 40°F (4.8°C) and the moisture/timer condition is needed to avoid air cavities.

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

Upfront cost will increase but will be made up for by reducing energy bills over the useful life of the system. Electric resistant heat is very expensive to run when it is not needed. Manual controls require user interaction which is unlikely to be effective. Anecdotally, many people have systems installed without automatic controls and then wonder why their electric bills are so high until they realize their heat tape system has been running all summer long.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: the proposal reduces costs for occupants.

Final Hearing Results

CEPI-82-21 Part II	AS

CEPI-83-21

Original Proposal

IECC®: SECTION 202 (New), C403.15 (New), DoD (New)

Proponents: Nicholas O'Neil, Energy 350, NEEA (noneil@energy350.com); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new definition as follows:

BEST EFFICIENCY POINT (BEP). The pump hydraulic power operating point (consisting of both flow and head conditions) that results in the maximum efficiency.

CLEAN WATER PUMP. A device that is designed for use in pumping water with a maximum nonabsorbent free solid content of 0.016 lb/ft^3 (0.256 kg/m^3) and with a maximum dissolved solid content of 3.1 lb/ft^3 (49.66 kg/m^3), provided that the total gas content of the water does not exceed the saturation volume, and disregarding any additives necessary to prevent the water from freezing at a minimum of 14°F (-10°C).

Add new text as follows:

C403.15 Clean water pumps. *Clean water pumps* meeting all the following criteria shall achieve a PEI rating not greater than 1.0:

1. Shaft input power is greater than or equal to 1.0 hp (0.75 kW) and less than or equal to 200 hp (149.1 kW) at its BEP.
2. Designated as either an End suction Close-coupled, End Suction Frame Mounted, In-line, Radially Split Vertical, or Submersible Turbine pump.
3. A flow rate of 25 gal/min (1.58 L/s) or greater at its*best efficiency point (BEP)* at full impeller diameter
4. Maximum head of 459 ft at its *BEP* at full impeller diameter and the number of stages required for testing
5. Design temperature range from 14°F (-10°C) to 248°F (120°C)
6. Designed to operate with either:
   6.1. a 2- or 4-pole induction motor, or
   6.2. a non-induction motor with a speed of rotation operating range that includes speeds of rotation between 2880 and 4320 rpm and/or 1440 and 2160 rpm, and
   6.3. in either (1) or (2), the driver and impeller must rotate at the same speed
7. For submersible turbine pumps, a 6 inches (152 mm) or smaller bowl diameter
8. For end-suction close-coupled pumps and end-suction frame-mounted/own bearings pumps, specific speed less than or equal to 5000 rpm when calculated using U.S. customary units

Exceptions: The following pumps are exempt from these requirements:

1. Fire pumps
2. Self-priming pumps
3. Prime-assisted pumps
4. Magnet-driven pumps

5. Pumps designed to be used in a nuclear facility subject to 10 CFR 50, “Domestic Licensing of Production and Utilization Facilities.”
6. Pumps meeting the design and construction requirements set forth in U.S. Military Specification MIL-P-17639F, “Pumps, Centrifugal, Miscellaneous Service, Naval Shipboard Use” (as amended); MIL-P-17881D, “Pumps, Centrifugal, Boiler Feed, (Multi-Stage)” (as amended); MIL-P-17840C, “Pumps, Centrifugal, Close-Coupled, Navy Standard (For Surface Ship Application)” (as amended); MIL-P-18682D, “Pump, Centrifugal, Main Condenser Circulating, Naval Shipboard” (as amended); MIL-P-18472G, “Pumps, Centrifugal, Condensate, Feed Booster, Waste Heat Boiler, And Distilling Plant” (as amended).

Add new definition as follows:

PUMP ENERGY INDEX (PEI). The ratio of a pump’s energy rating divided by the energy rating of a minimally compliant pump. For pumps with the constant load operating mode, the relevant PEI is PEI_{CL}. For pumps with the variable load operating mode, the relevant PEI is PEI_{VL}.

Add new text as follows:

DoD MIL-P-17639F (1996). Pumps, Centrifugal, Miscellaneous Service, Naval Shipboard Use

DoD MIL-P-17840C (1986). Pumps, Centrifugal, Close-Coupled, Navy Standard (For Surface Ship Application)

DoD MIL-P-17881D (1972). Pumps, Centrifugal, Boiler Feed (Multi-Stage)

DoD MIL-P-18472 (1989). Pumps, Centrifugal, Condensate, Feed Booster, Waste Heat Boiler, and Distilling Plant

DoD MIL-P-18682D. Pump, Centrifugal, Main Condenser Circulating, Naval Shipboard

Reason: As of January 27th, 2020, DOE published new minimum efficiency requirements for clean-water pumps which increased the minimum efficiency requirements for commercial and industrial pumping applications. This requirement applies to all pumps manufactured on or after January 27, 2020.

To rate the energy performance of pumps, the DOE established a new metric, the pump energy index (PEI). A value of PEI greater than 1.00 indicates the pump does not comply with the energy conservation standard, while a value less than 1.00 indicates the pump is more efficient than the standard requires. A pump model is considered compliant if its PEI rating is less than or equal to the adopted standard. The DOE based its final rule on the test methods recommended by the Hydraulic Institute and contained in its “Methods for Rotodynamic Pump Efficiency Testing.” THis PEI rating is now included on pump submittals as manufacturers have had 4 years to comply with the standard.

The methodology, requirements, and exceptions contained in this proposal mirror what is already included in ASHRAE 90.1-2019 and what is required by DOE to demonstrate compliance. Listing them in the IECC will provide designers with the necessary information on how to calculate PEI and which pumping systems are required to comply.

Bibliography: DEPARTMENT OF ENERGY 10 CFR Parts 429 and 431 [Docket Number EERE-2011-BT-STD-0031] RIN 1904-AC54
https://www.energy.gov/sites/prod/files/2015/12/f28/Pumps%20ECS%20Final%20Rule.pdf

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
As this proposal simply includes the minimum efficiency provisions adopted by DOE for clean water pumps, there it will not increase or decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Simplified version preferred by the committee. The methodology, requirements, and exceptions contained in this proposal mirror what is already included in ASHRAE 90.1-2019 and what is required by DOE to demonstrate compliance. Listing them in the IECC will provide designers with the necessary information on how to calculate PEI and which pumping systems are required to comply.

Final Hearing Results	
CEPI-83-21	AM

CEPI-84-21

Original Proposal

IECC®: SECTION 202 (New), C403.15 (New), DOE Chapter 06

Proponents: Diana Burk, New Buildings Institute, New Buildings Institute (diana@newbuildings.org)

2021 International Energy Conservation Code

Add new definition as follows:

INDOOR GROW. a space, other than a greenhouse, used exclusively for, and essential to horticultural production, cultivation or maintenance.

DESSICANT DEHUMIDIFICATION SYSTEM. A mechanical dehumidification technology that uses a solid or liquid material to remove moisture from the air.

INTEGRATED HVAC SYSTEM. An HVAC system designed to handle both sensible and latent heat removal. Integrated HVAC systems include, but are not limited to HVAC systems with a sensible heat ratio of 0.65 or less and the capability of providing cooling, dedicated outdoor air systems, single package air conditioners with at least one refrigerant circuit providing hot gas reheat, and *dehumidifiers* modified to allow external heat rejection.

DEHUMIDIFIER. A self-contained, electrically operated, and mechanically encased product with the sole purpose of dehumidifying the space consisting of:

1. A refrigerated surface (evaporator) that condenses moisture from the atmosphere,
2. A refrigerating system, including an electric motor,
3. An air-circulating fan, and
4. A means for collecting or disposing of the condensate.

A dehumidifier does not include a portable air conditioner, room air conditioner, or packaged terminal air conditioner.

Add new text as follows:

C403.15 Dehumidification in spaces for plant growth and maintenance. Equipment that dehumidifies *indoor grow* and *greenhouse* spaces shall be one or more of the following:

1. *Dehumidifiers*tested in accordance with the test procedure listed in DOE 10 CFR 430 and DOE 10 CFR 430, Subpart B, Appendix X or X1.
2. *Integrated HVAC system* with on-site heat recovery designed to fulfill not less than 75 percent of the annual energy for dehumidification reheat;
3. Chilled water system with on-site heat recovery designed to fulfill not less than 75 percent of the annual energy for dehumidification reheat; or
4. Solid or liquid *desiccant dehumidification system* for system designs that require dewpoint of not more than 50°F (10°C).

-

Revise as follows:

DOE

US Department of Energy
c/o Superintendent of Documents 1000 Independence Avenue SW
Washington, DC 20585

10 CFR, Part 430–2015	Energy Conservation Program for Consumer Products: Test Procedures and Certification and Enforcement Requirement for Plumbing Products; and Certification and Enforcement Requirements for Residential Appliances; Final Rule Table C403.3.2(1), Table C403.3.2(2), Table C403.3.2(5), Table C403.3.2(6), Table C403.3.2(14), Table C404.2, C403.15

Reason: Indoor agriculture energy usage is projected to grow significantly nationwide in this decade, driven in large part by state legalization of medical and recreational marijuana across the country. In 2017, a total of 20 million square feet of building space was dedicated to growing crops indoors. Energy use by HVAC systems in indoor horticulture facilities can account for 30 to 65% of energy use - primarily because these systems must maintain specific humidity and temperature levels to promote plant growth. Section 403 already requires HVAC systems meet a certain efficiency threshold but does not address the efficiency of dehumidification systems.

The proposed language provides projects with a range of efficient dehumidification strategies. Indoor grow facilities can install dehumidifiers that meet federal minimum efficiency requirements. The proposal also provides options for solid or liquid desiccant dehumidification systems, for utilizing recovered energy in integrated HVAC systems, and for chilled water systems that can meet dehumidification reheat needs.

This proposal is based largely on the requirements listed in Section 120.6(h)1 ofTitle 24-2022 and is similar to requirements adopted in Denver, CO and being considered for adoption in Washington State, Michigan, and Illinois.

Bibliography: *Energy Savings Potential of SSL in Horticultural Applications*. U.S. Department of Energy, Dec. 2017, https://www.energy.gov/sites/prod/files/2017/12/f46/ssl_horticulture_dec2017.pdf.

Schimelpfenig, Gretchen. *Energy Efficiency for Massachusetts Marijuana Cultivators*, Resource Innovation Institute, Sept. 2020, resourceinnovationinstitute.wildapricot.org/RII-REPORTS/.

Final CASE Report: Controlled Environment Horticulture, California Statewide Codes and Standards Enhancement (CASE) Program, Oct. 2020, https://title24stakeholders.com/wp-content/uploads/2020/10/2022-T24-NR-CEH-Final-CASE-Report.pdf.

15-Day Express Terms 2022 Energy Code - Residential and Nonresidentia,*l* California Energy Commission, 14 July 2021, https://efiling.energy.ca.gov/GetDocument.aspx?tn=238848.

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

The incremental cost of installing more efficient dehumidification systems is around $8.11 per square foot of canopy. This measure results in significant energy savings of between 212 to 255 TDV kBtu/yr per square foot of canopy in Climate Zones 2-4. Every dollar spent to install more efficient equipment resulted in between $2.33 and $2.80 in operating and maintenance cost savings over the life of the system.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Section 403 already requires HVAC systems meet a certain efficiency threshold but does not address the efficiency of dehumidification systems. The proposed language provides projects with a range of efficient dehumidification strategies.

Final Hearing Results

CEPI-84-21 AM

CEPI-85-21

Original Proposal

IECC®: C403.16 (New)

Proponents: Nicholas O'Neil, Energy 350, NEEA (noneil@energy350.com); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new text as follows:

C403.16 Service Water Pressure-Booster Systems. Service water pressure-booster *systems* shall be designed such that the following apply:

1. One or more pressure sensors shall be used to vary pump speed and/or start and stop pumps. The sensors shall either be located near the critical fixtures that determine the pressure required, or logic shall be employed that adjusts the set point to simulate operation of remote sensors.
2. No devices shall be installed for the purpose of reducing the pressure of all of the water supplied by any booster*system* pump or booster *system*, except for safety devices.
3. No booster *system* pumps shall operate when there is no service water flow.

Reason: The IECC does not have any requirements over pressure boost system operation currently. ASHRAE has had these requirements in place since 90.1-2010 and found them to be a cost-effective requirement for new buildings. Many modern pressure boost systems already comply with ASHRAE standards and have the sensor controls on-board, eliminating the need for a field mounted remote pressure sensor. Furthermore, the energy savings from variable speed pressure boost systems can be substantial, ranging from 20%-50% (depending on the type of pressure control method) as shown in the attached whitepaper.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Modern pressure boost systems have software to control logic on the booster pump skid that adjusts the set point to simulate the operation of remote sensor, foregoing the need to install a remote pressure sensor at the critical fixtures.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The IECC does not have any requirements over pressure boost system operation currently. ASHRAE has had these requirements in place since 90.1-2010 and found them to be a cost-effective requirement for new buildings. Many modern pressure boost systems already comply with ASHRAE standards and have the sensor controls on-board, eliminating the need for a field mounted remote pressure sensor. Furthermore, the energy savings from variable speed pressure boost systems can be substantial, ranging from 20%- 50% (depending on the type of pressure control method).

Final Hearing Results

CEPI-85-21	AS

CEPI-86-21

Original Proposal

IECC®: C403.2.3, C406.11

Proponents: William Fay, Energy Efficient Codes Coalition (bill@energyefficientcodes.org); Amy Boyce, Institute for Market Transformation, Energy Efficient Codes Coalition (amy.boyce@imt.org); Jason Reott, Alliance to Save Energy, Energy Efficient Codes Coalition

2021 International Energy Conservation Code

Revise as follows:

C403.2.3 Fault detection and diagnostics. ~~New buildings with anone or more HVAC systemsystems serving a gross conditioned floor area of 100,000 square feet (9290 m~~^{2}~~) or larger and controlled by a direct digital control (DDC) systemshall include a fault detection and diagnostics (FDD) system to monitor the HVAC system's performance and automatically identify faults. The FDD system shall:~~ Buildings with gross conditioned floor area of not less than 100,000 square feet (9290 m^{2}) served by one or more HVAC systems that are controlled by a direct digital control (DDC) system shall include a fault detection and diagnostics (FDD) system to monitor ~~the~~ HVAC system~~'s~~ performance and automatically identify faults. The FDD system shall:

1. Include permanently installed sensors and devices to monitor ~~the~~ HVAC system~~'s~~ performance.
2. Sample ~~the~~ HVAC system~~'s~~ performance at least once every 15 minutes.
3. Automatically identify and report HVAC system faults.
4. Automatically notify authorized personnel of identified HVAC system faults.
5. Automatically provide prioritized recommendations for repair of identified faults based on analysis of data collected from the sampling of HVAC system performance.
6. Be capable of transmitting the prioritized fault repair recommendations to remotely located authorized personnel.

Exception: R-1 and R-2 occupancies.

C406.11 Fault detection and diagnostics system. A fault detection and diagnostics system shall be installed to monitor ~~the~~ HVAC system ~~'s~~ performance and automatically identify faults. The system shall do all of the following:

1. Include permanently installed sensors and devices to monitor ~~the~~ HVAC system~~'s~~ performance.
2. Sample ~~the~~ HVAC system~~'s~~ performance at least once every 15 minutes.
3. Automatically identify and report HVAC system faults.
4. Automatically notify authorized personnel of identified HVAC system faults.
5. Automatically provide prioritized recommendations for repair of identified faults based on analysis of data collected from the sampling of ~~the~~ HVAC system performance.
6. Be capable of transmitting the prioritized fault repair recommendations to remotely located authorized personnel.

Reason: The purpose of this proposal is to clarify the code provisions related to Fault Detection and Diagnostics (FDD) systems. This proposal does not change any requirements of the code, but will make compliance and enforcement more straightforward. Since the FDD provisions were added to the 2021 IECC, some code users have questioned whether the existing language could be interpreted in a way that allows buildings with multiple HVAC systems to avoid complying with the requirement, and whether a building with no direct digital control system (DDC) should be required to comply. This code change proposal clarifies the original intent of the proposal, which is to require all new buildings with HVAC systems (whether a single HVAC system or multiple systems) serving at least 100,000 square feet of conditioned floor area--and controlled by a direct digital control (DDC) system--to include an FDD system. If the building does not include a

DDC system, the FDD requirement does not apply.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Because this code change proposal does not introduce any new measures into the code, but simply clarifies the intent of the requirement, there is no impact on cost of construction.

COST-EFFECTIVENESS

Because this code change proposal does not change the requirements of the code, a cost-effectiveness analysis does not apply.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Good clarifications that will improve enforcement.

Final Hearing Results

CEPI-86-21	AS

CEPI-97-21

Original Proposal

IECC®: SECTION 202 (New), C403.3.4 (New), C403.3.4.1 (New), TABLE C403.3.4.1 (New), C403.3.4, TABLE C403.3.4

Proponents: Nicholas O'Neil, Energy 350, NEEA (noneil@energy350.com); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new definition as follows:

PROCESS APPLICATION. A manufacturing, industrial, or commercial procedure or activity where the primary purpose is other than conditioning spaces and maintaining comfort and amenities for the occupants of a building.

Add new text as follows:

C403.3.4 Boilers. *Boiler Systems* shall comply with the following:

1. Combustion air positive shut-off shall be provided on all newly installed*boiler systems* as follows:
   - 1.1. All *boiler systems* with an input capacity of 2,500,000 Btu/h (732 kW) and above, in which the boiler is designed to operate with a nonpositive vent static pressure.
   - 1.2. All *boiler systems* where one stack serves two or more boilers with a total combined input capacity per stack of 2,500,000 Btu/h (732 kW).

2. *Boiler system* combustion air fans with motors 10 horsepower (7.46 kW) or larger shall meet one of the following for newly installed boilers:
   - 2.1. The fan motor shall be variable speed, or
   - 2.2. The fan motor shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume.

C403.3.4.1 Boiler oxygen concentration controls. Newly installed boilers with an input capacity of 5,000,000 Btu/h (1465 kW) and steady state full-load less than 90 percent shall maintain stack-gas oxygen concentrations not greater than the values specified in Table C403.3.4.1. Combustion air volume shall be controlled with respect to measured flue gas oxygen concentration. The use of a common gas and combustion air control linkage or jack shaft is prohibited.

TABLE C403.3.4.1 BOILER OXYGEN CONCENTRATIONS

Boiler System Application	**Minimum stack-gas oxygen concentration**[a]
≤ 10% of the boiler system capacity is used for*process applications* at design conditions	5%
Process Boilers	3%

a. Concentration levels measured by volume on a dry basis over firing rates of 20 to 100 percent.
Exception: These concentration limits do not apply 50 percent or more of the boiler system capacity serves Group R-2 occupancies.

Revise as follows:

~~C403.3.4~~ C403.3.4.2 Boiler turndown. *Boiler systems* with design input of greater than 1,000,000 Btu/h (293 kW) shall comply with the turndown ratio specified in Table ~~C403.3.4~~ C403.3.4.2.The system turndown requirement shall be met through the use of multiple single-input boilers, one or more *modulating boilers* or a combination of single-input and *modulating boilers*.

TABLE ~~C403.3.4~~ C403.3.4.2 BOILER TURNDOWN

BOILER SYSTEM DESIGN INPUT (Btu/h)	MINIMUM TURNDOWN RATIO
≥ 1,000,000 and ≤ 5,000,000	3 to 1
> 5,000,000 and ≤ 10,000,000	4 to 1
> 10,000,000	5 to 1

For SI: 1 British thermal unit per hour = 0.2931 W.

Reason: Boiler oxygen controls, combustion air controls, and variable fan motors have been commonplace in state codes on larger boilers for quite some time. This proposal would align existing requirements in state codes with IECC. The effect will be an improvement in the part-load operation of larger boilers.
Savings are estimated at 2.116 kBtu/sqft and derived from the Title 24 CASE study as follows:

Flue damper – 2.5 mmbtu boiler 229 therms

VFD – 10 hp fan 4080 kWh

O2 trim controls – 5 mmBtu boiler 2746 therms

Based on EnergyPlus modeling of prototype buildings for California CASE study for 2022 Title 24. Savings shown above are an example assuming a large office building in CA Climate Zone 2 which is 13 stories. Provisions shown to be cost-effective for commercial boilers in all modeled scenarios except mixed use and apartment high-rise. Process boilers shown to be cost-effective in all cases due to constant load assumptions.

Final CASE report available here: https://title24stakeholders.com/wp-content/uploads/2020/08/NR-Boilers-and-Water-Heating_Final-CASE-Report.pdf

Bibliography: Codes and Standards Enhancement (CASE) Initiative 2022 California Energy Code - High Efficiency Boilers and Service Water Heating, 2022-NR-HVAC3-F Final Case Report, August 2020

Cost Impact: The code change proposal will increase the cost of construction.
Expected cost to implement boiler controls is estimated at $0.098/sqft and derived from the Title 24 CASE study as follows:

Flue damper cost = $1665 ($1500 2013 inflated 11% to 2021) + $166 ($150 2013 inflated 11%) every 10 years
VFD cost = $4716 ($4249 2013 inflated 11% to 2021) + ½ hour per year in maintenance @$100/hr
O2 trim controls cost = $7500 (2022) + 4 hours per year in maintenance @$100/hr

https://title24stakeholders.com/wp-content/uploads/2020/08/NR-Boilers-and-Water-Heating_Final-CASE-Report.pdf

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Boiler oxygen controls, combustion air controls, and variable fan motors have been commonplace in state codes on larger boilers for

quite some time. This proposal would align existing requirements in state codes with IECC. The effect will be an improvement in the part-load operation of larger boilers.

Final Hearing Results	
CEPI-97-21	AM

CEPI-99-21

Original Proposal

IECC®: SECTION 202 (New), C403.4, C403.4.6 (New), C403.4.6.1 (New), C403.4.6.2 (New), AHRI Chapter 06 (New), ANSI Chapter 06 (New), IEC (New), OpenADR (New)

Proponents: Kim Cheslak, NBI, NBI (kim@newbuildings.org); Josh Keeling, Cadeo Group, Cadeo Group (jkeeling@cadeogroup.com); Ben Rabe, Fresh Energy (rabe@fresh-energy.org); Bryan Bomer, Department of Permitting Services, Montgomery County MD, Department of Permitting Services (bryan.bomer@montgomerycountymd.gov); Lauren Urbanek, Natural Resources Defense Council (lurbanek@nrdc.org); Howard Calvert Wiig, Hawaii State Energy Office, Hawaii State Energy Office (howard.c.wiig@hawaii.gov); Kim Burke, State of Colorado, Colorado Energy Office (kim.burke@state.co.us); Brad Smith, City of Fort Collins (brsmith@fcgov.com); Matthew Tidwell, Portland General Electric, Portland General Electric (matthew.tidwell@pgn.com); Chris Castro, City of Orlando, City of Orlando (chris.castro@orlando.gov); Amber Wood, ACEEE, ACEEE (awood@aceee.org)

2021 International Energy Conservation Code

Add new definition as follows:

DEMAND RESPONSE SIGNAL. A signal that indicates a price or a request to modify electricity consumption.

DEMAND RESPONSIVE CONTROL. A control capable of receiving and automatically responding to a*demand response signal*.

Revise as follows:

C403.4 Heating and cooling system controls. ~~Each h~~Heating and cooling system shall be provided with controls in accordance with Sections C403.4.1 through ~~C403.4.5~~C403.4.6.

Add new text as follows:

C403.4.6 Demand responsive controls. Buildings shall be provided with demand responsive controls capable of executing the following actions in response to a demand response signal:

1. Automatically increasing the zone operating cooling set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).
2. Automatically decreasing the zone operating heating set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).

Where a *demand response signal* is not available the heating and cooling system controls shall be capable of performing all other functions. Where thermostats are controlled by *direct digital control* including, but not limited to, an energy management system, the system shall be capable of *demand responsive control* and capable of adjusting all thermal setpoints to comply. The demand responsive controls shall comply with either Section C403.4.6.1 or Section C403.4.6.2

Exceptions:

1. Group I occupancies
2. Group H occupancies
3. Controls serving *data center systems*
4. Occupancies or applications requiring precision in indoor temperature control as*approved* by the *code official*
5. Controls that serve only fossil fuel equipment

C403.4.6.1 Air conditioners and heat pumps with two or more stages of control and cooling capacity of less than 65,000 Btu/h.

Thermostats for Air conditioners and heat pumps with two or more stages of control and a cooling capacity less than 65,000 Btu/h (19 kW) shall be provided with a *demand responsive control* that complies with the communication and performance requirements of AHRI 1380.

C403.4.6.2 All other HVAC systems. Thermostats for HVAC systems shall be provided with a*demand responsive control* that complies with one of the following:

1. Certified OpenADR 2.0a VEN, as specified under Clause 11, Conformance
2. Certified OpenADR 2.0b VEN, as specified under Clause 11, Conformance
3. Certified by the manufacturer as being capable of responding to a demand response signal from a certified OpenADR 2.0b VEN by automatically implementing the control functions requested by the VEN for the equipment it controls
4. IEC 62746-10-1
5. The communication protocol required by a controlling entity, such as a utility or service provider, to participate in an automated demand response program
6. The physical configuration and communication protocol of CTA 2045-A or CTA 2045-B.

Add new standard(s) as follows:

AHRI

Air-Conditioning, Heating, & Refrigeration Institute
2111 Wilson Blvd, Suite 500
Arlington, VA 22201

1380-2019	Demand Response through Variable Capacity HVAC Systems in Residential and Small Commercial Applications

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

ANSI/CTA-2045-A-2018	Modular Communications Interface for Energy Management
ANSI/CTA-2045-B-2019	Modular Communications Interface for Energy Management

Add new text as follows:

IEC IEC Regional Centre for North America. IEC 62746-10-1 - 2018 Systems interface between customer energy management system and the power management system – Part 10-1: Open automated demand response

OpenADR OpenADR OpenADR Alliance . OpenADR 2.0a and 2.0b – 2019: Profile Specification Distributed Energy Resources

Reason: Grid-integrated controls for thermostats are added based on language from California Title 24 and ASHRAE Standard 189.1. Any thermostat listed as “Title 24 compliant” would meet this requirement. The controls allow for dialing back heating and cooling, as well as to accept additional heating or cooling when renewable energy generation is high or energy prices are low, and both ramp up and down requirements in relationship to the utility/grid operator/third party aggregator signal to prevent rebound issues on the grid after the signal is released.

In health care and assisted living facilities, thermostat setpoints can impact more than just thermal comfort, and temperature can be part of the health care being provided. To ensure that this requirement cannot have an adverse impact on those services, these facilities have been exempted from this requirement.

HVAC system control, often through thermostats, has been at the center of demand response (DR) programs for decades. DR programs continue to rely deeply on thermostat control strategies, but the need for such controls is fast growing. As electricity systems transform to include more variable wind and solar energy, demand flexibility becomes increasingly critical to both grid operation and further transformation. Building systems that can use energy when it is abundant, clean, and low-cost not only help decarbonize the entire energy system, they also insulate their owners from future increases in demand charges and peak hour energy rates – a current and accelerating trend.

Today's demand response programs typically set event (call) durations between 15 minutes and 4 hours. The preconditioning strategies (cooling set point reduction / heating set point increase) and temporary setback strategies (cooling set point increase / heating set point reduction) will enable substantial HVAC system energy savings over this time frame. In many cases, in a building compliant with this code, tenants are unlikely to even notice a change in their thermal comfort. The inclusion of preconditioning helps ensure that the building is able to reduce electrical demand by adjusting HVAC setpoints while minimizing the risk of tenant disruption: in many cases the event will end before the higher cooling (or lower heating) set point is reached in the space.

Based on modeling by LBNL (foundational modeling supporting the May 2021 DOE Grid-integrated Efficient Buildings Roadmap), thermostat controls configured to deliver preconditioning and/or space temperature adjustments can reduce building peak demand by roughly 10% in many cases.

Bibliography: A National Roadmap for Grid-Interactive Efficient Buildings, U.S. Department of Energy, 17 May 2021, https://gebroadmap.lbl.gov/A%20National%20Roadmap%20for%20GEBs%20-%20Final.pdf.
Final CASE Report: Upgradeable Setback Thermostats, California Statewide Codes and Standards Enhancement (CASE) Program, October 2011, https://title24stakeholders.com/wp-content/uploads/2020/01/2013_CASE-Report_Upgradeable-Setback-Thermostats.pdf

SupplyHouse. "T3700 - Venstar T3700 - Explorer T3700 Residential Digital Thermostat (2 Heat, 1 Cool)." SupplyHouse.com, www.supplyhouse.com/Venstar-T3700-Explorer-T3700-Residential-Digital-Thermostat-2-Heat-1-Cool. SupplyHouse. "T1010 - Venstar T1010 -Single Day Programmable Digital Thermostat" SupplyHouse.com, https://www.supplyhouse.com/Venstar-T1010-Venstar-T1010-Single-Day-Programmable-Digital-Thermostat

https://www.homedepot.com/p/Honeywell-Home-Wi-Fi-7-Day-Programmable-Smart-Thermostat-with-Digital-Backlit-Display-RTH6580WF/203556922https://www.homedepot.com/p/Honeywell-Home-5-1-1-Day-Programmable-Thermostat-with-Digital-Backlit-Display-RTH2410B/203539465?ITC=AUC-63044-23-12070

2017 Tier III TRM Characterizations, Advanced Thermostat *https://publicservice.vermont.gov/sites/dps/files/documents/2017%20Tier%20III%20TRM%20Characterizations.pdf.*

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

For larger commercial buildings with building management systems, it is not common to install a thermostat without demand response capabilities. Therefore, there is no incremental equipment cost associated with this measure for those building types. However, there could be soft costs to ensure those demand responsive controls function properly with the building management system. Conversations with industry experts indicate these soft costs can be around $0.25/s.f. for a medium office building. The primary cost drivers in thermostats are not the grid-integration controls but rather other features. Therefore, incremental costs vary. An entry-level grid-integrated thermostat currently available from a national retailer costs about $70, while the same retailer lists a similar non-grid-integrated programmable unit for just over $35, indicating an incremental cost of about $35. This cost has dropped in the last (X years) – A 2017 study out of Vermont cited incremental costs for smart thermostats in new construction at roughly $150 – *a decrease in incremental costs of $115 over just 4 years.*

However, smart thermostats (i.e., those with grid-integrated controls) are very common in new construction and represent a growing share of the retrofit market. All major smart thermostat brands already include grid-integration controls that comply with this requirement, so there is generally no incremental cost to include these controls assuming a smart thermostat is installed either based on customer preference or efficiency requirements.

Multifamily buildings and smaller commercial buildings that install direct-attached thermostats, demand responsive thermostats (which were estimated in a 2011 study to cost $68 more than a programmable thermostat) were found to be extremely cost effective. It was estimated that installing demand responsive thermostats in a 10,000 s.f. office building resulted in 83kWh to 274 kWh of electricity savings and between 0.19 to 1.97kW in demand savings in Climate Zones 2-4. Every dollar spent on demand responsive thermostats yielded between $1.20 to $7 in operating cost savings over a 15-year period for office buildings. In the 10 years since, equipment prices have decrease and incremental costs are estimated to be only $40 making this measure even more cost effective than estimated previously for buildings without building management systems. This measure will not only result in cost savings for consumers but will also result in other significant societal benefits. According to DOE's report, "A National Roadmap for Grid-Interactive Efficient Buildings," every watt in peak demand savings was found to create 17 cents in annual electric grid system value. This value included energy savings, capacity savings, transmission deferral and ancillary services. A 10,000 square foot office building with a demand responsive thermostat which is estimated to reduce peak demand savings between 0.26 to 1.09kW would result in $44 to $334 in annual electric grid system value. Demand responsive thermostats which allow grid operators to reduce demand on the grid during the times when the carbon intensity of the electric grid is high also results in reduced carbon emissions generating additional significant societal benefits.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: HVAC system control, often through thermostats, has been at the center of demand response (DR) programs for decades. DR programs continue to rely deeply on thermostat control strategies, but the need for such controls is fast growing.

Final Hearing Results

CEPI-99-21 AM

CEPI-100-21

Original Proposal

IECC®: C403.4.2.3

Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Revise as follows:

C403.4.2.3 ~~Automatic~~Optimum start and stop.

~~Automatic~~ Optimum start and stop controls shall be provided for each HVAC systemwith direct digital control of individual zones. The ~~automatic~~optimum start controls shall be configured to automatically adjust the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy. ~~Automatic stop controls shall be provided for each HVAC system with direct digital control of individual *zones*.~~ The ~~automatic~~ optimum stop controls shall be configured to reduce the HVAC system's heating temperature setpoint and increase the cooling temperature setpoint by not less than 2°F (~~-16.6~~1.11ºC) before scheduled unoccupied periods based on the thermal lag and acceptable drift in space temperature that is within comfort limits.

Exception: *Dwelling units* and sleeping units are not required to have optimum start controls.

Reason: Based on addendum r to 90.1-2019.

This proposal:

1. Exempts residential occupancies because they do not start and stop equipment based on an occupancy schedule to which the requirement can be applied.
2. Makes an editorial change to make it clear that this applies to DDC-controlled systems. Though there are non-DDC systems that have a primitive automatic start and stop optimization capability, their savings are unproven.

Bibliography: ANSI/ASHRAE/IES Standard 90.1-2019 Energy Standard for Buildings Except Low-Rise Residential Buildings, Addendum r https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda/addenda-to-standard-90-1-2019

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

As it is unlikely that automatic start and stop is applied to Group R occupancies in practice, this exception will likely not have an effect on the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Based on addendum r to 90.1-2019.

This proposal:

Exempts residential occupancies because they do not start and stop equipment based on an occupancy schedule to which the requirement can be applied.

Makes an editorial change to make it clear that this applies to DDC-controlled systems. Though there are non-DDC systems that have a primitive automatic start and stop optimization capability, their savings are unproven.

Final Hearing Results

CEPI-102-21

Original Proposal

IECC®: SECTION 202 (New), C403.4.6 (New), C403.4.6.1 (New), C403.4.6.2 (New), C403.4.6.3 (New)

Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Add new definition as follows:

HUMIDISTATIC CONTROLS. Automatic controls used to maintain humidity at a fixed or adjustable setpoint.

Add new text as follows:

C403.4.6 Humidification and dehumidification controls.. Humidification and dehumidification controls shall be in accordance with this section.

C403.4.6.1 Dehumidification. *Humidistatic controls* shall not use mechanical cooling to reduce the humidity below the lower of a dew point of 55°F or relative humidity of 60% in the coldest zone served by the system. Lower humidity shall be permitted where mechanical cooling is being used for temperature control.

Exceptions:

1. Where approved, systems serving zones where specific humidity levels are required, such as museums and hospitals, and where *humidistatic controls* are capable of and configured to maintain a dead band of at least 10% relative humidity where no active humidification or dehumidification takes place.
2. Systems serving zones where humidity levels are required to be maintained with precision of not more than ±5% relative humidity to comply with applicable codes or accreditation standards or as approved by the authority having jurisdiction.

C403.4.6.2 Humidification. *Humidistatic controls* shall not use fossil fuels or electricity to produce relative humidity above 30% in the warmest zone served by the system.

Exceptions:

1. Where approved, systems serving zones where specific humidity levels are required, such as museums and hospitals, and where *humidistatic controls* are capable of and configured to maintain a dead band of at least 10% relative humidity where no active humidification or dehumidification takes place.
2. Systems serving zones where humidity levels are required to be maintained with precision of not more than ±5% relative humidity to comply with applicable codes or accreditation standards or as approved by the authority having jurisdiction.

C403.4.6.3 Control Interlock. Where a zone is served by a system or systems with both humidification and dehumidification capability, means such as limit switches, mechanical stops, or, for DDC systems, software programming shall be provided capable of and configured to prevent simultaneous operation of humidification and dehumidification equipment.

Exception: Systems serving zones where humidity levels are required to be maintained with precision of not more than ±5% relative humidity to comply with applicable codes or accreditation standards or as approved by the authority having jurisdiction.

Reason: The proposal adds requirements for control of HVAC systems when they are explicitly controlled to maintain humidity at maximum or minimum values or within a range.They prevent wasting of energy by dehumidifying or humidifying beyond the requirements for human comfort and health. Exceptions that allow designers to meet other code or accreditation requirements are included. These requirements do not apply when the space is only controlled by a thermostat and dehumidification is incidental to the cooling.

These requirements have been in ASHRAE 90.1 for many years. The text was updated in the 2019 version of the standard for clarity, including an informative note that explains lower humidity levels are allowed when the space conditions are controlled based on temperature.

Bibliography: ANSI/ASHRAE/IES Standard 90.1-2019 Energy Standard for Buildings Except Low-Rise Residential Buildings

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal does not require the use of humidistatic controls nor does it require equipment with capacities that are greater than a designer would have otherwise selected.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal would prevent wasting of energy by dehumidifying or humidifying beyond the requirements for human comfort and health. Exceptions that allow designers to meet other code or accreditation requirements are included. This proposal creates alignment with existing ASHRAE 90.1 requirements.

Final Hearing Results

CEPI-102-21	AM

CEPI-103-21

Original Proposal

IECC®: C403.5

Proponents: John Bade, 2050 Partners, California Investor Owned Utilities (johnbade@2050partners.com)

2021 International Energy Conservation Code

Revise as follows:

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

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

Exceptions: Economizers are not required for the following systems.

1. Individual fan systems not served by chilled water for buildings located in*Climate Zones* 0A, 0B, 1A and 1B.
2. Where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (1.7°C) dew-point temperature to satisfy process needs.
3. Systems expected to operate less than 20 hours per week.
4. Systems serving supermarket areas with open refrigerated casework.
5. Where the cooling efficiency is greater than or equal to the efficiency requirements in Table C403.5(2).
6. Systems that include a heat recovery system in accordance with Section C403.10.5.
7. ~~VRF systems~~ Direct-expansion fancoils or unitary equipment with a capacity less than 54,000 Btu/h (15.8 kW) and multiple stages of compressor capacity installed with a dedicated outdoor air system.

Reason: The exemption from economizer requirements for variable refrigerant flow (VRF) systems employed with a dedicated outdoor air system added in IECC 2021 was reasonable. However, limiting the exception to only VRF systems created an unfair advantage in the market for those systems. Other zone-level DX fan coil systems with multi-stage compressors, such as water-source heat pumps, provide equal or better energy savings. This proposal levels the playing field and eliminates the need to provide water coils in those products.

The limit to fan coils with a capacity of less than 54,000 Btu/h aligns the exception with the requirements in the body. VRF systems tested under AHRI 1230 do not include fan coils with a capacity of 54,000 Btu/h or more, and engineering analysis indicates that VRF systems that employ such fan coils very likely do not operate at the same level of efficiency as those that employ smaller capacity coils.

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

This proposal will eliminate the need to provide economizer water coils in DX fan coils in non-VRF systems. Since the market share of VRF fan coils with a capacity of 54,000 Btu/h or greater is very small, the net change in cost to builders will be negative.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: proposal provides an exception for small units being used with DOAS and expands exception to WSHPs.

Final Hearing Results

CEPI-103-21	AM

CEPI-106-21

Original Proposal

IECC®: C403.5.3.4
Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Revise as follows:

C403.5.3.4 Relief of excess outdoor air. Systems shall ~~be~~provide one of the following means ~~capable of~~to ~~relieving~~ relieve excess *outdoor air* during air economizer operation to prevent overpressurizing the building.

1. Return or relief fan(s) meeting the requirements of Section C403.10.1.
2. Barometric or motorized damper relief path with a total pressure drop at design relief airflow rate less than 0.10 inches water column (25 Pa) from the occupied space to outdoors. Design relief airflow rate shall be the design supply airflow rate minus any continuous exhaust flows, such as toilet exhaust fans, whose makeup is provided by the economizer system.

The relief air outlet shall be located to avoid recirculation into the building.

Reason: Based on addendum g to ASHRAE 90.1-2019.

The current language in Section 403.5.3.4 is vague and unenforceable. Consequently, it is often ignored and violated. The language added in the proposal is specific and enforceable and will achieve the desired intent of the current language.When the relief path has a high static resistance, and the relief is not fan-powered, economizer use results in overpressurization of the building. When the building is overpressurized, occupants often have difficulty opening or closing doors and complain of high air velocities through openings to the outside. The problem is too often resolved by disabling economizer operation and losing the associated energy savings. Requiring return/relief fans or properly sized barometric relief will prevent overpressurization and thus save energy by allowing 100% economizing and eliminating the need for building operators to disable economizers.

Bibliography: ANSI/ASHRAE/IES Standard 90.1-2019 Energy Standard for Buildings Except Low-Rise Residential Buildings, Addendum g
https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda/addenda-to-standard-90-1-2019

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change only clarifies the requirements for the prevention of building overpressurization.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Based on addendum g to ASHRAE 90.1-2019.

Proposal will improve code clarity and enforceability and will lead to better economizer operation and achievement of associated energy savings.

Final Hearing Results

CEPI-107-21
Original Proposal

IECC®: C403.6.1, ASHRAE Chapter 06 (New)
Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Revise as follows:

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

1. ~~Twenty~~ Thirty percent of the zone design peak supply for systems ~~with~~ without *direct digital control* (DDC) ~~and 30 percent for other systems~~.
2. Systems with DDC where all of the following apply:
   - 2.1. The airflow rate in the deadband between heating and cooling does not exceed ~~20 percent of the zone design peak supply rate or~~ the ~~higher~~ highest of the allowed rates under Items 3, 4, ~~and~~ 5 , or 6 of this section.
   - 2.2. The first stage of heating modulates the zone supply air temperature setpoint up to a maximum setpoint while the airflow is maintained at the deadband flow rate.
   - 2.3. The second stage of heating modulates the airflow rate from the deadband flow rate up to the heating maximum flow rate that is less than 50 percent of the zone design peak supply rate.
3. The outdoor airflow rate required to meet the minimum ventilation requirements of Chapter 4 of the International Mechanical Code.
4. The minimum primary airflow rate required to meet the Simplified Procedure ventilation requirements of ASHRAE Standard 62.1 for the zone and is permitted to be the average airflow rate as allowed by ASHRAE Standard 62.1

~~4~~ 5. Any higher rate that can be demonstrated to reduce overall system annual energy use by offsetting reheat/recool energy losses through a reduction in outdoor air intake for the system as approved by the code official.

~~5~~ 6. The airflow rate required to comply with applicable codes or accreditation standards such as pressure relationships or minimum air change rates.

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

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

Add new standard(s) as follows:

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

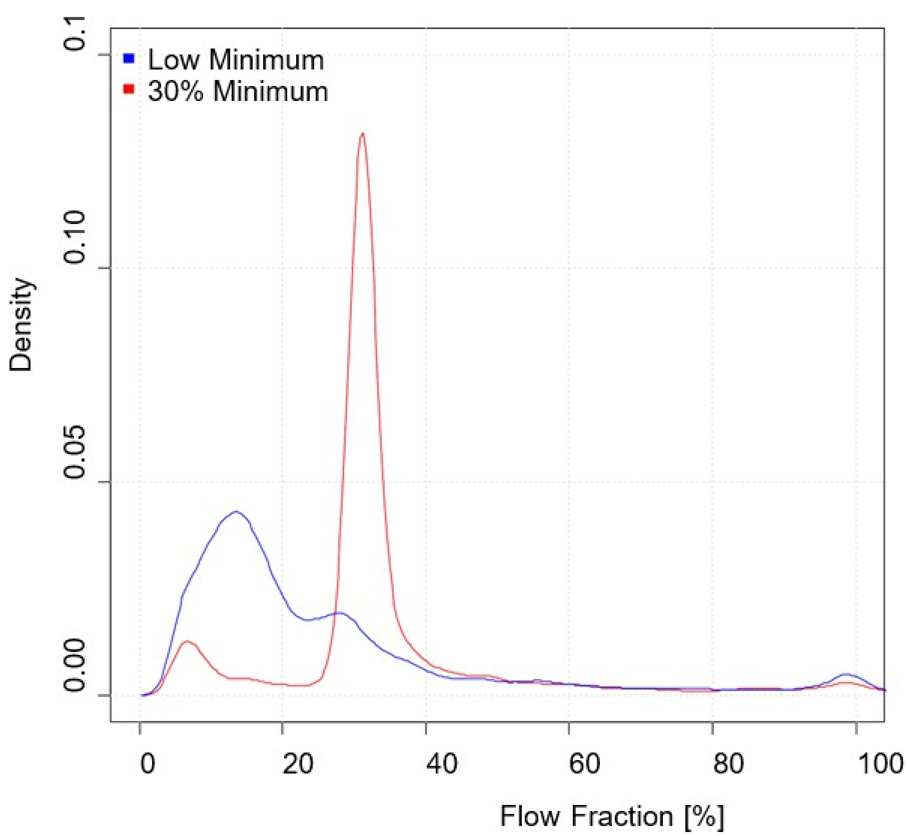
62.1-2019 Ventilation for Acceptable Indoor Air Quality

Reason: C403.6.1- Variable air volume and multiple-zone systems provides six options to determine the minimum air in each zone for a VAV system. For systems with DDC controls, there are two paths.

- Option 1 is a simplified method that allows the designer to assign a minimum of 20% of peak design airflow with no other requirements.

- Option 2 allows the user to use 20% of peak design airflow, or a higher value if required by the IMC or other codes or accreditation standards, or if it can be shown to otherwise save energy by reducing outdoor airflow. Unlike Option 1, the energy-saving dual max strategy during heating mode must be applied.

This proposal eliminates the blanket allowance to use 20% of the peak airflow rate in option 1 and the 20% floor in Option 2. Outdoor air rates are generally much lower than 20% of the maximum rate, but designers have felt they needed a higher percentage to meet the requirements of the IMC for multiple zone systems.Moreover, using percentages to determine minimums is problematic because VAV boxes are almost always oversized due to conservative load assumptions for occupants, lights, plug loads, etc. It is not unusual for boxes to be sized 3 or more times larger than they need to be, as was found to be the case in ASHRAE RP-1515 “Thermal and air quality acceptability in buildings that reduce energy by reducing minimum airflow from overhead diffusers.” The figure below from RP-1515 shows measured frequency of airflow rates in 7 California office buildings using 30% minimums (based on earlier versions of Standard 90.1) compared to the current “dual maximum” under Option 2. The figure shows that even if the minimums were set to 20% instead of 30%, excess air would have been supplied due to the oversized cooling maximum setpoint, wasting fan energy, heating energy, and cooling energy. RP-1515 also demonstrated that high minimums increased discomfort by “pushing” zones into heating mode in the summer months, causing overcooling complaints. Thus, based on RP-1515 results, we expect this addendum to both reduce energy costs and improve comfort.



The 20% floor was also removed from Option 2, which saves a lot of energy but does remove a "simplified" option for calculating the minimum airflow. The proposal suggests allowing an alternate simplified method from ASHRAE 62.1 which would save energy vs. the existing 20% floor. While the inclusion of the ASHRAE Simplified Method is not absolutely needed in the code, it would offer a simpler and easier to enforce path.

Addendum f to Standard 62.1 created a simplified way of determining outdoor air rates for multiple zone recirculating air handling systems that includes a simple prescriptive requirement for calculating minimum air handler outdoor air rates and minimum setpoints for VAV zones:

6.2.5.2 System Ventilation Efficiency. The system ventilation efficiency (Ev) shall be determined in accordance with Section 6.2.5.3 for the Simplified Procedure or Normative Appendix A for the Alternative Procedure.

6.2.5.3 Simplified Procedure

6.2.5.3.1 System Ventilation Efficiency. System Ventilation Efficiency (Ev) shall be determined in accordance with Equation 6.2.5.3.1A or B.

Ev = 0.88*D + 0.22 for D<0.60 (6.2.5.3.1A)

Ev = 0.75 for D≥0.60 (6.2.5.3.1B)

6.2.5.3.2

Zone Minimum Primary Airflow. For each zone, the minimum primary airflow (*Vpz-min*) shall be determined in accordance with equation 6.2.5.3.2.

Vpz-min = *Voz**1.5 (6.2.5.3.2)

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Cost impact. This addendum is not expected to increase the cost of construction. The requirement is simply for existing VAV terminal boxes to be set with a different dead band primary air minimum for dual maximum boxes.

Staff Note: ASHRAE 62.1 is only referenced in the IMC as an alternate method to select the system ventilation efficiency in Section 403.3.1.1.2.3.2,
by using Appendix A of the standard.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Reason: Subcommittee referred to the reason statement in the original proposal. To summarize, this proposal modifies language for options to determine minimum air for each zone in a VAV system. The revised language is supported by studies and research showing the current language and practice often leads to oversizing systems. This proposal is expected to both reduce energy costs and improve comfort.

Final Hearing Results

CEPI-107-21 AS

CEPI-108-21

Original Proposal

IECC®: SECTION 202 (New), C403.7, C403.7.8 (New), C403.7.8.1 (New), C403.7.8.2 (New)
Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Add new definition as follows:

OCCUPIED-STANDBY MODE. Mode of operation when an HVAC zone is scheduled to be occupied and an occupant sensor indicates no occupants are within the zone.

Revise as follows:

C403.7 Ventilation and exhaust systems. In addition to other requirements of Section C403 applicable to the provision of ventilation air or the exhaust of air, ventilation and exhaust systems shall be in accordance with Sections C403.7.1 through C403.7.~~7~~8.

Add new text as follows:

C403.7.8 Occupied Standby Controls. Occupied-standby controls are required for zones and systems serving zones where all spaces served by the zone are required to have occupant sensor lighting controls by Section C405.2.1 and are an ASHRAE Standard 62.1 occupancy category where the ASHRAE Standard 62.1 Ventilation Rate Procedure allows the ventilation air to be reduced to zero when the space is in *occupied-standby mode*. Spaces meeting these criteria include:

1. Post-secondary classrooms/lecture/training rooms
2. Conference/meeting/multipurpose rooms
3. Lounges/breakrooms
4. Enclosed offices
5. Open plan office areas
6. Corridors

C403.7.8.1 Occupied Standby Zone Controls. For zones meeting the occupied-standby control criteria, within five (5) minutes of all rooms in that zone entering *occupied-standby mode*, the zone control shall operate as follows:

1. Active heating set point shall be setback at least 1°F (0.55°C).
2. Active cooling set point shall be setup at least 1°F(0.55°C).
3. All airflow supplied to the zone shall be shut off whenever the space temperature is between the active heating and cooling set points.

Exception: Multiple zone systems without automatic zone flow control dampers.

C403.7.8.2 Occupied Standby System Controls. Multiple zone systems that can *automatically* reset the effective minimum outdoor air setpoint and that serve zones with occupied-standby zone controls shall reset the effective minimum outdoor air setpoint based on a zone outdoor air requirement of zero for all zones in *occupied-standby mode*. Sequences of operation for system outside air reset shall comply with an *approved* method.

Reason: This proposal would bring into the IECC, the benefits of occupied standby controls that are currently in ASHRAE 90.1 and other building codes. This saves energy by turning off ventilation air to zones that occupancy sensors identify as unoccupied but are scheduled to be occupied. This proposal also expands upon the ASHRAE standard by making explicit that for multiple zone systems, the system outside air also needs to be proportionately reduced when ventilation air has been shut off to one or more zones.

Standard 62.1-2019 allows zero ventilation in occupied standby mode for some occupancy categories including classrooms and offices (see TABLE 6.2.2.1 Minimum Ventilation Rates in Breathing Zone). Section C405.2.1 of the IECC already requires occupancy sensors for lighting control in certain spaces including classrooms, conference rooms, and offices of all sizes. Occupied standby was introduced into the 2019 of ASHRAE 90.1. We are recommending that IECC also capture tremendous global energy savings by reducing deadband airflow and thereby reducing fan energy, cooling energy and reheat. For the spaces chosen, the occupancy sensors are already in the spaces, this proposal requires a modest levels of cost for lighting systems and HVAC integration to realize the energy and operating cost savings.

The occupied standby requirement in 90.1-2019 requires shutting off ventilation air to unoccupied zones. For single zone systems this saves fan energy and the thermal energy associated with conditioning outside air. For multi-zone systems, the zone ventilation air is shut off which reduces fan energy and reheat energy, but currently there is not an explicit requirement in ASHRAE 90.1 to reset the outside air amounts at the system level and thus there is not the thermal energy savings associated with conditioning less outside air. Significant energy savings can be achieved by also resetting the minimum outside airflow setpoint at the air handler. Thus this proposal makes explicit what was implied in ASHRAE 90.1 in regards to resetting multiple zone system outside air amounts.

For systems that already have the ability to reset the minimum outside airflow setpoint this is a minor sequence change. No additional hardware or software is required. ASHRAE Guideline 36-2021 already includes the sequences needed for multiple zone systems to reset the effective minimum outdoor air setpoint based on a zone outdoor air requirement of zero for all zones in occupied standby mode.

Bibliography: ASHRAE Standard 90.1-2019 *Energy Standard for Buildings Except Low-rise residential Buildings.* Section 6.5.3.8 Occupied- Standby Controls. American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASHRAE Standard 62.1-2019. *Ventilation for Acceptable Indoor Air Quality.* American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASHRAE Guideline 36-2021. *High-Performance Sequences of Operation for HVAC Systems.* American Society of Heating, Refrigerating and Air-Conditioning Engineers

Integral Group and Taylor Engineering. 2018. Codes and Standards Enhancement (CASE) Initiative*2019 California Building Energy Efficiency Standards: Proposals Based on ASHRAE 90.1-2016 – Results Report* http://title24stakeholders.com/wp-content/uploads/2019/01/T24-2019-CASEStudy-Results-Reports-Proposal-Based-on-ASHRAE-90.1-_Final_with_Attachments.pdf

LBNL. 2011. *A Meta-Analysis of Energy Savings from Lighting Controls in Commercial Buildings.* Lawrence Berkeley National Laboratory. LBNL-5095E https://eta-publications.lbl.gov/sites/default/files/a_meta-analysis_of_energy_savings_from_lighting_controls_in_commercial_buildings_lbnl-5095e.pdf

PNNL 2015 *"Cost-effectiveness Analysis of Occupant standby control for HVAC"* prepared by Reid Hart at Pacific Northwest National Laboratory

Texas A&M ARPA-E Projects (see two papers below) - https://hvac.engr.tamu.edu/arpa-e/

Pang, Z., Chen, Y., Zhang, J., O'Neill, Z., Cheng, H., & Dong, B. (2020).*Nationwide HVAC energy-saving potential quantification for office buildings with occupant-centric controls in various climates*. Applied Energy, 279, 115727. https://www.sciencedirect.com/science/article/abs/pii/S0306261920312186

Ye, Y., Chen, Y., Zhang, J., Pang, Z., O'Neill, Z., Dong, B., & Cheng, H. (2021).*Energy-saving potential evaluation for primary schools with occupant-centric controls.* Applied Energy, 293, 116854. https://www.sciencedirect.com/science/article/abs/pii/S0306261921003469

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

There is a first cost impact associated with this measure. For the analysis done for ASHRAE 90.1, the estimated cost was $100 per zone plus $20 per room. The cost of the occupancy sensor is not included as this proposal only applies to those zones where all the spaces served by the zone are already required to have occupant sensor control of the lighting.

For the 2019 ASHRAE 90.1 proposal, a typical office building was simulated in eQuest in 3 climates. Assumptions:

- 50,000 ft2, 5 story office
- Packaged VAV with HW reheat
- Standby control reduces zone flow by 0.3 cfm/ft2 in standby mode
- Average single room zone size of 800 ft2
- Average multiple room zone size of 200 ft2/room
- Average utility rates of $0.10/kwh and $1.0/therm
- Required scalar: 10yr simple payback
- Total incremental cost: $100/zone + $20 per additional room if more than one room in the zone.

Life Cycle Cost-Effectiveness Results

In order to meet the scalar a single room zone would only have to be unoccupied 8% of the time in Los Angeles, 9% in Atlanta and 10% is Chicago.

A zone with (5) 200 ft2 rooms must have all rooms unoccupied at least 12% of the time in Los Angeles, 13% in Atlanta and 14% in Chicago. In comparison, the LBNL meta-study of lighting controls found that on average occupancy sensors reduced the operating hours of lighting by 30%. Thus, the savings on average are at least twice that needed to render the measure cost-effective.

Texas A&M ARPA-E Projects (Pang et al and Ye et al Occupant-centric controls studies)

These projects compared a Baseline Case with no occupancy sensing, Advanced Case I with occupancy presence sensing, and Advanced Case II with occupant counting sensing. Advanced Case I is essentially occupied-standby control (turn off ventilation when no one is in the zone) and Advanced Case II is occupied standby control plus demand control ventilation (reduce ventilation based on the number of people in the zone and turn off ventilation when no one is in the zone). The following figure is from the Pang et al paper for the medium office building prototype simulated in the IECC climate zones. The three bars in each climate zone correspond to the baseline case, Advanced Case I, and Advanced Case II from left to right. The yellow and orange texts on top of the bars show the HVAC energy saving fractions of Advanced Case I and Advanced Case II against the baseline. These savings range from 19% to 43% of total HVAC site energy consumption.

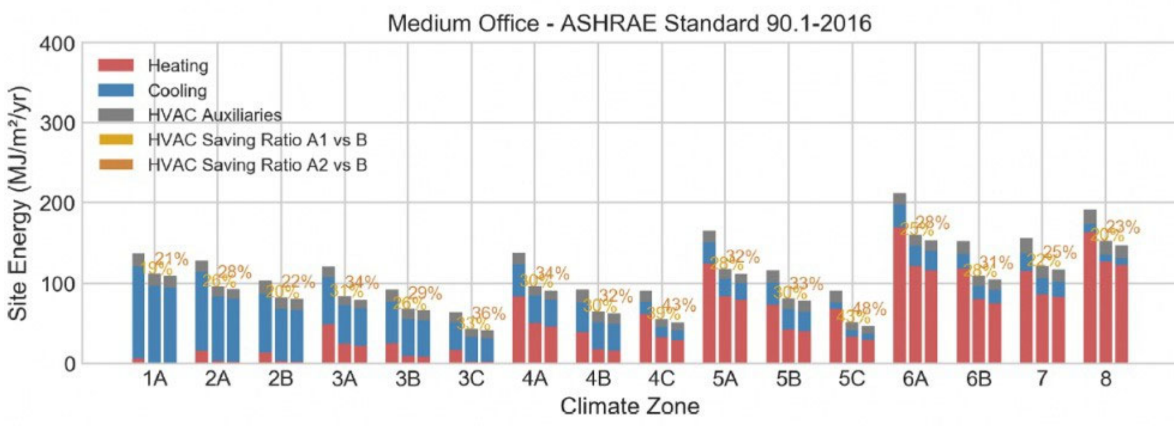
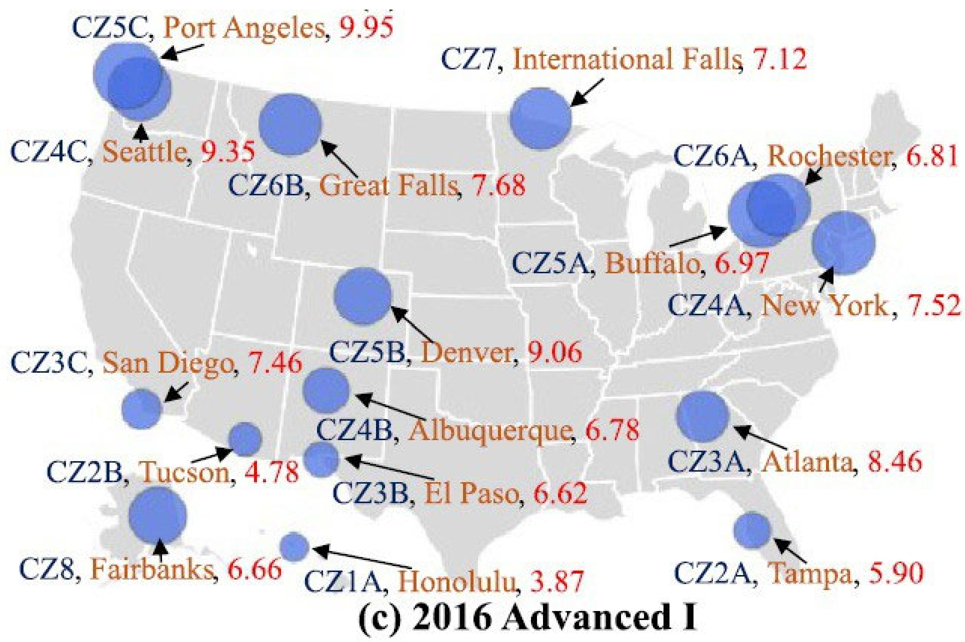


Fig. 18. HVAC energy simulation results of the medium office building per ASHRAE Standard 90.1 – 2016.

The second figure is from the Ye et al paper which conducts the same evaluation for schools. The savings from “Advanced Control 1” represent the occupied-standby control percent savings for the school prototype for all of the reference cities for the various IECC climate zones. These values range between 3% and almost 10% of whole building site energy savings. These are massive savings. More details are in the papers listed in the Bibliography.



Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal is a compilation of two ASHRAE documents plus addendum, with a needed clarification of intent.

Final Hearing Results

CEPI-108-21	AM

CEPI-110-21

Original Proposal

IECC®: C403.7.1

Proponents: Mike Kennedy, Mike D. Kennedy Inc., Northwest Energy Efficiency Alliance; Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

C403.7.1 Demand control ventilation. Demand control ventilation (DCV) shall be provided forthe following: ~~all single-zone systems required to comply with Sections C403.5 through C403.5.3 and spaces larger than 500 square feet (46.5 m2) and with an average occupant load of 15 people or greater per 1,000 square feet (93 m2) of floor area, as established in Table 403.3.1.1 of the International Mechanical Code, and served by systems with one or more of the following:~~

1. ~~An air-side economizer~~. Spaces with ventilation provided by single-zone systems where an air-side economizer is provided in accordance with Section C403.5.
2. ~~Automatic modulating control of the outdoor air damper.~~ Spaces larger than 250 sqaure feet (23.2 m2) in climate zones 5A, 6, 7, and 8 and spaces larger than 500 square feet (46.5 m2) in other climate zones wihc have a design occupant load of 15 people or greater per 1,000 square feet (93 m2) of floor area, as established in Table 403.3.1.1 of the International Mechanical Code, and are served by systems with one or more of the following:
   - 2.1. An air-side economizer.
   - 2.2. Automatic modulating control of the outdoor air damper.
   - 2.3 A design outdoor airflow greater than 3,000 cfm (1416 L/s)
3. ~~A design outdoor airflow greater than 3,000 cfm (1416 L/s)~~.

Exceptions:

1. Spaces served by systems ~~Systems~~ with energy recovery ~~complying~~ in accordance with Section C403.7.4.2 ~~.~~ and that have floor area less than:
   - 1.1 6000 square feet (2600 m^2) in climate zone 3C.
   - 1.2 2000 square feet (190 m^2) in climate zones 1A, 3B, and 4B.
   - 1.3 1000 square feet (90 m^2) in climate zones 2A, 2B, 3A, 4A, 4C, 5 and 6.
   - 1.4 400 square feet (40 m^2) in climate zones 7 and 8.
2. Multiple-zone systems without direct digital control of individual zones communicating with a central control panel.
3. Spaces served by multiple- ~~Multiple-~~zone systems with a system design outdoor airflow less than 750 cfm (354 L/s).
4. Spaces where more than 75 percent of the space design outdoor airflow is required for makeup air that is exhausted from the space or transfer air that is required for makeup air that is exhausted from other spaces.
5. Spaces with one of the following occupancy classifications as defined in Table 403.3.1.1 of the*International Mechanical Code*: correctional cells, education laboratories, barber, beauty and nail salons, and bowling alley seating areas.

Reason: This proposal clarifies where DCV is required. All exceptions are edited to be space centric since the requirement is for spaces to have DCV. The only substantive change is to remove exception 2. During the Washington State Energy Code technical advisory group meetings several engineers felt this was unneeded: that most all multi-zone systems have DDC, and if not they should.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is a restatement of the DCV language to clarify the intent and remove an exception that is no longer useful given the state of building controls. There is no cost impact as when and where DCV is required is not changed.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal clarifies where demand-controlled ventilation (DCV) is required. It also improves the exceptions related to energy recovery.

Final Hearing Results

CEPI-110-21	AM

CEPI-112-21

Original Proposal

IECC®: SECTION 202 (New), C403.7.3

Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Add new definition as follows:

<u>**Energy recovery, series.** A three-step process in which the first step is to remove energy from a single airstream without the use of mechanical cooling. In the second step the air stream is mechanically cooled for the purpose of dehumidification. In the third step the energy removed in step one is reintroduced to the air stream.</u>

Revise as follows:

C403.7.3 Ventilation air heating control. Units that provide ventilation air to multiple zones and operate in conjunction with zone heating and cooling systems shall not use heating or heat recovery to warm supply air to a temperature greater than 60°F (16°C) when representative building loads or outdoor air temperatures indicate that the majority of zones require cooling.

<u>**Exception:** Units that heat the airstream using only series energy recovery when representative building loads or outdoor air temperature indicate that the majority of zones require cooling in Climate Zones 0A, 1A, 2A, 3A, and 4A.</u>

Reason: Based on addendum n to 90.1-2019

This proposal

1. Adds a definition for series energy recovery.
2. Provides an exception for systems equipped with series energy recovery to the requirement.

Series energy recovery is a well-established method to provide both passive free cooling and reheating to an airstream. It is typically done with a wrap-around coil where heat is absorbed into the fluid upstream of a dehumidifying cooling and released downstream of the coil to provide reheat. A sensible-only plate heat exchanger can be employed as well. Unlike condenser heat recovery, which only provides free reheat, this process reduces the load on the dehumidifying cooling coil.

The requirement to provide cool air from a 100% outside air unit while the building needs cooling is so that the work done by the compressor to cool the air is not wasted. When air is provided at higher temperatures, the zone cooling systems must recool the air. The exception for series energy recovery is warranted because any excess reheat was provided by a reduction of the cooling load on the dehumidifying coil, so there is no net gain in compressor load. The exception is desirable because adding the capability to control the discharge temperature of a series energy recovery system is expensive.

Bibliography: ANSI/ASHRAE/IES Standard 90.1-2019 Energy Standard for Buildings Except Low-Rise Residential Buildings, Addendum n

https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda/addenda-to-standard-90-1-2019

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

The proposal removes the need for costly controls that do not save energy.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Reason: Subcommittee referenced the reason statement from the proposal.

Based on addendum n to 90.1-2019

This proposal

1. Adds a definition for series energy recovery.

2. Provides an exception for systems equipped with series energy recovery to the requirement.

Series energy recovery is a well-established method to provide both passive free cooling and reheating to an airstream. It is typically done with a wrap-around coil where heat is absorbed into the fluid upstream of a dehumidifying cooling and released downstream of the coil to provide reheat. A sensible-only plate heat exchanger can be employed as well. Unlike condenser heat recovery, which only provides free reheat, this process reduces the load on the dehumidifying cooling coil. The requirement to provide cool air from a 100% outside air unit while the building needs cooling is so that the work done by the compressor to cool the air is not wasted. When air is provided at higher temperatures, the zone cooling systems must recool the air. The exception for series energy recovery is warranted because any excess reheat was provided by a reduction of the cooling load on the dehumidifying coil, so there is no net gain in compressor load. The exception is desirable because adding the capability to control the discharge temperature of a series energy recovery system is expensive.

Final Hearing Results	
CEPI-112-21	AS

CEPI-113-21

Original Proposal

IECC®: C403.7.4.1

Proponents: Mike Moore, Stator LLC, The Home Ventilating Institute (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

C403.7.4.1 Nontransient dwelling units. Nontransient dwelling units shall be provided with outdoor air energy recovery ventilation systems with an *enthalpy recovery ratio* of not less than 50 percent at cooling design condition and not less than 60 percent at heating design condition.

Exceptions:

1. Nontransient dwelling units in Climate Zone 3C.
2. Nontransient dwelling units with not more than 500 square feet (46 m^2) of *conditioned floor area* in Climate Zones 0,1, 2, 3, 4C, and 5C and either adjoin an open-ended corridor or do not adjoin a corridor.
3. Nontransient dwelling units with not more than 500 square feet (46 m^2) of conditioned floor area that are located in Climate Zones 1A, 2B, 3B, and 3C.

~~3~~ 4. *Enthalpy recovery ratio* requirements at heating design condition in Climate Zones 0, 1 and 2.

~~4~~ 5. *Enthalpy recovery ratio* requirements at cooling design condition in Climate Zones 4, 5, 6, 7 and 8.

Reason: This proposal expands the requirement for heat or energy recovery ventilators (i.e., an HRV or an ERV) for high-rise dwelling units in Group R-2 buildings based on a cost effectiveness analysis. The proposal expands the climate zones and dwelling unit sizes where an H/ERV is considered to be cost effective. Clarity is also provided that the system is expected to be a balanced ventilation system (now defined in the IMC and IRC) and that a heat or energy recovery ventilation system may be used, provided the system meets the minimum performance requirements of this section.

Bibliography:

1. Sontag et al. 2020. Time Dependent Valuation of Energy for Developing Building Efficiency Standards. Prepared by Energy and Environmental Economics, Inc. for the California Energy Commission. See especially p. 47-48.
2. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990. Interagency Working Group on Social Cost of Greenhouse Gases, United States Government. February 2021.
3. Bohac D., and Sweeney L. 2020. Energy Code Field Studies: Low-Rise Multifamily Air Leakage Testing. Prepared by the Center for Energy and Environment, Ecotope, and The Energy Conservatory. Prepared for the U.S. Department of Energy Office of Energy Efficiency & Renewable Energy. https://www.energycodes.gov/sites/default/files/documents/LRMF_AirLeakageTesting_FinalReport_2020-07-06.pdf. [See Table 45, which shows average leakage to "common" area of 42%. The report also notes, "for buildings in this study, "common areas" are made up almost completely of corridors and a few small rooms such as mechanical closets and elevator rooms.]
4. Lstiburek, J.W. 2019. Compartmentalization, Distribution and Balance. ASHRAE Journal: Vol. 61, no. 7.
5. Brelih, N. and Seppänen, O. 2011. Ventilation rates and IAQ in European standards and national regulations. Proceedings of the 32nd AIVC Conference and 1st TightVent Conference in Brussels, Belgium.
6. Sundell et al. 1994. Sick Building Syndrome (SBS) in Office Workers and Facial Skin Symptoms among VDT-Workers in Relation to Building and Room Characteristics: Two Case-Referent Studies. Indoor Air, 4: 83-94.
7. Milton et al. 2000. Risk of Sick Leave Associated with Outdoor Air Supply Rate, Humidification, and Occupant Complaints. Indoor Air, 10:212-221.
8. Bornehag, C & Sundell, Jan & Hägerhed, Linda. (2003). Asthma and allergy among children and the association to ventilation rate at home, a case control study. Epidemiology. 14. 10.1097/00001648-200309001-00224.

9. Seppänen, O. A., and W. Fisk. 2006. Some quantitative relations between indoor environmental quality and work performance or health. HVAC&R Research 12 (4):957-73. doi:10.1080/10789669.2006.10391446.
10. Tejsen et al. 2016. The effects of bedroom air quality on sleep and next-day performance. Indoor Air, 26:679-686.
11. LBNL. Indoor Air Quality Scientific Findings Resource Bank. Building Ventilation. Accessed May 6, 2021. https://iaqscience.lbl.gov/ventsummary#:~:text=Just%20over%20half%20of%20studies,improve%20with%20increased%20ventilation

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

The cost effectiveness analysis was based on the ASHRAE 90.1 scalar method (values < 12.5 were considered cost effective) and also included considerations for the monetization of carbon emissions. The included table highlights cost-effective applications in green. Key assumptions:

- ASHRAE 62.2 ventilation rates (equivalent to 2021 IMC high-rise dwelling unit rates for the 1000 ft2 dwelling unit and slightly lower than the 2021 IMC high-rise dwelling unit rate for the 500 ft2 dwelling unit; tentatively approved for low-rise dwelling R-2 dwelling units in the 2024 IMC pending final approval through the OGCV of M19-21); these rates are ~30% lower than ASHRAE 62.1 and European rates (see additional rationale below). Note: HRVs and ERVs are more cost effective at higher ventilation rates.
- Balanced ventilation as the minimum code-compliant reference system (see additional rationale below)
- Fan efficacy compliant with the 2021 IECC
- 1000 ft2, 2-bed/2-bath and 500 ft2 1-bed/1-bath dwelling units
- Energy prices determined from 5-year national average of EIA data
- Effect of carbon price analyzed at four levels. This analysis was performed to permit the committee to identify the final climate zone exceptions that are appropriate in this section, based on the committee's final selection of a carbon price. See the following table for cost effectiveness under the four carbon pricing scenarios evaluated.
    - $0/metric ton
    - Cap and Trade: $29.63/metric ton[1] (used to justify cost effectiveness for this proposal)
    - IWG Social Cost of Carbon: $51/metric ton[2]
    - CEC Emissions Abatement Cost: $106/metric ton[1]
- Simulation and cost effectiveness analysis documents can be found at the following address: https://www.dropbox.com/sh/yuodjpuvkwrefwl/AADK5WsKTfh1VrlGSCGbqsPVa?dl=0

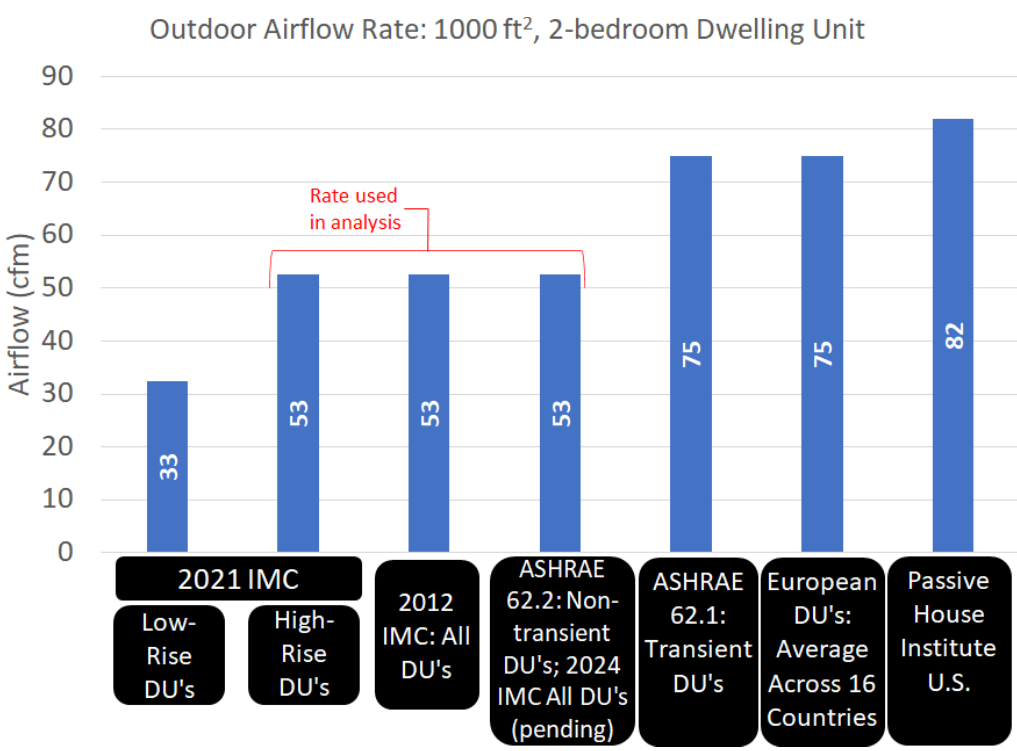
Climate Zone	Scalar Ratio Calculation							
	Carbon @ $0/metric ton		Carbon @ $29.63/metric ton		Carbon @ $51/metric ton		Carbon @ $106/metric ton	
	500 ft^2	1000 ft^2	500 ft^2	1000 ft^2	500 ft^2	1000 ft^2	500 ft^2	1000 ft^2
0A	4.4	1.5	4.0	1.4	3.7	1.3	3.2	1.2
0B	13.7	4.0	12.5	3.6	11.8	3.4	10.2	2.9
1A	44.7	8.0	40.8	7.3	38.4	6.8	33.3	5.9
1B	9.1	2.9	8.2	2.6	7.7	2.5	6.7	2.1
2A	13.7	3.9	12.4	3.6	11.6	3.4	10.0	2.9
2B	42.7	7.8	36.4	6.9	32.8	6.4	26.3	5.3
3A	10.6	3.3	9.1	2.8	8.3	2.6	6.7	2.1
3B	23.5	5.7	19.9	4.9	18.0	4.5	14.3	3.7
3C	No annual savings	No annual savings	No annual savings	No annual savings	No annual savings	No annual savings	No annual savings	No annual savings
4A	5.0	2.0	4.3	1.7	4.0	1.6	3.2	1.3
4B	9.5	3.4	8.2	3.0	7.4	2.7	5.9	2.2
4C	6.6	2.5	5.6	2.2	5.1	2.0	4.1	1.6
5A	4.0	1.6	3.4	1.4	3.1	1.3	2.5	1.1
5B	5.9	2.3	5.1	2.0	4.6	1.8	3.7	1.5
5C	4.8	1.9	4.2	1.7	3.8	1.5	3.1	1.3
6A	3.2	1.3	2.7	1.2	2.5	1.1	2.0	0.9
6B	3.9	1.6	3.3	1.4	3.0	1.3	2.5	1.0
7	2.5	1.0	2.1	0.9	1.9	0.8	1.6	0.7
8	1.9	0.8	1.6	0.7	1.5	0.6	1.2	0.5

Why choose balanced ventilation as the reference ventilation system?

Recent research has documented significant leakage pathways between the walls of newer, tight dwelling units and adjacent corridors in Group R-2 buildings, with approximately 40% of dwelling unit leakage area to the corridor.[3] Based on this finding, operating an unbalanced outdoor air ventilation system in a dwelling unit with a wall adjacent to a corridor is expected to establish a pressure differential with respect to the corridor. When a supply ventilation system is specified for the dwelling unit, this is expected to pressurize the dwelling unit, transferring air from the dwelling unit to the corridor. When an exhaust system is specified for the dwelling unit, this is expected to depressurize the dwelling unit, transferring air from the corridor to the dwelling unit. Transferring air to or from the corridor and an adjoining dwelling unit is a violation of IBC Section 1020.5 and IMC 601.2, which prohibit corridors from serving as “supply, return, exhaust, relief, or ventilation air ducts.” Physically speaking, to comply with these requirements in the IBC and IMC, an outdoor air ventilation system must be balanced. Joe Lstiburek provides pages of rationale supporting this concept in his article, “Compartmentalization, Distribution and Balance” – which in 2019 laid out a game plan for energy efficient, construction and ventilation of multifamily dwelling units to achieve the building code’s fire safety, IAQ, and energy efficiency objectives.[4] Perhaps for such reasons, prior to 2015, any dwelling unit having mechanical ventilation was required to provide mechanical ventilation “by a method of supply and return or exhaust air,” where “the amount of supply air shall be approximately equal to the amount of return and exhaust air” (2012 IMC 403.1). As such, for the cost effectiveness analysis, this proposal assumes a balanced ventilation system for Group R-2 building dwelling units adjoining a corridor.

Why choose ASHRAE 62.2-2019 Ventilation Rates?

Within the cost effectiveness study supporting this proposal, ASHRAE 62.2-2019 ventilation rates were selected for dwelling units in low-rise Group R-2 buildings. ASHRAE 62.2-2019 ventilation rates are roughly equivalent to: the 2012 IMC ventilation rates for all dwelling units, the 2021 IMC ventilation rates for high-rise residential dwelling units in the 2021 IMC, and the pending 2024 IMC ventilation rates for all R-2 dwelling units (pending final action on M19-21). These rates are also more conservative (~30% lower) than European rates,[5] ASHRAE 62.1 rates, and Passive House rates. The 2015-2021 IMC rates for low-rise R-2 dwelling units are incredibly low – and are based on an old ASHRAE 62.2 formula for leaky, single-family, detached homes that is not relevant for tight, multifamily construction with higher occupant density and higher indoor air pollution concentration than single-family detached homes.



Additionally, the rates promulgated by ASHRAE 62.2-2019 and the IMC are recognized as rates needed to provide*minimum acceptable indoor air quality*. It is expected that members of the public seeking improved IAQ may elect to use higher rates to reduce pollutant concentration and support better productivity and health outcomes, which have also been linked to increases in wages. Studies that have shown better health outcomes or improved performance for building occupants as a function of higher ventilation rates include:

- Sundell[6]: Sick building syndrome declines as ventilation rate increases.
- Milton[7]: Sick leave decreases as ventilation rate increases.
- Bornehag[8]: Risk of asthma for children increases with decreasing ventilation rate in homes.
- Seppänen[9]: Productivity decreases with decreasing ventilation rate.
- Tejsen[10]: Productivity increases with increasing residential ventilation rate.

While some of these studies were conducted in commercial buildings, LBNL's[11] analysis of residential studies concluded that, "Just over half of (residential) studies report one or more statistically significant health benefits of increased ventilation rates." LBNL noted that, "The findings of research on how ventilation rates in homes affect health are mixed," but that "overall… the number of reported statistically significant improvements in health with increased ventilation rates far exceeded the anticipated chance improvements in health."

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Subcommittee referenced the reason statement from the proposal and proponent modifications.

Final Hearing Results

CEPI-113-21	AM

CEPI-116-21

Original Proposal

IECC®: SECTION 202 (New), C403.7.4.2

Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Add new definition as follows:

Energy recovery, series. A three-step process in which the first step is to remove energy from a single airstream without the use of mechanical cooling. In the second step, the air stream is mechanically cooled for the purpose of dehumidification. In the third step, the energy removed in step one is reintroduced to the air stream.

Energy recovery ratio, series (SERR). The difference between the dry bulb air temperatures leaving the series energy recovery unit and leaving the dehumidifying coil divided by the difference between 75˚F (24˚C) and the dry bulb temperature of the air leaving the dehumidifying cooling coil.

Revise as follows:

C403.7.4.2 Spaces other than nontransient dwelling units. Where the supply airflow rate of a fan system serving a space other than a nontransient dwelling unit exceeds the values specified in Tables C403.7.4.2(1) and C403.7.4.2(2), the system shall include an energy recovery system. The energy recovery system shall provide an *enthalpy recovery ratio* of not less than 50 percent at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls that permit operation of the economizer as required by Section C403.5.

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

1. Where energy recovery systems are prohibited by the *International Mechanical Code*.
2. Laboratory fume hood systems that include not fewer than one of the following features:
   - 2.1. Variable-air-volume hood exhaust and room supply systems configured to reduce exhaust and makeup air volume to 50 percent or less of design values.
   - 2.2. Direct makeup (auxiliary) air supply equal to or greater than 75 percent of the exhaust rate, heated not warmer than 2°F (1.1°C) above room setpoint, cooled to not cooler than 3°F (1.7°C) below room setpoint, with no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. Systems serving spaces that are heated to less than 60°F (15.5°C) and that are not cooled.
4. Heating energy recovery where ~~Where~~ more than 60 percent of the outdoor heating energy is provided from site-recovered or site-solar energy in Climate Zones 5 through 8.
5. *Enthalpy recovery ratio* requirements at heating design condition in *Climate Zones* 0, 1 and 2.
6. *Enthalpy recovery ratio* requirements at cooling design condition in *Climate Zones* 3C, 4C, 5B, 5C, 6B, 7 and 8.
7. Systems in Climate Zones 0 through 4 requiring dehumidification that employ *series energy recovery* ~~in series with the cooling coil~~ and have a minimum SERR of 0.40.
8. Where the largest source of air exhausted at a single location at the building exterior is less than 75 percent of the design *outdoor air* flow rate.
9. Systems expected to operate less than 20 hours per week at the *outdoor air* percentage covered by Table C403.7.4.2(1).
10. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
11. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.

Reason: This proposal revises two exceptions to the requirement to use energy recovery. One change limits the exception for solar heating to cooler climates.The second clarifies the exemption for the use of “energy recovery in series with the cooling coil” by creating a new definition for series energy recovery. This definition is required because some users of the standard have confused condenser heat recovery and site-recovered energy with series energy recovery. They are quite different.

There is also a new definition that defines the performance of series energy recovery. The purpose is to ensure that the series energy recovery system performs well enough to justify allowing it to be used in lieu of conventional energy recovery. The format of the code does not allow formulas to be used in a definition, so the series energy recovery ratio is described in the text. For clarity, the formula is shown here:

SERR = (TL – TC)/(TE – TC)

Where

SERR = Series energy recovery ratio

TL = Rated dry bulb temperature of the air leaving the device.

TC = Dry bulb temperature of the air leaving the dehumidifying cooling coil TE = Dry bulb temperature of the air entering the first step of 75ºF In addition, the exemption for series energy recovery has been limited to warmer climate zones.

Bibliography: ANSI/ASHRAE/IES Standard 90.1-2019 Energy Standard for Buildings Except Low-Rise Residential Buildings

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The changes only clarify the intent of the code.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal revises two exceptions to the requirement to use energy recovery. One change limits the exception for solar heating to cooler climates. The second clarifies the exemption for the use of “energy recovery in series with the cooling coil” by creating a new definition for series energy recovery. This definition is required because some users of the standard have confused condenser heat recovery and site-recovered energy with series energy recovery. They are quite different. There is also a new definition that defines the performance of series energy recovery. The purpose is to ensure that the series energy recovery system performs well enough to justify allowing it to be used in lieu of conventional energy recovery.

Final Hearing Results

CEPI-116-21	AS

CEPI-118-21

Original Proposal

IECC®: C403.7.7
Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Revise as follows:

C403.7.7 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 elevator 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, or by thermostatic control systems.

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

1. In buildings less than three stories in height above grade plane.
2. In buildings of any height located in*Climate Zones* 0, 1, 2 or 3.
3. Where the design exhaust capacity is not greater than 300 cfm (142 L/s).

Nonmotorized gravity dampers shall have an air leakage rate not greater than 20 cfm/f^{2}t (101.6 L/s × m^2) where not less than 24 inches (610 mm) in either dimension and 40 cfm/ft^2 (203.2 L/s × m^2) where less than 24 inches (610 mm) in either dimension. The rate of air leakage shall be determined at 1.0 inch water gauge (249 Pa) when tested in accordance with AMCA 500D for such purpose. The dampers shall be labeled by an *approved agency*.

Reason: Based on ASHRAE 90.1-2019 Addendum m.
Elevator shaft vents are no longer required by most model codes, but many machine-room-less elevator manufacturers insist on a vent to help maintain shaft temperatures that may rise due to heat produced by the cab-mounted elevator machinery. These vents are not likely necessary or even useful for temperature control in most applications due to the heat losses to the conditioned spaces adjacent to the elevator shaft that should result in acceptable shaft temperatures. However, they are being used nonetheless.

These vents are typically open year-round. This proposal requires that if such vents are installed, they are controlled to only open based on a thermostatic setting.

Bibliography: ANSI/ASHRAE/IES Standard 90.1-2019 Energy Standard for Buildings Except Low-Rise Residential Buildings, Addendum m
https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda/addenda-to-standard-90-1-2019

Cost Impact: The code change proposal will increase the cost of construction.
The cost of construction is increased in cases where elevator manufacturers require a vent in the elevator shaft.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Based on ASHRAE 90.1-2019 Addendum m.

Elevator shaft vents are no longer required by most model codes, but many machine-room-less elevator manufacturers insist on a vent to help maintain shaft temperatures that may rise due to heat produced by the cab-mounted elevator machinery. These vents are not likely necessary or even useful for temperature control in most applications due to the heat losses to the conditioned spaces adjacent to the elevator shaft that should result in acceptable shaft temperatures. However, they are being used nonetheless.

These vents are typically open year-round. This proposal requires that if such vents are installed, they are controlled to only open based on a thermostatic setting.

Final Hearing Results	
CEPI-118-21	AS

CEPI-119-21

Original Proposal

IECC®: SECTION 202, SECTION 202 (New), C202 (New), C403.8.1, TABLE C403.8.1(1), TABLE C403.8.1(1) (New), TABLE C403.8.1(2), TABLE C403.8.1(4) (New), C403.8.1.1 (New), C403.8.1.2 (New), C503.3, C503.3.2 (New), AHRI Chapter 06 (New), Table C403.8.1(2) (New), TABLE C403.8.1(3) (New), TABLE C503.3 (New)

Proponents: John Bade, 2050 Partners, California Investor Owned Utilities (johnbade@2050partners.com)

2021 International Energy Conservation Code

Revise as follows:

ENTHALPY RECOVERY RATIO <u>(ERR)</u>. Change in the enthalpy of the *outdoor air* supply divided by the difference between the *outdoor air* and entering exhaust air enthalpy, expressed as a percentage.

FAN SYSTEM DESIGN CONDITIONS. Operating conditions that can be expected to occur during normal system operation that result in the highest supply fan airflow rate <u>of</u> ~~to conditioned spaces served by~~ the <u>*fan system*</u> ~~system~~, other than during air economizer operation.

Add new definition as follows:

<u>**FAN ELECTRICAL INPUT POWER**</u>**.** <u>The electrical input power in kilowatts required to operate an individual fan or fan array at design conditions. It includes the power consumption of motor controllers, where present.</u>

<u>**FAN NAMEPLATE ELECTRICAL INPUT POWER**</u>**.** <u>Is the nominal electrical input power rating stamped on a fan assembly nameplate</u>.

<u>**FAN SYSTEM**</u>**.** <u>All the fans that contribute to the movement of airserving *spaces* that pass through a point of a common duct, plenum, or cabinet.</u>

<u>**FAN SYSTEM, COMPLEX**</u>**.** <u>A *fan system* that combines a *single-cabinet fan system* with other supply fans, exhaust fans, or both</u>.

<u>**FAN SYSTEM, EXHAUST/RELIEF**</u>**.** <u>A *fan system* dedicated to the removal of air from interior spaces to the outdoors</u>.

<u>**FAN SYSTEM, RETURN**</u>**.** <u>A *fan system* dedicated to removing air from the interior where some or all the air is to be recirculated except during economizer operation.</u>

<u>**FAN SYSTEM, SINGLE-CABINET**</u>**.** <u>A *fan system* where a single fan, single fan array, a single set of fans operating in parallel, or fans or fan arrays in series and embedded in the same cabinet that both supply air to a space and recirculate the air.</u>

<u>**FAN SYSTEM, TRANSFER**</u>**.** <u>A *fan system* that exclusively moves air from one occupied space to another</u>.

<u>**FAN SYSTEM AIRFLOW**</u>**.** <u>The sum of the airflow of all fans with *fan electrical input power* greater than 1 kW at *fan system design conditions*, excluding the airflow that passes through downstream fans with *fan electrical input power* less than 1 kW</u>.

Revise as follows:

FAN SYSTEM ELECTRICAL INPUT POWER. The sum of the fan electrical <u>input</u> power of all fans that are required to operate at *fan system design conditions* ~~to supply air from the heating or cooling source to the conditioned spaces and/or return it to the source or exhaust it to the outdoors~~.

Delete and substitute as follows:

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

~~limitation.~~

~~**Exceptions:**~~

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

C403.8.1 Fan power. For each *fan system* serving an occupied space or other enclosed space that includes one or more fans or fan arrays with *fan electrical input power* greater than 1 kW, *fan system electrical input power* determined per Section C403.8.1.2 at the *fan system design airflow* shall not be greater than the limit is calculated in accordance with Section C403.8.1.1. This section does not apply to fans service heat rejection equipment.

Delete without substitution:

~~**TABLE C403.8.1(1) FAN POWER LIMITATION**~~

	LIMIT	CONSTANT VOLUME	VARIABLE VOLUME
Option 1: Fan system motor nameplate hp	Allowable nameplate motor hp	hp ≤ CFM_S × 0.0011	hp ≤ CFM_S × 0.0015
Option 2: Fan system bhp	Allowable fan system bhp	bhp ≤ CFM_S × 0.00094 + *A*	bhp ≤ CFM_S × 0.0013 + *A*

~~For SI: 1 bhp = 735.5 W, 1 hp = 745.5 W, 1 cfm = 0.4719 L/s.~~

~~where:~~

~~CFM_S = The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.~~

~~hp = The maximum combined motor nameplate horsepower.~~

~~bhp = The maximum combined fan brake horsepower.~~

~~*A* = Sum of [*PD* × CFM_D / 4131].~~

~~where:~~

~~*PD* = Each applicable pressure drop adjustment from Table C403.8.1(2) in. w.c.~~

~~CFM_D = The design airflow through each applicable device from Table C403.8.1(2) in cubic feet per minute.~~

Add new text as follows:

TABLE C403.8.1(1) SUPPLY FAN POWER ALLOWANCES (W/CFM)

Multi-Zone VAV Fan System Airflow (cfm)[a]				All Other Fan Systems Airflow (cfm)		
Air system Component	<5,000	5,000 to <10,000	>=10,000	<5,000	5,000 to <10,000	>=10,000
W/cfm						
Supply System Base Allowance for each fan system	0.413	0.472	0.480	0.243	0.267	0.248
Particle filtration (select all that apply)						

Filter not higher than MERV 12	0.094	0.079	0.073	0.097	0.084	0.075
MERV 13 to MERV 16 filter	0.210	0.177	0.165	0.217	0.185	0.168
HEPA filter	0.347	0.292	0.277	0.357	0.304	0.278
Heating (select all that apply)						
Hydronic heating coil (central)	0.047	0.050	0.055	0.049	0.053	0.057
Electric heat	0.047	0.040	0.037	0.049	0.042	0.038
Gas or oil furnace <90% Et or <90% AFUE	0.071	0.060	0.073	0.061	0.063	0.075
Gas or oil furnace >= 90% Et or >=90% AFUE	0.117	0.099	0.092	0.122	0.104	0.094
Cooling and dehumidification (select all that apply)						
Hydronic/DX cooling coil, or heat pump coil (wet) [Healthcare facilities can select twice]	0.141	0.118	0.110	0.146	0.125	0.112
Fluid economizer coil	0.141	0.118	0.110	0.146	0.125	0.112
Desiccant system-solid or liquid	0.164	0.138	0.128	0.170	0.145	0.131
Hot gas reheat coil	0.047	0.040	0.037	0.049	0.042	0.038
Series energy recovery	0.141	0.118	0.110	0.146	0.125	0.112
Evaporative humdifier/cooler in series with a cooling coil. Value shown is allowed W/cfm per 1.0 in. wg. Determine pressure loss (in. wg.) at the lesser of 400 fpm or maximum velocity allowed by the manufacturer. [Calculation required[b]]	0.233	0.196	0.184	0.241	0.205	0.186
Energy recovery						
Enthalpy Recovery Ratio >=0.50 and <0.55	0.141	0.118	0.110	0.146	0.125	0.112
Enthalpy Recovery Ratio >=0.55 and <0.60	0.166	0.140	0.130	0.172	0.147	0.133
Enthalpy Recovery Ratio >=0.60 and <0.65	0.191	0.161	0.151	0.198	0.169	0.153
Enthalpy Recovery Ratio >=0.65 and <0.70	0.217	0.182	0.171	0.224	0.191	0.173
Enthalpy Recovery Ratio >=0.70 and <0.75	0.242	0.204	0.191	0.250	0.213	0.193
Enthalpy Recovery Ratio >=0.75 and <0.80	0.267	0.225	0.212	0.276	0.235	0.213
Enthalpy Recovery Ratio >=0.80	0.292	0.246	0.232	0.301	0.257	0.234
Run-around liquid or refrigerant coils	0.141	0.118	0.110	0.146	0.125	0.112
Gas-phase filtration						
Gas-phase filtration	0.233	0.196	0.184	0.241	0.205	0.186
Other						
Economizer return damper	0.049	0.042	0.038	0.049	0.043	0.039
100% Outdoor air system[c]	0.000	0.000	0.000	0.073	0.104	0.112
Low-turndown single-zone VAV fan systemsd	0.000	0.000	0.000	0.073	0.104	0.094
Air blender	0.047	0.040	0.037	0.049	0.042	0.038
Sound attenuation section [fans serving spaces with design background noise goals below NC35]	0.035	0.030	0.027	0.036	0.032	0.029
Deducation for systems that feed a terminal unit or fan coil with a fan with electrical input power <1kWe	-0.500	-0.500	-0.500	-0.100	-0.100	-0.100

a. See section C408.3.1.1 for requirements for a Multi-Zone VAV system.

b. Power allowances require further calculation. Multiply the actual pressure drop of the device or component by the fan power allowance in Table C403.8.1(2).

c. The 100 percent outdoor air system must serve 3 or more HVAC zones.

d. A low-turndown single-zone VAV fan system must be capable of and configured to reduce airflow to 50 percent of design airflow and use no more than 30 percent of the design wattage at that airflow. No more than 10 percent of the design load served by the equipment shall have fixed loads.

e. The deduction of 0.500 W/cfm is a default value for multizone VAV fan systems. If the terminal unit or fan coil manufacturer can demonstrate that the share of the unit's fan power required to move the fan system's air is less than 0.500 W/cfm, that value may be used. The W/cfm shall be calculated by dividing the power required to operate the terminal unit's fan at fan system design conditions by the airflow of the terminal unit at those conditions.

Delete without substitution:

~~TABLE C403.8.1(2) FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT~~

~~DEVICE~~	~~ADJUSTMENT~~
~~Credits~~	
~~Return air or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms~~	~~0.5 inch w.c. (2.15 inches w.c. for laboratory and vivarium systems)~~
~~Return and exhaust airflow control devices~~	~~0.5 inch w.c.~~
~~Exhaust filters, scrubbers or other exhaust treatment~~	~~The pressure drop of device calculated at fan system design condition~~
~~Particulate filtration credit: MERV 9 thru 12~~	~~0.5 inch w.c.~~
~~Particulate filtration credit: MERV 13 thru 15~~	~~0.9 inch w.c.~~

~~DEVICE~~	~~ADJUSTMENT~~
~~Credits~~	
Particulate filtration credit: MERV 16 and greater and electronically enhanced filters	~~Pressure drop calculated at 2 times the clean filter pressure drop at fan system design condition.~~
Carbon and other gas-phase air cleaners	~~Clean filter pressure drop at fan system design condition.~~
~~Biosafety cabinet~~	~~Pressure drop of device at fan system design condition.~~
Energy recovery device, other than coil runaround loop	~~For each airstream, (2.2 × energy recovery effectiveness - 0.5) inch w.c.~~
~~Coil runaround loop~~	~~0.6 inch w.c. for each airstream.~~
Evaporative humidifier/cooler in series with another cooling coil	~~Pressure drop of device at fan system design conditions.~~
Sound attenuation section (fans serving spaces with design background noise goals below NC35)	~~0.15 inch w.c.~~
Exhaust system serving fume hoods	~~0.35 inch w.c.~~
Laboratory and vivarium exhaust systems in high-rise buildings	~~0.25 inch w.c./100 feet of vertical duct exceeding 75 feet.~~
~~Deductions~~	
Systems without central cooling device	~~- 0.6 inch w.c.~~
Systems without central heating device	~~- 0.3 inch w.c.~~
Systems with central electric resistance heat	~~- 0.2 inch w.c.~~

~~For SI: 1 inch w.c. = 249 Pa, 1 inch = 25.4 mm, 1 foot = 304.8 mm.~~

~~w.c. = Water Column, NC = Noise Criterion~~.

Add new text as follows:

TABLE C403.8.1(4) DEFAULT VALUES FOR FAN ELECTRICAL INPUT POWER BASED ON MOTOR NAMEPLATE HP[a,b]

Motor Nameplate Horsepower	Variable-Speed Drive (kW)	Without Variable-Speed Drive (kW)
<1	0.96	0.89
≥1 and <1.5	1.38	1.29
≥1.5 and <2	1.84	1.72
≥2 and <3	2.73	2.57
≥3 and <5	4.38	4.17
≥5 and <7.5	6.43	6.15
≥7.5 and <10	8.46	8.13
≥10 and <15	12.47	12.03
≥15 and <20	16.55	16.04
≥20 and <25	20.58	19.92
≥25 and <30	24.59	23.77
≥30 and <40	32.74	31.70

≥40 and <50	40.71	39.46
≥50 and <60	48.50	47.10
≥60 and <75	60.45	58.87
≥75 and ≤100	80.40	78.17

a. This table cannot be used for Motor Nameplate Horsepower values greater than 100.

b. This table is to be used only with motors with a service factor ≤1.15. If the service factor is not provided, this table may not be used.

C403.8.1.1 Determining Fan Power Limit. The maximum allowed *fan system electrical input power*, shall be determined in accordance with the following steps 1 through 5:

1. The *fan system's* classification shall be determined. A fan system is considered to be multizone VAV where it meets the following requirements; *fan systems* that do not meet the following requirements shall be classified as other fans:
   1.1. The fan system shall serve three or more HVAC zones and airflow to each shall be individually controlled based on heating, cooling and/or ventilation requirements.
   1.2. The sum of the minimum airflows for each HVAC zone shall be not greater than 40 percent of the*fan system design conditions*.

   -

   Exception: Hospital, vivarium, and laboratory systems that use flow control devices on exhaust or return to maintain space pressure relationships necessary for occupant health and safety or environmental control shall use the multizone VAV fan power allowances.

2. Determine the fan system airflow and choose the applicable table(s) for fan power allowance.
   2.1. For *single-cabinet fan systems*, use the *fan system airflow* and the power allowances in both Table C403.8.1(1) and Table C403.8.1(2).
   2.2. For *supply-only fan systems*, use the fan system airflow and power allowances in Table C403.8.1(1).
   2.3. For *relief fan systems*, use the design relief airflow and the power allowances in Table C403.8.1(2).
   2.4. For exhaust, return and transfer *fan systems*, use the *fan system airflow* and the power allowances in Table C403.8.1(2).
   2.5. For *complex fan systems* and DOAS with energy recovery *fan systems*, separately calculate the fan power allowance for the supply and return/exhaust systems and sum them. For the supply airflow at the *fan system* design conditions, and the power allowances in Table C403.8.1(1). For the return/exhaust airflow, use return or exhaust airflow at the *fan system design conditions*, and the power allowances in Table C403.8.1(2).

3. For each *fan system* determine the components included in the *fan system* and sum the fan power allowances of those components. All *fan systems* shall include the System Base Allowance. If, for a given component, only a portion of the*fan system airflow* passes through the component, calculate the fan power allowance for the component per equation 4-9:

   $FPA_{adj} = (Q_{comp}/Q_{sys}) * FPA_{comp}$ **(Equation #)**

   where:FPA_{adj} = The corrected fan power allowance for the component in w/cfmQ_{comp} = The airflow through component in cfmQ_{sys} = The fan system airflow in cfmFPA_{comp} = The fan power allowance of the component from Table C403.8.1(1) or Table C403.8.1(2)

4. Multiply the fan system airflow by the sum of the fan power allowances for the fan system, then divide by 1000 to convert to KW.

   $FPL = (Q_{sys} * FPA_{sum})/1000$ **(Equation #)**

   where:FPL = The fan power limit in KWQ_{sys} = The fan system airflow in cflm (L/s)FPA_{sum} = The sum of the fan power allowance for the system in W/cfm1000 = The conversion from W to kW

5. For building sites at elevations greater than 3,000 feet (900 m), multiply the fan power limit by the correction factor from Table C408.3.1(3).

$FPL_{alt} = FPL * C_{alt}$ **(Equation #)**

where:FPL_{alt} = The adjusted fan power limit in KW.FPL = The fan power limit in KW calculated in step 4.C_{alt} = The altitude correction factor from Table C408.3.1(3)

C403.8.1.2 Determining *Fan System Electrical Input Power*. The *fan system electrical input power* is the sum of the *fan electrical input power* of each fan or fan array included in the fan system other than fans with*fan electrical input power* ≤ 1 kW. If variable speed drives are used their efficiency losses shall be included. *Fan system input power* shall be calculated with mid-life filter pressure drop, which is the mean of the clean filter pressure drop and design final filter pressure drop. The *fan electrical input power* for each fan or fan array shall be determined using one of the following methods. There is no requirement to use the same method for all fans in a *fan system*:

1. Use the default *fan electrical input power* in Table C408.3.1(4) for one or more of the fans. This method cannot be used for complex *fan systems*.
2. Use the *fan electrical input power* at *fan system design conditions* provided by the manufacturer of the fan, *fan array*, or equipment that includes the fan or *fan array*, calculated per a test procedure included in 10 CFR Part 430, 10 CFR Part 431, ANSI/AMCA Standard 210, ASHRAE 51 AHRI Standard 430, AHRI Standard 440, or ISO 5801.
3. Use the *fan electrical input power* provided by the manufacturer, calculated at *fan system design conditions* per one of the methods listed in section 5.3 of ANSI/AMCA 208.
4. Use the *fan nameplate electrical input power*.

C503.3 Heating and cooling systems. New heating, cooling and duct systems that are part of the *alteration* shall comply with Sections C403 and C408.

Add new text as follows:

C503.3.2 Additional fan power allowances. Additional Fan Power Allowances are available when determining the Fan Power Budget (Fan kW_{budget}) as specified in Table C503.4. These values can be added to the Fan Power Allowance values in Table C403.8.1(1) and Table C403.8.1(2) when calculating a new Fan kW_{budget} for the *fan system* being altered.

Add new standard(s) as follows:

AHRI

Air-Conditioning, Heating, & Refrigeration Institute
2111 Wilson Blvd, Suite 500
Arlington, VA 22201

AHRI 1060-2018	Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment
AHRI Standard 430-2020	Performance Rating of Central Station Air-Handling Units

Add new definition as follows:

FAN SYSTEM, COMPLEX. A *fan system* that combines a *single-cabinet fan system* with other supply fans, exhaust fans, or both.

FAN SYSTEM, EXHAUST or RELIEF. A *fan system* dedicated to the removal of air from interior spaces to the outdoors.

FAN SYSTEM, RETURN. A *fan system* dedicated to removing air from the interior where some or all the air is to be recirculated except during economizer operation.

FAN SYSTEM, SINGLE-CABINET. A *fan system* where a single fan, single fan array, a single set of fans operating in parrallel, or fans or fan arrays in series and embedded in the same cabinet that both supply air to a space and recirculate the air.

FAN SYSTEM, TRANSFER. A *fan system* that exclusively moves air from one occupied space to another.

Add new text as follows:

Table C403.8.1(2) EXHAUST, RETURN, RELIEF, TRANSFER FAN SYSTEM POWER ALLOWANCES (W/CFM)

Mult-Zone VAV Fan System airflow[a] (cfm)				All Other Fan Systems Airflow (cfm)		
Air System Component	<5,000	5,000 to <10,000	>=10,000	<5,000	5,000 to <10,000	>=10,000
W/cfm						
Exhaust, Return, Relief, and Transfer System Base Allowance for each *fan system*	0.231	0.256	0.248	0.194	0.192	0.200
Particle filtration						
Filter (any MERV value)[b]	0.049	0.042	0.038	0.049	0.043	0.039
Energy recovery						
Enthalpy Recovery Ratio >= 0.50 and <0.55	0.146	0.125	0.112	0.146	0.128	0.114
Enthalpy Recovery Ratio >=0.55 and <0.60	0.173	0.148	0.133	0.173	0.150	0.135
Enthalpy Recovery Ratio >=0.60 and <0.65	0.199	0.170	0.153	0.199	0.173	0.155
Enthalpy Recovery Ratio >=0.65 and <0.70	0.225	0.192	0.173	0.226	0.196	0.176
Enthalpy Recovery Ratio >=0.70 and <0.75	0.250	0.214	0.193	0.252	0.218	0.196
Enthalpy Recovery Ratio >=0.75 and <0.80	0.276	0.236	0.213	0.277	0.240	0.216
Enthalpy Recovery Ratio >=0.8	0.302	0.258	0.234	0.303	0.263	0.236
Run-around liquid or refrigerant coils	0.146	0.125	0.112	0.146	0.128	0.114
Special exhaust and return system requirements (select all that apply)						
Return or exhaust systems required to be fully ducted by code or accreditation standards	0.122	0.105	0.094	0.122	0.107	0.096
Return and/or exhaust airflow control devices required by code or accreditation standards to maintain pressure relationships between *spaces*	0.122	0.105	0.094	0.122	0.107	0.096
Laboratory and vivarium exhaust *systems* in high-rise buildings for vertical duct exceeding 75 feet. Value shown is allowed W/cfm per 0.25 inch wg for each 100 feet exceeding 75 feet. [Calculation requiredc]	0.061	0.053	0.047	0.061	0.054	0.048
Exhaust system serving fume hoods	0.085	0.074	0.066	0.085	0.075	0.067
Biosafety cabinet. Value shown is allowed W/cfm per 1.0 inch wg air pressure drop [Calculation required[c]]	0.241	0.206	0.186	0.242	0.210	0.188
Exhaust filters, scrubbers, or other exhaust treatment required by code or standard. Value shown is allowed W/cfm per 1.0 inch wg air pressure drop. [Calculation requiredc]	0.241	0.206	0.186	0.242	0.210	0.188
Other						
Sound attenuation section (fans serving spaces with design background noise goals below NC35)	0.036	0.032	0.029	0.036	0.032	0.029

a. See Section C408.3.1.1 for requirements for a Multi-Zone VAV System.

b. Particle filter pressure loss can only be counted once per *fan system*.

c. Power allowances require further calculation. Multiply the actual pressure drop of the device or component by the fan power allowance in Table C403.8.1(2).

TABLE C403.8.1(3) FAN POWER LIMIT ALTITUDE CORRECTION FACTOR

Altitude (ft)	Correction factor
<3,000	1.000
>=3,000 and <4,000	0.896
>=4,000 and <5,000	0.864
>=5,000 and <6,000	0.832
>=6,000	0.801

C503.3.2 Fan power limit. If a new *fan system* is installed and the existing duct system is not replaced, a fan power allowance as shown in Table C503.3 shall be added to that allowed in Section C403.8

TABLE C503.3 ADDITIONAL FAN POWER ALLOWANCES (W/CFM)

Multi-zone VAV Fan System Airflow[a] (cfm)			All Other Fan Systems Airflow (cfm)			
Air *System* Component	<5,000	5,000 to <10,000	>=10,000	<5,000	5,000 to <10,000	>=10,000
W/cfm						
Supply fan *system*	0.358	0.386	0.372	0.460	0.468	0.434
Exhaust, return, relief, transfer fan *system*	0.253	0.256	0.232	0.289	0.291	0.262
unit with adapter curb						
Exhaust, return, relief, transfer fan *system*	0.070	0.061	0.054	0.070	0.062	0.055
Additional allowance						
Exhaust, return, relief, transfer fan *system*	0.016	0.017	0.220	0.000	0.000	0.000

a. See definition of fan system, multi-zone variable air volume (VAV).

Reason: The fan power limits were one of the most successful energy savings addenda in the IECC. However, they have not been updated in a decade. This proposal provides some increase in stringency, but more importantly, it addresses flaws in the original to improve both enforceability and clarity.

The improvements include:

- The requirements are based on actual energy input rather than brake horsepower.
- Designs now get credit for using direct-drive transmissions vs. belt-drive.
- The scope has been expanded to include fan systems down to 1 kW of input power from the previous lower threshold of 5 brake horsepower.
- Fan systems to which the requirements apply have been clearly defined.
- Fan system components that were not included previously have been added (e.g., hot gas reheat coils)
- Equipment that does not include mechanical heating or cooling have been brought into scope.

A similar proposal was approved by the California Energy Commission for Title 24-2022. The measure was reviewed with stakeholders in several meetings and went through three stages of public review. The Codes and Standards Enhancement Report that includes an in=depth discussion of the proposal and energy savings analysis is available at this link: https://title24stakeholders.com/wp-content/uploads/2020/09/2022_T24-Final-CASE-Report_Air-Distribution.pdf.

This proposal is also soon to be voted on by SSPC 90.1. The draft of that addendum has been reviewed in two rounds of stakeholder meetings.

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

Cost-effectiveness for Proposal 510 – Fan Power Limits

The proposed values reduce the allowed fan system electrical input power by about 10% on average, the amount varies by system. A large multi-zone VAV system will see a reduction of about 13% if it includes MERV-13 filters. On the other hand with the new credit for single-zone VAV systems that are configured to turn down to 50% of airflow, there is no increase in stringency at all.

There are many ways to improve a system to achieve the goal. Though the improvements here are based on the cost difference between a belt-drive centrifugal fan and a direct-drive plenum fan, there are many options to reduce pressure drop in the fan system that will yield the same results for less money. In fact, the California Title 24 cost-effectiveness was based entirely on improving the design of the duct system while leaving the current minimum-efficiency air handler systems unchanged. Some of the options for improving fan system performance include:

- Reducing duct pressure drop through the selection of high-performance fittings.
- Using angle filters in place of flat filters.
- Locating equipment so that duct runs, and in particular vertical shafts, are straight.
- Careful consideration of design and the placement of the first turn in the duct system after leaving the air handler (this is often the highest pressure drop in the system).

However, for the purpose of this exercise, the cost of a belt-driven centrifugal fan with a variable-frequency drive was compared to a direct-drive plenum fan. The reduction in transmission losses alone make up for most of the required improvement in electrical input power. The two systems were run in the prototype buildings used by ASHRAE 90.1 in all climate zones. The majority of fans in the prototype buildings that are large enough to meet the threshold of 1 kW of input power in the proposal are variable-speed fans. Manufacture cost data was used to compare the cost per design cfm of the two different fans at two different sizes:

- 3,000 cfm - $0.346 per cfm
  - 10,000 cfm - $0.192 per cfm

The following tables show the annual energy cost savings for various buildings. The savings vary by climate, with warmer and wetter climates generally showing higher savings. The annual savings were multiplied by 12, which is the ASHRAE scalar limit for equipment with a 15-year lifespan. In nearly all cases, the cost per cfm of an improved fan is less than the scalar limit.
Primary school – these typically have fans that are about 3,000 cfm or a little more. In all cases, the savings are greater than the $0.346 additional cost:

	Elec Energy Savings (kWh)	Gas Energy Savings (Therm)	Elec Energy Cost Savings ($)	Gas Energy Cost Savings ($)	Total Energy Cost Savings ($)	Annual Savings X12	Modeled Airflow	$/cfm
Albuquerque	13085	-84	1438	-67	1371	$16,450	25169.5	$0.65
Atlanta	12935	-7	1422	-5	1416	$16,994	25169.5	$0.68
Buffalo	11531	-51	1267	-41	1226	$14,717	25169.5	$0.58
Denver	12004	-118	1319	-95	1224	$14,694	25169.5	$0.58
Dubai	18103	0	1990	0	1990	$23,875	25169.5	$0.95
ElPaso	13822	-50	1519	-40	1479	$17,744	25169.5	$0.70
Fairbanks	14078	-157	1547	-126	1422	$17,059	25169.5	$0.68
GreatFalls	11509	-40	1265	-32	1232	$14,790	25169.5	$0.59
HoChiMinh	14873	0	1635	0	1635	$19,615	25169.5	$0.78
InternationalFalls	12749	-95	1401	-76	1325	$15,904	25169.5	$0.63
Miami	15460	0	1699	0	1699	$20,384	25169.5	$0.81
NewDelhi	16277	1	1789	1	1790	$21,476	25169.5	$0.85
NewYork	11932	-12	1311	-10	1302	$15,622	25169.5	$0.62
PortAngeles	10436	-1	1147	-1	1146	$13,756	25169.5	$0.55
Rochester	12563	-72	1381	-58	1323	$15,872	25169.5	$0.63
SanDiego	11373	-10	1250	-8	1242	$14,903	25169.5	$0.59
Seattle	11632	-139	1278	-111	1167	$14,004	25169.5	$0.56
Tampa	16769	-1	1843	-1	1842	$22,108	25169.5	$0.88
Tucson	12771	0	1404	0	1404	$16,847	25169.5	$0.67

Large Hotel – These typically use large VAV fans. Again, in all cases, the additional cost of $0.192 per cfm is much less than the projected savings:

	Elec Energy Savings (kWh)	Gas Energy Savings (Therm)	Elec Energy Cost Savings ($)	Gas Energy Cost Savings ($)	Total Energy Cost Savings ($)	Annual Savings X12	Modeled Airflow	$/cfm
Albuquerque	24756	-20	2721	-16	2704	$32,451	40110.4	$0.81
Atlanta	20992	-24	2307	-19	2288	$27,453	40110.4	$0.68
Buffalo	19504	-60	2144	-49	2095	$25,140	40110.4	$0.63
Denver	24984	-45	2746	-36	2710	$32,520	40110.4	$0.81
Dubai	24856	-3	2732	-2	2729	$32,752	40110.4	$0.82
ElPaso	23902	-12	2627	-10	2617	$31,407	40110.4	$0.78
Fairbanks	16880	-72	1855	-58	1797	$21,565	40110.4	$0.54
GreatFalls	21103	-55	2319	-44	2275	$27,300	40110.4	$0.68
HoChiMinh	26707	-10	2935	-8	2927	$35,128	40110.4	$0.88
Honolulu	22710	-3	2496	-3	2493	$29,918	40110.4	$0.75
InternationalFalls	18937	-73	2081	-59	2022	$24,267	40110.4	$0.61
NewDelhi	24433	-8	2685	-7	2679	$32,143	40110.4	$0.80
NewYork	20083	-38	2207	-31	2177	$26,118	40110.4	$0.65
PortAngeles	19082	-24	2097	-19	2078	$24,937	40110.4	$0.62
Rochester	19824	-84	2179	-67	2112	$25,338	40110.4	$0.63
SanDiego	19085	-16	2097	-13	2084	$25,013	40110.4	$0.62
Seattle	19438	-27	2136	-22	2115	$25,375	40110.4	$0.63
Tampa	23725	-9	2607	-7	2600	$31,201	40110.4	$0.78
Tucson	23380	-11	2569	-9	2560	$30,726	40110.4	$0.77

Standalone Retail – These prototypes use a mix of small and large fans. However, the 12-year savings are much higher than the per cfm cost of both sizes.

	Elec Energy Savings (kWh)	Gas Energy Savings (Therm)	Elec Energy Cost Savings ($)	Gas Energy Cost Savings ($)	Total Energy Cost Savings ($)	Annual Savings X12	Modeled Airflow	$/cfm
Albuquerque	7589	-85	834	-68	766	$9,195	23371.2	$0.39
Atlanta	4501	-43	495	-35	460	$5,521	23371.2	$0.24
Buffalo	6972	-152	766	-122	645	$7,736	23371.2	$0.33
Denver	7759	-136	853	-109	744	$8,927	23371.2	$0.38
Dubai	10695	0	1175	0	1175	$14,103	23371.2	$0.60
ElPaso	10139	-66	1114	-53	1061	$12,736	23371.2	$0.54
Fairbanks	7159	-186	787	-149	638	$7,653	23371.2	$0.33
GreatFalls	7475	-171	822	-137	684	$8,210	23371.2	$0.35
HoChiMinh	10356	0	1138	0	1138	$13,657	23371.2	$0.58
InternationalFalls	6591	-140	724	-113	612	$7,341	23371.2	$0.31
Miami	9071	-1	997	-1	996	$11,956	23371.2	$0.51
NewDelhi	9863	-15	1084	-12	1072	$12,863	23371.2	$0.55
NewYork	6897	-121	758	-97	661	$7,927	23371.2	$0.34
PortAngeles	6750	-133	742	-106	635	$7,625	23371.2	$0.33
Rochester	7617	-179	837	-144	693	$8,320	23371.2	$0.36
SanDiego	6986	-11	768	-9	759	$9,109	23371.2	$0.39
Seattle	6975	-114	767	-92	675	$8,100	23371.2	$0.35
Tampa	7270	-12	799	-10	789	$9,472	23371.2	$0.41
Tucson	7817	-10	859	-8	851	$10,216	23371.2	$0.44

Large Office – These prototypes use large VAV fans. In this case, the additional cost of $0.192 per cfm meets the scalar for most climate zones. It does not meet the scalar for Climate Zone 8.

	Elec Energy Sa	Gas Energy Sa	Total Energy U	nergy Savings (	ergy Savings (T	hergy Cost Savi	ergy Cost Savi	nergy Cost Savi	Annual Savings X12	Modeled Airflow	$/cfm
Albuquerque	222.89	-9.75	213.14	61963	-92	6810	-74	6736	$80,828	255854.8	$0.32
Atlanta	172.59	-0.7	171.89	47980	-7	5273	-5	5268	$63,212	255854.8	$0.25
Buffalo	152.66	-1.6	151.06	42439	-15	4664	-12	4652	$55,823	255854.8	$0.22
Denver	200.94	-15.33	185.61	55861	-145	6139	-117	6023	$72,271	255854.8	$0.28
Dubai	224.07	-0.08	223.99	62291	-1	6846	-1	6845	$82,143	255854.8	$0.32
ElPaso	231.17	-3.94	227.23	64265	-37	7063	-30	7033	$84,394	255854.8	$0.33
Fairbanks	52.95	-4.04	48.91	14720	-38	1618	-31	1587	$19,044	255854.8	$0.07
GreatFalls	148.99	-7.86	141.13	41419	-75	4552	-60	4492	$53,906	255854.8	$0.21
HoChiMinh	352.43	-0.45	351.98	97976	-4	10768	-3	10764	$129,169	255854.8	$0.50
InternationalFalls	189.47	-1.72	187.75	52673	-16	5789	-13	5776	$69,308	255854.8	$0.27
Miami	334.69	-0.31	334.38	93044	-3	10226	-2	10223	$122,678	255854.8	$0.48
NewDelhi	215.16	-1.05	214.11	59814	-10	6574	-8	6566	$78,788	255854.8	$0.31
NewYork	226.87	-0.49	226.38	63070	-5	6931	-4	6928	$83,132	255854.8	$0.32
PortAngeles	191.2	-16.32	174.88	53154	-155	5842	-124	5717	$68,610	255854.8	$0.27
Rochester	102.91	-0.29	102.62	28609	-3	3144	-2	3142	$37,703	255854.8	$0.15
SanDiego	158.62	-1.12	157.5	44096	-11	4846	-9	4838	$58,052	255854.8	$0.23
Seattle	240.28	-13.24	227.04	66798	-126	7341	-101	7240	$86,885	255854.8	$0.34
Tampa	222.8	-0.17	222.63	61938	-2	6807	-1	6806	$81,669	255854.8	$0.32
Tucson	219.17	-1.47	217.7	60929	-14	6696	-11	6685	$80,219	255854.8	$0.31

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The fan power limits were one of the most successful energy savings addenda in the IECC. However, they have not been updated in a decade. This proposal provides some increase in stringency, but more importantly, it addresses flaws in the original to improve both enforceability and clarity

Final Hearing Results

CEPI-119-21 AM

CEPI-120-21

Original Proposal

IECC®: C403.8.4, C403.7.8 (New)

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

C403.8.4 Fractional hp fan motors. Motors for fans that are not less than $^{1}/_{12}$ hp (0.062 kW) and are less than 1 hp (0.746 kW) shall be electronically commutated motors or shall have a minimum motor efficiency of 70 percent, rated in accordance with DOE 10 CFR 431. These motors shall have the means to adjust motor speed for either balancing or remote control. The use of belt-driven fans to sheave adjustments for airflow balancing instead of a varying motor speed shall be permitted.

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

1. Motors in the airstream within fan coils and terminal units that only provide heating to the space served.
2. Motors in space-conditioning equipment that comply with Section C403.3.2 or Sections C403.8.1. through C403.8.3.
3. Motors that comply with Section C405.8.

Add new text as follows:

C403.7.8 Dwelling unit ventilation system. A fan that is the air mover for a heating or cooling system that serves an individual *dwelling unit* shall not be used to provide outdoor air.

Exception: Where the fan efficacy is not less than 1.2 cfm of outdoor airflow per watt when there is no demand for heating or cooling.

Reason: This proposal crosswalks the 2021 IECC-R Table R403.6.2 dwelling unit outdoor air fan efficacy requirements to the IECC-C (specifically as related to air handlers; other efficacy requirements are coordinated through other proposals). When space conditioning air handlers are used as the primary supply fan to provide outdoor air to dwelling units, the energy penalty can be significant. Such systems are commonly referred to as "central fan integrated" or CFI systems. The typical energy penalty associated with using a CFI system instead of a dedicated outdoor air supply fan is about 1148 kWh annually per dwelling unit[1] – an enormous penalty that is comparable to adding ~3 refrigerators[2] to a dwelling unit. This proposal would ensure that, where specified, a CFI system's outdoor air fan efficacy requirements would align with the 2021 IECC-R requirements and would comply with at least the minimum fan efficacy requirement of the alternatives provided in Table C403.8.5.

1. Annual central air handler energy use for a typical apartment was estimated at 1270 kWh, based on the following assumptions: 1000 sqft, 2-bedrooms, 53 cfm OA flow requirement, OA duct provides 1.5 x 53 cfm on an intermittent basis (i.e., 79 cfm; 67% annual duty cycle for ventilation), 25% annual duty cycle for central air handler run time to provide heating/cooling (source: Rudd, A., I. Walker 2007. “Whole House Ventilation System Options – Phase 1 Simulation Study.” ARTI Report No. 30090-01, Final Report, March. Air-Conditioning and Refrigeration Technology Institute, Arlington, VA), probability of coincidental operation of central air handler for heating/cooling and variable ventilation system for outdoor air: 67%*25%=17% (this is the % of “free” central air handler energy for distributing ventilation air), 0.58 W/cfm air handler fan efficacy (source: CEC Title 24 Section 150.1(c)10 prescriptive requirement for air handler efficacy that is not connected to a forced air furnace), 1.5-ton central cooling unit with airflow rate of 400 cfm/ton, air handler operates at design airflow rate when providing ventilation air (provides an upper bound for coincidental energy use). Result: 762 kWh/yr consumed by central air handler for heating and cooling, 2032 kWh/yr consumed by central air handler for heating, cooling, and distributing ventilation air, 1270 kWh/yr fan energy use for ventilation. If a dedicated outdoor air supply fan with an efficacy of 3.8 cfm/W were used instead, the dwelling unit would use 387 kWh instead (53 cfm / 3.8 cfm/W, continuous operation), a savings of 1148 kWh annually.

2 U.S. DOE's Federal Energy Management Program estimates typical, new refrigerators to use 403 kWh annually: https://www.energy.gov/eere/femp/purchasing-energy-efficient-residential-refrigerators.

Motorized Damper for use with Air Handler			
Manufacturer	**Model**	**Price**	**Source**
Honeywell	Y8150A1017	$202.39	Zoro.com
AirCycler	AC-G1D-06	$230.60	AirCycler website
Broan	FIN-6MD	$180.25	camperid.com
Aldes	FAK-II-MD-6	$187.50	HVACQuick.com
		$200.19	

Discrete Supply Fan			
Manufacturer	**Model**	**Price**	**Source**
Broan	FIN-180B	$225.69	SupplyHouse.com
Broan	FIN-180P	$295.00	SupplyHouse.com
AirKing	QuFAM	$397.00	ACWholesalers.com
AprilAire	8142	$321.22	SupplyHouse.com
AprilAire	8145	$309.43	SupplyHouse.com
Panasonic	FV-15NLFS1	$537.50	SupplyHouse.com
Soler & Palau	RF8-120EC	$447.20	HVACQuick.com
		$361.86	

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

As noted in the reason statement for the proposal that introduced this requirement in the IECC-R (RE134-19), "For buildings that are already using an independent fan strategy (exhaust, supply, or balanced) or an integrated fan strategy that utilizes a small enough horsepower motor, this proposal will not increase or decrease the cost of construction. For buildings that are currently using (a motorized damper coupled with) a standard AHU/furnace fan motor (i.e., CFI system) as their mechanical ventilation fan, the cost of construction may increase as they will need to adjust their mechanical ventilation design strategy in order to comply." If designers elect to specify a dedicated in-line supply fan, the incremental first cost to the consumer is estimated to average ~$160 (with options as low as ~$45). See the included table for pricing information collected in September 2021. This incremental first cost can be recouped quickly based on energy savings of ~1148 kWh/year by using a dedicated in-line supply fan instead of a CFI system to deliver outdoor air.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: per the proponent's reason statement submitted.

Final Hearing Results

CEPI-120-21 AM

CEPI-121-21

Original Proposal

IECC®: TABLE C403.8.5, C403.8.5, CSA Chapter 06 (New), ASHRAE Chapter 06 (New)
Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE C403.8.5 LOW-CAPACITY VENTILATION FAN EFFICACY[a]

FAN LOCATIONSYSTEM TYPE	AIRFLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	TEST PROCEDURE	AIRFLOW RATE MAXIMUM (CFM)
Balanced ventilation system without heat or energy recovery	Any	1.2[a]	ASHRAE Standard 51 (ANSI/AMCA Standard 210)	
HRV, or ERV	Any	1.2 cfm/watt	CAN/CSA 439-18	Any
Range hood	Any	2.8	ASHRAE 51 (ANSI/AMCA Standard 210)	
In-line supply or exhaust fan	Any	3.8 cfm/watt		Any
Bathroom, utility room	10< 90	2.8 cfm/watt		< 90
Other exhaust fan	>=90 and < 200	3.5 cfm/watt		Any
	>= 200	4.0		

For SI: 1 cfm/ft = ~~47.82 W~~0.47 L/s.

a. For balanced systems, HRVs, and ERVs, determine the efficacy as the outdoor airflow divided by the total fan power.

~~Airflow shall be tested in accordance with HVI 916 and listed. Efficacy shall be listed or shall be derived from listed power and airflow. Fan efficacy for fully ducted HRV, ERV, balanced and in-line fans shall be determined at a static pressure not less than 0.2 inch w.c. Fan efficacy for ducted range hoods, bathroom and utility room fans shall be determined at a static pressure not less than 0.1 inch w.c.~~

C403.8.5 Low-capacity ventilation fans. Mechanical ventilation system fans with motors less than $^{1}/_{12}$ hp (0.062 kW) in capacity shall meet the efficacy requirements of Table C403.8.5 at one or more rating points. Airflow shall be tested in accordance with the test procedure referenced by Table C403.8.5 and listed. The airflow shall be reported in the product listing or on the label. Fan efficacy shall be reported in the product listing or shall be derived from the input power and airflow values reported in the product listing or on the label. Fan efficacy for fully ducted HRV, ERV, balanced, and in-line fans shall be determined at a static pressure not less than 0.2 inch w.c. (49.85 Pa). Fan efficacy for ducted range hoods, bathroom, and utility room fans shall be determined at a static pressure not less than 0.1 inch w.c. (24.91 Pa).

Exceptions:

1. Where ventilation fans are a component of a listed heating or cooling appliance.
2. Dryer exhaust duct power ventilators, domestic range hoods and domestic range booster fans that operate intermittently.
3. Fans in radon mitigation systems.
4. Fans not covered within the scope of the test methods referenced in Table C403.8.5.
5. Ceiling fans regulated under 10 CFR 430 Appendix U.

Add new standard(s) as follows:

CSA

CSA Group
8501 East Pleasant Valley Road
Cleveland, OH 44131-5516

CAN/CSA-C439-18	Laboratory methods of test for rating the performance of heat/energy-recovery ventilators

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

ASHRAE Standard 51-16 / ANSI/*AMCA* Standard 210-16.	Laboratory Methods Of Testing Fans For Certified Aerodynamic Performance Rating

Reason: This proposal improves alignment between the IECC-C fan efficacy table with ENERGY STAR specifications and ASHRAE 90.1 and IECC-R fan efficacy tables, providing better organization and clarity, establishing the minimum fan efficacy for balanced systems, establishing minimum fan efficacy for exhaust fans exceeding 200 cfm, and moving footnote information into the main body. Note that the change of the table header from "fan location" to "system type" and the additions of "balanced" and "range hood" system types were approved by ICC through approval of RE133-19, RE137-19, and RE178-19 and should show up in the 2021 version, pending ICC approval of submitted errata. The efficacy value introduced for range hoods is in the 2018 IECC-R table, is aligned with the ENERGY STAR Ventilating Spans v4.1 and is only applicable for range hoods operated continuously (as noted in the exceptions to the table's charging language. The new efficacy value introduced for exhaust fans exceeding 200 cfm is aligned with ENERGY STAR Ventilating Fans v4.1 and was found to be cost effective through the ASHRAE 90.1 process. All efficacy values track with ENERGY STAR values for the product type. The three exceptions were added to ensure that the section does not preempt federal regulations, does not apply to radon fans (which may operate at higher static pressures -- and lower efficacies -- than typical ventilation fans), and does not apply to fans that are not regulated by the test standards referenced (e.g., fans integrated with an appliance are exempt). Finally, the test methods referenced are those referenced by ASHRAE 90.1 and are those used by industry for testing and listing.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The only element of this proposal that may affect first costs is the introduction of a fan efficacy requirement for exhaust fans exceeding 200 cfm and a motor less than 1/12 horsepower. This requirement is aligned with ENERGY STAR Ventilating Fans v4.1 and has already been vetted by ASHRAE 90.1, which has cost effectiveness requirements. Additionally, a small sample of internet retail pricing for units that would be affected by this requirement showed that price was not heavily correlated with efficacy:

Compliant:

Model A: 300 cfm, 7.3 cfm/watt, $185

Model B: 200 cfm, 11.4 cfm/watt, $179

Not Compliant:

Model C 200 cfm, 3.5 cfm/watt, $159

Model D: 200 cfm, 3.6 cfm/watt, $212

Pricing gathered October 2021 from airxheat, ecomfort, homedepot, and amazon.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies the code and moves the footnote to show it applies to all the issues

Final Hearing Results

CEPI-121-21	AM

CEPI-123-21

Original Proposal

IECC®: C403.8.6.2 (New)

Proponents: Glory O'Brien, Western Mechanical Solutions (glory.obrien@westernmechanicalsolutions.com)

2021 International Energy Conservation Code

Add new text as follows:

C403.8.6.2 Intermittent exhaust control for bathrooms and toilet rooms. Where an exhaust system serving a bathroom or toilet room is designed for intermittent operation, the exhaust system shall be provided with manual-on capability and one or more of the following controls:

1. A timer control that has a minimum setpoint not greater than 30 minutes.
2. An *occupant sensor control* that automatically turns off exhaust fans within 30 minutes after all occupants have left the space.
3. A humidity control capable of manual or automatic adjustment from a minimum setpoint not greater than 50 percent to a maximum setpoint not greater than 80 percent relative humidity.
4. A contaminant control that responds to a particle or gaseous concentration.

Exception: Bathroom and toilet room exhaust systems serving as an integral component of an outdoor air ventilation system in Group R-2, R-3, and R-4 occupancies shall not be required to provide controls other than manual on capability.

An off setpoint shall not be used to comply with a minimum setpoint requirement.

Reason: To reduce energy consumption and unnecessary infiltration in buildings.

Substantiation: Bin analysis was run on a 50 cfm bath exhaust fan in Denver. It was assumed the fan would run 2 hours a day with a manual switch vs. 5 minutes with a timer. Only heating energy and fan energy was reviewed, savings was $ 27 per year based on 10¢/KWH.

Assuming $ 100 installed cost, the payback is 4 years . Added benefit is that occupants no longer need to remember to go back and shutoff the bathroom exhaust fan.

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

A small increase in cost can significantly reduce the time a bathroom fan is on.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: this proposal will reduce energy consumption and unnecessary infiltration in buildings.

Final Hearing Results

CEPI-123-21	AM

CEPI-124-21

Original Proposal

IECC®: SECTION 202, C403.9, TABLE C403.9 (New), C403.9.1 (New), AMCA Chapter 06, DOE Chapter 06 (New)

Proponents: Amanda Hickman, The Hickman Group, Air Movement and Control Association (AMCA) (amanda@thehickmangroup.com); Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Revise as follows:

LARGE-DIAMETER CEILING FAN. A ceiling fan that is greater than or equal to 84.5 inches (2.15 meters) ~~7 feet (2134 mm)~~ in diameter. These fans are sometimes referred to as High-Volume, Low-Speed (HVLS) fans.

C403.9 Large-diameter ceiling fans. Where provided, *large-diameter ceiling fans* shall be tested and labeled in accordance with AMCA 230 and shall meet the efficiency requirements of Table C403.9 and Section C403.9.1.

Add new text as follows:

TABLE C403.9 CEILING FAN EFFICIENCY REQUIREMENTS[a]

EQUIPMENT TYPE	MINIMUM EFFICIENCY[b,c]	TEST PROCEDURE
Large-diameter ceiling fan for applications outside the U.S.[c]	CFEI ≥ 1.00 at high (maximum) speed CFEI ≥ 1.31 at 40% of high speed or the nearest speed that is not less than 40% of high speed	10 CFR 430 Appendix U or AMCA Standard 230 and AMCA Standard 208 (for FEI calculations)
Large-diameter ceiling fan	CFEI ≥ 1.00 at high (maximum) speed; and CFEI ≥ 1.31 at 40% of high speed or the nearest speed that is not less than 40% of high speed	10 CFR 430 Appendix U

a. The minimum efficiency requirements at both high speed and 40% of maximum speed shall be met or exceeded to comply with this code.

b. Ceiling fans are regulated as consumer products by 10 CFR 430.

c. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

C403.9.1 Ceiling Fan Energy Index (CFEI). The Ceiling Fan Energy Index shall be calculated as the ratio of the electric input power of a reference large-diameter ceiling fan to the electric input power of the actual large-diameter ceiling fan as calculated in accordance with AMCA 208 with the following modifications to the calculations for the reference fan: using an airflow constant (Q) of 26,500 cfm (12.507 m^3/s), a pressure constant (P) of 0.0027 in. of water (0.6719 Pa), and fan efficiency constant (η) of 42%.

Revise as follows:

AMCA

Air Movement and Control Association Internationa
30 West University Drive
Arlington Heights, IL 60004-1806

230—15 with errata   Laboratory Methods of Testing Air Circulating Fans for Rating and Certification

Add new standard(s) as follows:

DOE

US Department of Energy
c/o Superintendent of Documents 1000 Independence Avenue SW
Washington, DC 20585

10 CFR, Part 430, App U Uniform Test Method for Measuring the Energy Consumption of Ceiling Fans

Reason:

Large-diameter ceiling fans (LDCF) are used in many buildings covered by the International Energy Conservation Code. In recent years, the usage of this class of products has increased significantly. However, the 2021 IECC has no minimum energy efficiency requirements for this type of fan.

On January 19, 2017, the U.S. Department of Energy (DOE) completed a rulemaking and published a final rule establishing new federal minimum energy efficiency standards for ceiling fans. In doing so, it established the LDCF product class, which are ceiling fans with a blade span greater than 2.13 m (84 in.) and a corresponding efficiency metric of cubic feet per minute per Watt, or CFM/W.

The DOE test procedure's requirement is to round the measured blade span to the nearest inch, which does not appear in AMCA 230-15 or AMCA 208-18. Therefore, to provide equivalent requirements, the LDCF product class is all ceiling fans with blade spans greater than or equal to 84.5 in. (2.15m) when determined in accordance with the AMCA standards and 2.13 m (84 in.) when determined in accordance with 10 CFR 430.

On December 27, 2020, the U.S. House of Representatives Bill HR-133, aka the "Consolidated Appropriations Act, 2021," became Public Law No: 116-260. HR-133, Section 1008, entitled "Ceiling Fan Improvement Act," replaced the CFM/W efficiency metric with Ceiling Fan Energy Index (CFEI).

Specifically, Section 1008 of the Energy Act of 2020 (the ''Act'') amended section 325(ff)(6) of EPCA to specify that LDCF manufactured on or after January 21, 2020, are not required to meet minimum ceiling fan efficiency requirements in terms of the total airflow to the total power consumption, CFM/W, as established in the January 2017 Final Rule. Instead, LDCF are required to meet minimum efficiency requirements based on the CFEI metric. (42 U.S.C. 6295(ff)(6)(C)(i)(I), as codified). Small-diameter ceiling fans use a different test procedure, have a different efficiency metric, and were not impacted by the Energy Act of 2020.

The Act requires large-diameter ceiling fans to have a CFEI greater than or equal to 1.00 at high speed and greater than or equal to 1.31 at 40 percent speed or the nearest speed that is not less than 40 percent speed. (42 U.S.C. 6295(ff)(6)(C)(i)(II), as codified). Further, the Act specifies that CFEI is to be calculated in accordance with ANSI/AMCA Standard 208-18, with the following modifications to the constants used for the reference fan: (I) Using an Airflow Constant (Q_0) of 26,500 cubic feet per minute; (II) Using a Pressure Constant (P_0) of 0.0027 inches water gauge; and (III) Using a Fan Efficiency Constant (h_0) of 42 percent. (42 U.S.C. 6295(ff)(6)(C)(ii), as codified). The EPCA language did not provide metric equivalents for the replacement coefficients, however, the metric conversions are provided in the proposed addendum.

This proposal adds the minimum energy efficiency requirements from 42 U.S.C. 6295(ff)(6)(C)(ii) for large-diameter ceiling fans to the IECC and is consistent with the federal standards. DOE's analysis from the final rule indicates that the adopted energy conservation standards for all ceiling fan product classes would save a significant amount of energy. Relative to the case without amended standards (referred to as the "no-new-standards case"), the lifetime energy savings for ceiling fans purchased in the 30-year period amounts to 2.008 quadrillion British thermal units (Btu), or quads.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Building on the explanation above, additional details regarding the energy savings and economic calculations can be found in DOE's Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Ceiling Fans, published November 2016 which can be found at the link below. https://www.regulations.gov/document/EERE-2012-BT-STD-0045-0149

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: matches current federal regulations

Final Hearing Results	
CEPI-124-21	AS

CEPI-125-21

Original Proposal

IECC®: SECTION 202 (New), C404.11 (New), TABLE C404.11 (New), ANSI Chapter 06 (New), ASME Chapter 06 (New)

Proponents: Kimberly Cheslak, NBI, NBI (kim@newbuildings.org); Josh Keeling, Cadeo Group, Cadeo Group (jkeeling@cadeogroup.com); Ben Rabe, Fresh Energy (rabe@fresh-energy.org); Bryan Bomer, Department of Permitting Services, Montgomery County MD, Department of Permitting Services (bryan.bomer@montgomerycountymd.gov); Lauren Urbanek, Natural Resources Defense Council (lurbanek@nrdc.org); Howard Calvert Wiig, Hawaii State Energy Office, Hawaii State Energy Office (howard.c.wiig@hawaii.gov); Kim Burke, State of Colorado, Colorado Energy Office (kim.burke@state.co.us); Matthew Tidwell, Portland General Electric, Portland General Electric (matthew.tidwell@pgn.com); Chris Castro, City of Orlando, City of Orlando (chris.castro@orlando.gov); Brad Smith, City of Fort Collins (brsmith@fcgov.com); Amber Wood, ACEEE, ACEEE (awood@aceee.org)

2021 International Energy Conservation Code

Add new definition as follows:

DEMAND RESPONSE SIGNAL. A signal that indicates a price or a request to modify electricity consumption for a limited time period.

DEMAND RESPONSIVE CONTROL. A control capable of receiving and automatically responding to a demand response signal.

Add new text as follows:

C404.11 Demand responsive water heating. Electric storage water heaters with a rated water storage volume of 40 gallons (150L) to 120 gallons (450L) and a nameplate input rating equal to or less than 12kW shall be provided with *demand responsive controls* in accordance with Table C404.11 or another equivalent *approved* standard.

Exceptions:

1. Water heaters that provide a hot water delivery temperature of 180°F (82°C) or greater.
2. Water heaters that comply with Section IV, Part HLW or Section X of the ASME Boiler and Pressure Vessel Code.
3. Water heaters that use 3-phase electric power.

TABLE C404.11 DEMAND RESPONSIVE CONTROLS FOR WATER HEATING

Equipment Type	Controls	
	Manufactured before 7/1/2025	Manufactured on or after 7/1/2025
Electric storage water heaters	ANSI/CTA-2045-B Level 1 and also capable of initiating water heating to meet the temperature set point in response to a *demand response signal*.	ANSI/CTA-2045-B Level 2, except “Price Stream Communication” functionality as defined in the standard.

Add new standard(s) as follows:

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

ANSI/CTA 2045-B Modular Communications Interface for Energy Management

ASME

American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990

BPVC Boiler and Pressure Vessel Code

Reason: With increasing penetrations of intermittent renewable energy, volatile wholesale power prices, and subsequent growth in dynamic rates/demand response programs, grid-interactive end uses present an opportunity to help homes manage their bills, participate in programs, and support efficient grid operations. Water heaters can provide many services to the grid, including generation, transmission, and distribution capacity, energy arbitrage, and ancillary services. In their assessment of the National Potential for Load Flexibility, Brattle estimated that across all measures these services could provide as much as $15 billion per year in value to the electric system.

As electricity systems transform to include more variable wind and solar energy, demand flexibility becomes increasingly critical to both grid operation and further transformation. Building systems that can use energy when it is abundant, clean, and low-cost not only help decarbonize the entire energy system, they also insulate their owners from future increases in demand charges and peak hour energy rates – a current and accelerating trend. Water heaters offer an unparalleled opportunity for load shifting: tanks full of hot water are inherently energy storage devices. Including the controls necessary to take advantage of this opportunity is relatively simple and affordable in new construction. Compared to other energy storage technologies such as batteries, smart, grid-integrated water heater controls can deliver substantial dispatchable (that is, reliable to the grid operator) energy flexibility. The controls specified by ANSI/CTA-2045-B ensure negligible risk of occupant disruption (that is, the hot water will not run out). Water heaters provide a particularly attractive option as they have inherent thermal storage that allows energy consumption to be shifted with little to no impact to the end user. This capability has been demonstrated in several contexts, most recently through regional demonstrations conducted by EPRI and BPA.

In their Grid-interactive and Efficient Buildings (GEBs) Roadmap, the US Department of Energy estimates that approximately 15 GW of additional load flexibility is expected to be added to the system under reference case assumptions. Combined with energy efficiency, this is expected to provide $13 billion/year of peak demand savings to the power system and its customers. Through a comprehensive literature review and interviewing dozens of national experts, the USDOE team found that one of the biggest barriers was the lack of interoperability. A key tool to solve this problem is building codes, which can help to ensure that interoperable devices and controls are installed at the time of construction. USDOE cited explicitly the use of codes and standards as one of its recommended pathways to enable greater adoption of GEBs technologies.

It is important to include the requirement for two-way communication (specifically, communication from the behind-the-meter control module back to the utility, grid operator, or other third party entity) because this communication ensures that the controls capability can be fully deployed when needed. With legacy demand response systems, a signal is sent out but the ability to track and quantify the impacts of that signal is effectively nonexistent. This one-way communication paradigm is a key reason that the “firmness” or reliability of many flexibility-related demand side management strategies, particularly demand response, is often considered to be very low. However, a two-way communication paradigm enables much more reliable impact tracking. Buildings whose controls include two-way communication capability, that is, those with grid-interactive controls as defined here, will be better able to participate in the demand response programs of the future, and their owners will have improved financial prospects through enhanced ability to participate in potentially lucrative utility demand response programs.

ANSI/CTA-2045-B standardizes the socket, and communications protocol, for electric water heaters so they can communicate with the grid, and with demand response signal providers. In addition, 2045-B adds control and communications requirements for mixing valves in water heaters, which enable them to provide greater storage capacity to support increased load shifting while eliminating scalding risk.

Versions of this standard are included in codes or other requirements in California, Oregon, and Washington and are referenced explicitly by ENERGY STAR.

Bibliography: Brattle, The National Potential for Load Flexibility (2019) https://brattlefiles.blob.core.windows.net/files/16639_national_potential_for_load_flexibility_-_final.pdf

BPA, CTA-2045 Water Heater Demonstration Report (2018) https://www.bpa.gov/EE/Technology/demand-response/Documents/Demand%20Response%20-%20FINAL%20REPORT%20110918.pdf

EPRI, CEA-2045 Field Demonstrations Project Description (2014) https://www.epri.com/research/products/000000003002004009

USDOE, A National Roadmap for Grid-Interactive Efficient Buildings (2021) https://gebroadmap.lbl.gov/A%20National%20Roadmap%20for%20GEBs%20-%20Final.pdf

Washington State Revised Code of Washington, Title 19, Chapter 19.260, Section 19.260.080, available at https://app.leg.wa.gov/RCW/default.aspx?cite=19.260.080

Oregon Department of Energy, Energy Efficiency Standards Rulemakinghttps://www.oregon.gov/energy/Get-Involved/Pages/EE-Standards-Rulemaking.aspx

U.S. EPA Energy Star Program, Connected Criteria for ENERGY STAR Products, https://www.energystar.gov/products/spec/connected_criteria_energy_star_products_pd

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

To enable grid-interactive controls, there are two sources of costs: the incremental cost to ensure that equipment is interoperable with CTA-2045-B and the cost of the control module installed in that device. The incremental manufacturing cost is in the range of a few dollars, and negligible at higher volumes. The current incremental cost to include a CTA-2045-B compliant control module ranges from about $60 (direct current, hard-wired connection) to $160 (alternating current, wireless cellular connection); this is expected to decline as manufacturing lines are brought up to larger scale (source: Advanced Water Heating Initiative). The major determinant of cost if the chosen radio pathway as chipset costs vary considerably between different frequencies/standards.

In the BPA report, manufacturers stated a range of $2-$30 for regional deployment, but noted that there would be economies of scale for a national rollout. The main cost was development of firmware/hardware to accommodate the standard, but these costs have already been incurred to meet codes/standards in OR, WA, and CA.

Public Hearing Results

Committee Action	**As Modified**

Committee Reason: Grid-interactive end uses present an opportunity to help homes manage their bills, participate in programs, and support efficient grid operations. Water heaters can provide many services to the grid, including generation, transmission, and distribution capacity, energy arbitrage, and ancillary services.

Final Hearing Results

CEPI-125-21	AM

CEPI-127-21

Original Proposal

IECC®: TABLE C404.2

Proponents: Mike Kennedy, Mike D. Kennedy Inc., Northwest Energy Efficiency Alliance; Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Delete and substitute 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[e], ≥ 20 gallons and ≤ 120 gallons~~	~~0.93 - 0.00132V, EF~~	~~DOE 10 CFR Part 430~~
		~~Resistance ≥ 20 gallons and ≤ 55 gallons~~	~~0.960 - 0.0003V, EF~~	
		~~Grid-enabled[f] > 75 gallons and ≤ 120 gallons~~	~~1.061 - 0.00168V, EF~~	
	~~> 12 kW~~	~~Resistance~~	~~(0.3 + 27/V $_m$), %/h~~	~~ANSI Z21.10.3~~
	~~≤ 24 amps and ≤ 250 volts~~	~~Heat pump > 55 gallons and ≤ 120 gallons~~	~~2.057 - 0.00113V, EF~~	~~DOE 10 CFR Part 430~~
~~Storage water heaters, gas~~	~~≤ 75,000 Btu/h~~	~~≥ 20 gallons and > 55 gallons~~	~~0.675 - 0.0015V, EF~~	~~DOE 10 CFR Part 430~~
		~~> 55 gallons and ≤ 100 gallons~~	~~0.8012 - 0.00078V, EF~~	
	~~> 75,000 Btu/h and ≤ 155,000 Btu/h~~	~~< 4,000 Btu/h/gal~~	~~80% E_t~~ $(Q/800 + 110\sqrt{V})SL$, Btu/h	~~ANSI Z21.10.3~~
	~~> 155,000 Btu/h~~	~~< 4,000 Btu/h/gal~~	~~80% E_t~~ $(Q/800 + 110\sqrt{V})SL$, Btu/h	
~~Instantaneous water heaters, gas~~	~~> 50,000 Btu/h and < 200,000 Btu/h[c]~~	~~≥ 4,000 Btu/h/gal and < 2 gal~~	~~0.82 - 0.00 19V, EF~~	~~DOE 10 CFR Part 430~~
	~~≥ 200,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and < 10 gal~~	~~80% E_t~~	~~ANSI Z21.10.3~~
	~~≥ 200,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and ≥ 10 gal~~	~~80% E_t~~ $(Q/800 + 110\sqrt{V})SL$, Btu/h	
~~Storage water heaters, oil~~	~~≤ 105,000 Btu/h~~	~~≥ 20 gal and ≤ 50 gallons~~	~~0.68 - 0.0019V, EF~~	~~DOE 10 CFR Part 430~~
	~~≥ 105,000 Btu/h~~	~~< 4,000 Btu/h/gal~~	~~80% E_t~~ $(Q/800 + 110\sqrt{V})SL$, Btu/h	~~ANSI Z21.10.3~~
~~Instantaneous water heaters, oil~~	~~≤ 210,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and < 2 gal~~	~~0.59 - 0.0019V, EF~~	~~DOE 10 CFR Part 430~~
	~~> 210,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and < 10 gal~~	~~80% E_t~~	~~ANSI Z21.10.3~~
	~~> 210,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and ≥ 10 gal~~	~~78% E_t~~ $(Q/800 + 110\sqrt{V})SL$, Btu/h	
~~Hot water supply boilers, gas and oil~~	~~≥ 300,000 Btu/h and < 12,500,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and < 10 gal~~	~~80% E_t~~	~~ANSI Z21.10.3~~
~~Hot water supply boilers, gas~~	~~≥ 300,000 Btu/h and < 12,500,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and ≥ 10 gal~~	~~80% E_t~~ $(Q/800 + 110\sqrt{V})SL$, Btu/h	
~~Hot water supply boilers, oil~~	~~> 300,000 Btu/h and < 12,500,000 Btu/h~~	~~> 4,000 Btu/h/gal and > 10 gal~~	~~78% E_t~~ $(Q/800 + 110\sqrt{V})SL$, 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: 1 foot = 304.8 mm, 1 square foot = 0.0929 m², °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 (E_t) 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 V_m 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/h) 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 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. ~~Was 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 nonwater-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."~~

TABLE C404.2 MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	DRAW PATTERN	PERFORMANCE REQUIRED[a]	TEST PROCEDURE[b]
Electric Table-top water heaters[c]	≤12 kW	≥ 20 gal ≤ 120 gal[d]	Very small Low Medium High	UEF ≥ 0.6323 - (0.0058 × Vr) UEF ≥ 0.9188 - (0.0031 × Vr) UEF ≥ 0.9577 - (0.0023 × Vr) UEF ≥ 0.9884 - (0.0016 × Vr)	DOE 10 CFR Part 430 App. E

Electric Storage water heaters[e,f]: resistance and heat pump	≤12 kW	≥ 20 gal ≤ 55 gal [f]	Very small Low Medium High	UEF ≥ 0.8808 - (0.0008 × Vr) UEF ≥ 0.9254 - (0.0003 × Vr) UEF ≥ 0.9307 - (0.0002 × Vr) UEF ≥ 0.9349 - (0.0001 × Vr)	DOE 10 CFR Part 430 App. E
	≤12 kW	> 55 gal ≤120 gal [f]	Very small Low Medium High	UEF ≥ 1.9236 - (0.0011 × Vr) UEF ≥ 2.0440 - (0.0011 × Vr) UEF ≥ 2.1171 - (0.0011 × Vr) UEF ≥ 2.2418 - (0.0011 × Vr)	DOE 10 CFR Part 430 App. E
Electric Storage water heaters[e,f]	> 12 kW			(0.3 + 27/Vm), %h	DOE 10 CFR 431.106 App B.
Grid-enabled water heaters [g]		>75 gal [d]	Very small Low Medium High	UEF ≥ 1.0136 - (0.0028 × Vr) UEF ≥ 0.9984 - (0.0014 × Vr) UEF ≥ 0.9853 - (0.0010 × Vr) UEF ≥ 0.9720 - (0.0007 × Vr)	10 CFR 430 Appendix E
Electric Iinstantaneous water heaters[h]	≤12 kW	< 2 gal [d]	Very small Low Medium High	UEF ≥ 0.91 UEF ≥ 0.91 UEF ≥ 0.91 UEF ≥ 0.92	DOE 10 CFR Part 430
	>12 kW & ≤ 58.6 kW [i]	≤ 2 gal & ≤180F	All	UEF ≥ 0.80	DOE 10 CFR Part 430
Gas Storage water heaters[e]	≤ 75,000 Btu/h	≥20 gal & ≤ 55 gal[d]	Very small Low Medium High	UEF ≥ 0.3456 - (0.0020 × Vr) UEF ≥ 0.5982 - (0.0019 × Vr) UEF ≥ 0.6483 - (0.0017 × Vr) UEF ≥ 0.6920 - (0.0013 × Vr)	DOE 10 CFR Part 430 App. E
	≤ 75,000 Btu/h	> 55 gal & ≤ 100 gal[d]	Very small Low Medium High	UEF ≥ 0.6470 - (0.0006 × Vr) UEF ≥ 0.7689 - (0.0005 × Vr) UEF ≥ 0.7897 - (0.0004 × Vr) UEF ≥ 0.8072 - (0.0003 × Vr)	DOE 10 CFR Part 430 App. E
	> 75,000 Btu/h and ≤ 105,000 Btu/h [j,k]	≤ 120 gal ≤ 180 F	Very small Low Medium High	UEF ≥ 0.2674-0.0009 x Vr UEF ≥ 0.5362-0.0012 x Vr UEF ≥ 0.6002-0.0011 x Vr UEF ≥ 0.6597-0.0009 x Vr	DOE 10 CFR Part 430 App. E
	> 105,000 Btu/h [k]			80% E_t SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Gas Instantaneous water heaters[i]	> 50,000 Btu/h and < 200,000 Btu/h[k]	< 2 gal[d]	Very small Low Medium High	UEF ≥ 0.80 UEF ≥ 0.81 UEF ≥ 0.81 UEF ≥ 0.81	DOE 10 CFR Part 430 App. E
	≥ 200,000 Btu/h [k]	< 10 gal		80% Et	DOE 10 CFR 431.106
	≥ 200,000 Btu/h [k]	≥10 gal		80% E_t SL ≤ (Q/800 +110√V), Btu/h	
Oil Storage water heaters[e]	≤ 105,000 Btu/h	≤ 50 gal[d]	Very small Low Medium High	UEF = 0.2509 - (0.0012 × Vr) UEF = 0.5330 - (0.0016 × Vr) UEF = 0.6078 - (0.0016 × Vr) UEF = 0.6815 - (0.0014 × Vr)	DOE 10 CFR Part 430
	> 105,000 Btu/h and ≤ 140,000 Btu/h [l]	≤ 120 gal ≤ 180 F	Very small Low Medium High	UEF ≥ 0.2932-0.0015 x Vr UEF ≥ 0.5596-0.0018 x Vr UEF ≥ 0.6194-0.0016 x Vr UEF ≥ 0.6740-0.0013 x Vr	DOE 10 CFR Part 430 App. E

	>140,000 Btu/h	All		80% *Et* SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Oil Instantaneous water heaters[h]	≤ 210,000 Btu/h	< 2 gal		80% Et EF ≥ 0.59 - 0.0005 x V	DOE 10 CFR Part 430 App. E
	> 210,000 Btu/h	< 10 gal		80% *Et*	DOE 10 CFR 431.106
	> 210,000 Btu/h	≥ 10 gal		78% *Et* SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106

Hot water supply boilers, gas and oil[h]	≥300,000 Btu/h and < 12,500,000 Btu/h	< 10 gal	-	80% *Et*	DOE 10 CFR 431.106
Hot water supply boilers, gas[i]	≥300,000 Btu/h and < 12,500,000 Btu/h	≥ 10 gal	-	80% E_t SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Hot water supply boilers, oil[h]	≥300,000 Btu/h and < 12,500,000 Btu/h	≥ 10 gal	-	78% E_t SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Pool heaters, gas[d]	All	—[f]	-	82% *Et*	DOE 10 CFR Part 430 App. P
Heat pump pool heaters	All	50°F db 44.2°F wb outdoor air 80.0°F entering water	-	4.0 COP	DOE 10 CFR Part 430 App. P
Unfired storage tanks	All	—	-	Minimum insulation requirement R-12.5 (h-ft^2-°F)/Btu	(none)

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m^2, °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. Thermal efficiency (E_t) is a minimum requirement, while standby loss is a maximum requirement. In the standby loss equation, V is the rated volume in gallons and Q is the nameplate input rate in Btu/h. V_m is the measured volume in the tank in gallons. Standby loss for electric water heaters is in terms of %/h and denoted by the term "S," and standby loss for gas and oil water heaters is in terms of Btu/h and denoted by the term "SL" Draw pattern (DP) refers to the water draw profile in the Uniform Energy Factor (UEF) test. UEF and Energy Factor (EF) are minimum requirements. In the UEF standard equations, V_r refers to the rated volume in gallons.

b. Chapter 6 contains a complete specification, including the year version, of the referenced test procedure.

c. A tabletop water heater is a storage water heater that is enclosed in a rectangular cabinet with a flat top surface not more than three feet (0.91 m) in height and has a ratio of input capacity (Btu/h) to tank volume (gal) < 4000.

d. Water heaters or gas pool heaters in this category are regulated as consumer products by the USDOE as defined in 10 CFR 430.

e. Storage water heaters have a ratio of input capacity (Btu/h) to tank volume (gal)<4000.

f. Efficiency requirements for electric storage water heaters ≤ 12 kW apply to both electric resistance and heat pump water heaters. There are no minimum efficiency requirements for electric heat pump water heaters greater than 12kW or for gas heat pump water heaters.

g. 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 (284 L).
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 a 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."

h. Instantaneous water heaters and hot water supply boilers have an input capacity (Btu/h) divided by storage volume (gal) ≥ 4000 Btu/h-gal. i. Electric instantaneous water heaters with input capacity >12 kW and ≤58.6 kW that have either (1) a storage volume >2 gal(7.6L); or (2) is designed to provide outlet hot water at temperatures greater than 180°F(82ºC); or (3) uses three-phase power has no efficiency standard.j. Gas storage water heaters with input capacity >75,000 Btu/h (21.98 kW) and ≤105,000 Btu/h (30.77 kW) must comply with the requirements for the >105,000 Btu/h (30.77 kW) if the water heater either (1) has a storage volume >120 gal (454L); (2) is designed to provide outlet hot water at temperatures greater than 180°F (82ºC); or (3) uses three-phase power.

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k. Refer to Section C404.2.1 for additional requirements for gas storage and instantaneous water heaters and gas hot-water supply boilers.l. Oil storage water heaters with input capacity>105,000 Btu/h (30.77 kW) and ≤140,000 Btu/h (41.03 kW) must comply with the requirements for the >140,000 Btu/h (41.03 kW) if the water heater either (1) has a storage volume > 120 gal(454L); (2) is designed to provide outlet hot water at temperatures greater than 180ºF (82ºC); or (3) uses three-phase power.

Reason: The current IECC Table C404.2 uses Energy Factor (EF) which DOE replaced with the Universal Energy Factor (UEF) in 2017. New equipment are ratings are published in UEF and EF is generally not published. As such this table needs to be changed.

The proposed table C404.2 updates the values to the current DOE standards requirements. It is taken from language proposed for the Washington State Energy Code. Alternate approaches would include deleting the table entirely or adopting a table similar to 90.1. Most of the values in Table C404.2 are based upon national standards of one sort and another. As such most equipment will comply whether the table is in the code or not. Simply eliminating the table is an option and would keep code officials from worrying about water heater efficiency. Or a table similar to that adopted by 90.1 could be used. It lists all the equipment categories but for standards equipment simply states that it's regulated by DOE standards.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal updates code to reflect current federal standards and therefore will not increase the cost.

CEPI-126-21 proposes changes to Table C404.2 as well.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The current IECC Table C404.2 uses Energy Factor (EF) which DOE replaced with the Universal Energy Factor (UEF) in 2017. New equipment are ratings are published in UEF and EF is generally not published. As such this table needs to be changed. The proposed table C404.2 updates the values to the current DOE standards requirements. It is taken from language proposed for the Washington State Energy Code. Alternate approaches would include deleting the table entirely or adopting a table similar to 90.1. Most of the values in Table C404.2 are based upon national standards of one sort and another. As such most equipment will comply whether the table is in the code or not. Simply eliminating the table is an option and would keep code officials from worrying about water heater efficiency. Or a table similar to that adopted by 90.1 could be used. It lists all the equipment categories but for standards equipment simply states that it's regulated by DOE standards.

Final Hearing Results

CEPI-127-21	AM

CEPI-128-21

Original Proposal

IECC®: C404.2.1

Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Revise as follows:

C404.2.1 High input service water-heating systems. Gas-fired service water-heating equipment installed in new buildingswhere the total input capacity provided by high-capacity service water heating equipment is 1,000,000 Btu/h (293 kW) or greater shall be in compliance with ~~this section~~ either or both of the following requirements. ~~Where a singular piece of water-heating equipment serves the entire building and the input rating of the equipment is 1,000,000 Btu/h (293 kW) or greater, such equipment shall have a thermal efficiency, E_t, of not less than 92 percent. Where multiple pieces of water-heating equipment serve the building and the combined input rating of the water-heating equipment is 1,000,000 Btu/h (293 kW) or greater, the combined input-capacity-weighted-average thermal efficiency, E_t, shall be not less than 90 percent.~~

1. Where a singular piece of high-capacity gas-fired service water-heating equipment is installed, such equipment shall have a thermal efficiency, E_t, of not less than 92 percent.
2. Where multiple pieces of high-capacity gas-fired service water-heating equipment are connected to the same service water-heating system, the combined input-capacity-weighted-average thermal efficiency, E_t, shall not be less than 90 percent and a minimum of 30 percent of the input to the gas-fired equipment in the service water-heating system shall have a thermal efficiency of not less than 92 percent.

High-capacity gas-fired service water-heating equipment is comprised of gas-fired instantaneous water heaters with a rated input both greater than 200,000 Btu/h (58.6 kW) and not less than 4,000 Btu/h per gallon (310 W per litre) of stored water, and gas-fired storage water heaters with a rated input both greater than 105,000 Btu/h (30.8 kW) and less than 4,000 Btu/h per gallon (310 W per litre) of stored water.

Exceptions:

~~1. Where not less than 25 percent of the annual service water-heating requirement is provided by *on-site renewable energy* or site-recovered energy, the minimum thermal efficiency requirements of this section shall not apply.~~

~~2.~~ 1. The input rating of water heaters installed in individual dwelling units shall not be required to be included in the total input rating of service water-heating equipment for a building.

~~3.~~ 2. The input rating of water heaters with an input rating of not greater than ~~100,000~~ 105,000 Btu/h (~~29.3~~ 30.8 kW) shall not be required to be included in the total input rating of service water-heating equipment for a building.

Reason: Addendum ah to 90.1-2019

This addendum makes a slight modification the to requirements for high-capacity water heaters.

- Currently, the 92% E_t requirement applies if there is just one water heater in the entire building. The change requires that the 92% E_t apply for any individual system that is high-capacity.
- Where multiple water heaters are connected to the same system, the average thermal efficiency is still 90%, but now at least 30% of the capacity must have a thermal efficiency of 92% or better.

Clear criteria have been established for high-capacity water heaters.

Commercial water heaters in the United States are regulated by the US Department of Energy (US DOE) under 10 CFR Part 431. These are the definitions of the products from the regulation:

- Gas-fired instantaneous water heaters with a rated input both greater than 200,000 Btu/h and not less than 4,000 Btu/h per gallon of stored water; or,

- Gas-fired storage water heaters with a rated input both greater than 105,000 Btu/h and less than 4,000 Btu/h per gallon of stored water.

These definitions are used to describe “high-capacity gas-fired service water heating equipment.” Service water heaters that are not included are consumer products regulated under 10 CFR Part 430 and “residential-duty commercial water heaters” as defined in 10 CFR Part 431. These products are rated using the Uniform Energy Factor, which cannot be readily compared to Et.

Other changes:

The exception for buildings that use site-solar or on-site recovered energy has been deleted since there are now general provisions covering renewables in other parts of the code.

Bibliography: ANSI/ASHRAE/IES Standard 90.1-2019 Energy Standard for Buildings Except Low-Rise Residential Buildings, Addendum ah

https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda/addenda-to-standard-90-1-2019

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Neither US DOE’s Compliance Certification Database nor AHRI’s Certification Database includes any commercial gas-fired storage water heaters rated in the range from 90% to <92% thermal efficiency (Et). There are only four model numbers of commercial gas-fired instantaneous water heaters rated in the range from 90% to <92% Et. Three of these models are part of a product line with a range of Et from 87% to 90%, and the manufacturer’s literature lists all models in that line at 87% Et, leaving only one model number from one manufacturer. That model has a maximum input of 250,000 Btu/h.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: per the proponent’s reason statement submitted.

Final Hearing Results

CEPI-128-21 AM

CEPI-130-21

Original Proposal

IECC®: C404.4, C404.4.1 (New), TABLE C404.4.1 (New)

Proponents: Gary Klein, Gary Klein and Associates, Inc., Self (gary@garykleinassociates.com); Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org); John Bade, 2050 Partners, California Investor Owned Utilities (johnbade@2050partners.com)

2021 International Energy Conservation Code

Revise as follows:

C404.4 ~~Insulation of piping~~ Service water heating system piping insulation. ~~Piping from a water heater to the termination of the heated water fixture supply pipe shall be insulated in accordance with Table C403.12.3. On both the inlet and outlet piping of a storage water heater or heated water storage tank, the piping to a heat trap or the first 8 feet (2438 mm) of piping, whichever is less, shall be insulated. Piping that is heat traced shall be insulated in accordance with Table C403.12.3 or the heat trace manufacturer's instructions. Tubular pipe insulation shall be installed in accordance with the insulation manufacturer's instructions. Pipe insulation shall be continuous except where the piping passes through a framing member. The minimum insulation thickness requirements of this section shall not supersede any greater insulation thickness requirements necessary for the protection of piping from freezing temperatures or the protection of personnel against external surface temperatures on the insulation.~~Service water heating system piping shall be surrounded by uncompressed insulation. The wall thickness of the insulation shall be not less than the thickness shown in Table C404.4.1. Where the insulation thermal conductivity is not within the range in the table, the following equation shall be used to calculate the minimum insulation thickness: $t_{alt} = r\cdot[(1 + t_{table}/r)k_{alt}/k_{upper} - 1]$ Where:t_{alt} = minimum insulation thickness of the alternate material (in.) (mm)

r = actual outside radius of pipe (in.) (mm)

t_{table} = insulation thickness listed in this table for applicable fluid temperature and pipesizek_{alt} = thermal conductivity of the alternate material at mean rating temperature indicatedfor the applicable fluid temperature [Btu·in/h·ft2·°F] [W (m·°C)]

k_{upper} = the upper value of the thermal conductivity range listed in this table for the applicable fluid temperature [Btu·in/h·ft2·°F] [W (m·°C)] For nonmetallic piping thicker than Schedule 80 and having thermal resistance greater than that of steel pipe, reduced insulation thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot (meter) than a steel pipe of the same size with the insulation thickness shown in the table.

Exception: Tubular pipe insulation shall not be required on the following:

1. ~~The tubing from the connection at the termination of the fixture supply piping to a plumbing fixture or plumbing appliance.~~ Factory-installed piping within water heaters and hot water storage tanks
2. Valves, pumps, and strainers ~~and threaded unions~~ in piping that is not greater than 1 inch (25 mm) ~~or less~~ in nominal diameter.
3. Piping that conveys hot water that has not been heated through the use of fossil fuels or electricity

~~3.~~ 4. Piping from user-controlled shower and bath mixing valves to the water outlets.

~~4.~~ 5. Cold-water piping of a demand recirculation water system. .

~~5. Tubing from a hot drinking-water heating unit to the water outlet~~.

6. Piping in existing buildings where alterations are made to existing service water heating systems where there is insufficient space or access to meet the requirements.

~~6.~~ 7. Piping at locations where a vertical support of the piping is installed.

~~7. Piping surrounded by building insulation with a thermal resistance (*R*-value) of not less than R-3~~.

8. Where piping passes through a framing member if it requires increasing the size of the framing member

Add new text as follows:

C404.4.1 Installation Requirements. The following piping shall be insulated per the requirements of this section:

1. Recirculating system piping, including the supply and return piping
2. The first 8 feet (2.4m) of outlet piping from:
   2.1. Storage water heaters
   2.2. Hot water storage tanks
   2.3. Any water heater and hot water supply boiler containing not less than 10 gallons (37.9 L) of water heated by a direct heat source, an indirect heat source, or both a direct heat source and an indirect heat source.
3. The first 8 feet (2.4m) of branch piping connecting to recirculated, heat traced, or impedance heated piping.
4. The make-up water inlet piping between heat traps and the storage water heaters and the storage tanks they are serving, nonrecirculating service water heating storage-system.
5. Hot water piping between multiple water heaters, between multiple hot water storage tanks, and between water heaters and hot water storage tanks.
6. Piping that is externally heated (such as heat trace or impedance heating).
7. For direct-buried service water heating system piping, reduction of these thicknesses by 1.5 inches (38.1 mm) shall be permitted (before thickness adjustment required in T C404.4) but not to thicknesses less than 1 in (25.4 mm).

TABLE C404.4.1 MINIMUM PIPING INSULATION THICKNESS FOR SERVICE WATER HEAING SYSTEMS[a]

Service Hot-Water Temperature Range	Insulation Thermal Conductivity		Nominal Pipe or Tube Size, in.				
	Conductivity, Btu·in/h·ft2·°F	Mean Rating Temperature,°F	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
			Insulation Thickness, in.				
105°F to 140°F	0.22 to 0.28	100	1.0	1.0	1.5	1.5	1.5
>140°F to 200°F	0.25 to 0.29	125	1.0	1.0	2.0	2.0	2.0
>200°F	0.27 to 0.30	150	1.5	1.5	2.5	3.0	3.0

a. These thicknesses are based on energy efficiency considerations only. Additional insulation may be necessary for safety.

Reason: This proposal has been submitted to create a placeholder for the IECC to incorporate changes that are being considered for inclusion in the 2022 update to ASHRAE Standard 90.1.

The existing pipe insulation thickness requirements for service water heating piping come from Table C403.12.3, which was developed primarily for space heating. The major change in this proposal is to include a pipe insulation wall thickness table in the service water heating section of the IECC. Having a separate table will allow requirements for service water heating piping insulation to be based on typical service water heating operation and operating temperatures, which may be very different from those for mechanical systems.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The revisions proposed to this section will not change construction costs.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The existing pipe insulation thickness requirements for service water heating piping come from Table C403.12.3, which was developed primarily for space heating. The major change in this proposal is to include a pipe insulation wall thickness table in the service water heating section of the IECC. Having a separate table will allow requirements for service water heating piping insulation to be based on typical service water heating operation and operating temperatures, which may be very different from those for mechanical systems.

Final Hearing Results	
CEPI-130-21	AM

CEPI-131-21

Original Proposal

IECC®: C404.6.1

Proponents: Lisa Rosenow, Evergreen Technology Consulting, Self (lrosenow@evergreen-tech.net); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

C404.6.1 Circulation systems. Heated-water circulation systems shall be provided with a circulation pump.<u>Gravity and thermo-syphon circulation systems are prohibited.</u> The system return pipe shall be a dedicated return pipe<u>.</u> ~~or a cold water supply pipe. Gravity and thermo-syphon circulation systems shall be prohibited. Controls for circulating hot water system pumps~~ <u>Controls</u> shall <u>be configured to</u> automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is not a demand for hot water. ~~The controls shall limit the temperature of the water entering the cold water piping to not greater than 104ºF (40°C).~~ <u>Where a circulation pump serves multiple risers or piping zones, controls shall include self-actuating thermostatic balancing valves or another means of flow control to automatically balance the flow rate through each riser or piping zone.</u>

Reason: In service water heating systems, circulation pumps with electronically commutated motors (ECM) offer energy savings compared to circulation pumps with standard induction motors by providing the ability to balance system flow based on demand. The use of thermostatic balancing valves optimizes hot water flow to each zone in multiple zone or multiple riser systems. Both of these strategies reduce waste of heated water.

As a clarification, language regarding the use of a cold water supply pipe as the return has been removed. This language is covered under Section C404.6.1.1 for demand recirculation systems.

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

Cost Increase Information

Cost comparison is between a circulation pump with a standard A/C induction motor and a circulation pump with an electronically commutated motor.

Circulation pump size used for cost analysis - 2.5 - 5 gpm at 15 ft/hd, 145 psi

Installed cost for circulation pump with A/C induction motor - $750

Installed cost for circulation pump with ECM - $1,000

$250 incremental cost increase per pump based on manufacturer data from Bell and Gossett. Refer to manufacturer literature attached.

Projected Energy Savings

Assumptions - 4,000 hrs/yr pump operation; Circulation pump w/ECM ~ 30% more efficient

Circulation pump with standard motor - 70 watts

Circulation pump with ECM - 100 watts

30 watt savings x 4,000 hours/yr/1,000 = 120 kWh/yr

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The use of thermostatic balancing valves optimizes hot water flow to each zone in multiple zone or multiple riser systems and reduces waste of heated water.

Final Hearing Results	
CEPI-131-21	AM

CEPI-133-21

Original Proposal

IECC®: C405.1

Proponents: Jack Bailey, One Lux Studio, International Association of Lighting Designers (jbailey@oneluxstudio.com)

2021 International Energy Conservation Code

Revise as follows:

C405.1 General. Electrical power and lL~~L~~ighting systems ~~controls, the maximum lighting power for interior and exterior applications, and electrical energy consumption~~ shall comply with this section. *Sleeping units* shall comply with Section C405.2.5 and with~~either~~ Section C405.1.1~~ or C405.3~~. *General lighting* shall consist of all lighting included when calculating the total connected interior lighting power in accordance with Section C405.3.1 and which does not require specific application controls in accordance with Section C405.2.5.Transformers, uninterruptable power supplies, motors and electrical power processing equipment in data center systems shall comply with Section 8 of ASHRAE 90.4 in addition to this code.

Reason: The description of the scope of this section has not kept pace with the actual content of the section. This should be updated to more accurately represent the current scope.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The change is editorial.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Provides clarity to scope of C405.

Final Hearing Results

CEPI-133-21	AM

CEPI-134-21

Original Proposal

IECC®: C405.1, C405.9 (New)

Proponents: Jack Bailey, One Lux Studio, International Association of Lighting Designers (jbailey@oneluxstudio.com)

2021 International Energy Conservation Code

Revise as follows:

C405.1 General. Lighting system controls, the maximum lighting power for interior and exterior applications, and electrical energy consumption shall comply with this section. *Sleeping units* shall comply with Section C405.2.5 and with either Section C405.1.1 or C405.3. *General lighting* shall consist of all lighting included when calculating the total connected interior lighting power in accordance with Section C405.3.1 and which does not require specific application controls in accordance with Section C405.2.5. ~~Transformers, uninterruptable power supplies, motors and electrical power processing equipment in data center systems shall comply with Section 8 of ASHRAE 90.4 in addition to this code.~~

Add new text as follows:

C405.9 Data Center Systems. Transformers, uninterruptable power supplies, motors and electrical power processing equipment in data center systems shall comply with Section 8 of ASHRAE 90.4 in addition to this code.

Reason: This technical content does not belong in C405.1. It should be in a new subsection C405.9 (between motor efficiencies and vertical and horizontal transportation systems).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change is entirely editorial in nature.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: It makes sense to remove from current location under general, to a new section. This will also make it easier for searching in digital codes.

Final Hearing Results

CEPI-134-21	AS

CEPI-135-21

Original Proposal

IECC®: C405.1, C405.1.1, TABLE C405.3.2(2), TABLE C405.3.2(1), C405.3.2.1, C405.3.2.2, C405.3.1, C405.2.5

Proponents: Glenn Heinmiller, Lam Partners, International Association of Lighting Designers (glenn@lampartners.com)

2021 International Energy Conservation Code

Revise as follows:

C405.1 General. Lighting system controls, the maximum lighting power for interior and exterior applications, and electrical energy consumption shall comply with this section. *Sleeping units* shall comply with Section C405.2.5 and with~~either~~ Section C405.1.1 ~~or C405.3~~ . *General lighting* shall consist of all lighting included when calculating the total connected interior lighting power in accordance with Section C405.3.1 and which does not require specific application controls in accordance with Section C405.2.5.Transformers, uninterruptable power supplies, motors and electrical power processing equipment in data center systems shall comply with Section 8 of ASHRAE 90.4 in addition to this code.

C405.1.1 Lighting <u>power</u> for <u>sleeping units and</u> dwelling units. No less than 90 percent of the permanently installed lighting serving <u>sleeping units and</u> dwelling units, excluding kitchen appliance lighting, shall be provided by lamps with an efficacy of not less than 65 lm/W or luminaires with an efficacy of not less than 45 lm/W~~, or shall comply with Sections C405.2.4 and C405.3~~.

TABLE C405.3.2(2) INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE TYPES[a]	LPD (watts/ft²)
Atrium	
Less than 40 feet in height	0.48
Greater than 40 feet in height	0.60
Audience seating area	
In an auditorium	0.61
In a gymnasium	0.23
In a motion picture theater	0.27
In a penitentiary	0.67
In a performing arts theater	1.16
In a religious building	0.72
In a sports arena	0.33
Otherwise	0.33
Banking activity area	0.61
Breakroom (See Lounge/breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	0.89
Otherwise	0.71
Computer room, data center	0.94
Conference/meeting/multipurpose room	0.97
Copy/print room	0.31
Corridor	
In a facility for the visually impaired (and not used primarily by the staff[b])	0.71
In a hospital	0.71
Otherwise	0.41
Courtroom	1.20
Dining area	
In bar/lounge or leisure dining	0.86
In cafeteria or fast food dining	0.40
In a facility for the visually impaired (and not used primarily by the staff[b])	1.27
In family dining	0.60
In a penitentiary	0.42
Otherwise	0.43
Electrical/mechanical room	0.43
Emergency vehicle garage	0.52
Food preparation area	1.09
<u>Guestroom[c, d]</u>	<u>0.41</u>
Laboratory	

COMMON SPACE TYPES	LPD (watts/ft²)
In or as a classroom	1.11
Otherwise	1.33
Laundry/washing area	0.53
Loading dock, interior	0.88
Lobby	
For an elevator	0.65
In a facility for the visually impaired (and not used primarily by the staff[b])	1.69
In a hotel	0.51
In a motion picture theater	0.23
In a performing arts theater	1.25
Otherwise	0.84
Locker room	0.52
Lounge/breakroom	
In a healthcare facility	0.42
Otherwise	0.59
Office	
Enclosed	0.74
Open plan	0.61
Parking area, interior	0.15
Pharmacy area	1.66
Restroom	
In a facility for the visually impaired (and not used primarily by the staf[b]f	1.26
Otherwise	0.63
Sales area	1.05
Seating area, general	0.23
Stairwell	0.49
Storage room	0.38
Vehicular maintenance area	0.60
Workshop	1.26
BUILDING TYPE SPECIFIC SPACE TYPES[a]	**LPD (watts/ft²)**
Automotive (see Vehicular maintenance area)	
Convention Center—exhibit space	0.61
~~Dormitory—living quarters[c, d]~~	~~0.50~~
Facility for the visually impaired[b]	
In a chapel (and not used primarily by the staff)	0.70
In a recreation room (and not used primarily by the staff)	1.77
~~Fire Station—sleeping quarters[c]~~	~~0.23~~
Gymnasium/fitness center	
In an exercise area	0.90
In a playing area	0.85
Healthcare facility	
In an exam/treatment room	1.40
In an imaging room	0.94
In a medical supply room	0.62
In a nursery	0.92
In a nurse's station	1.17
In an operating room	2.26
~~In a patient room[c]~~	~~0.68~~
In a physical therapy room	0.91
In a recovery room	1.25
Library	
In a reading area	0.96
In the stacks	1.18
Manufacturing facility	
In a detailed manufacturing area	0.80
In an equipment room	0.76
In an extra-high-bay area (greater than 50 feet floor-to-ceiling height)	1.42
In a high-bay area (25-50 feet floor-to-ceiling height)	1.24
In a low-bay area (less than 25 feet floor-to-ceiling height)	0.86
Museum	
In a general exhibition area	0.31
In a restoration room	1.10
Performing arts theater—dressing room	0.41
Post office—sorting area	0.76
Religious buildings	
In a fellowship hall	0.54
In a worship/pulpit/choir area	0.85
Retail facilities	
In a dressing/fitting room	0.51
In a mall concourse	0.82
Sports arena—playing area	

COMMON SPACE TYPES	LPD (watts/ft²)
For a Class I facility[~~e~~c]	2.94
For a Class II facility[~~f~~d]	2.01
For a Class III facility[~~g~~e]	1.30
For a Class IV facility[~~h~~f]	0.86
Transportation facility	
At a terminal ticket counter	0.51
In a baggage/carousel area	0.39
In an airport concourse	0.25
Warehouse—storage area	
For medium to bulky, palletized items	0.33
For smaller, hand-carried items	0.69

For SI: 1 foot = 304.8 mm, 1 watt per square foot = 10.76 w/m^2.

a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply.

b. A 'Facility for the Visually Impaired' is a facility that is licensed or will be licensed by local or state authorities for senior long-term care, adult daycare, senior support or people with special visual needs.

c. ~~Where sleeping units are excluded from lighting power calculations by application of Section R404.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.~~

d. ~~Where dwelling units are excluded from lighting power calculations by application of Section R404.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.~~

~~e~~ c. Class I facilities consist of professional facilities; and semiprofessional, collegiate, or club facilities with seating for 5,000 or more spectators.

~~f.~~ d. Class II facilities consist of collegiate and semiprofessional facilities with seating for fewer than 5,000 spectators; club facilities with seating for between 2,000 and 5,000 spectators; and amateur league and high school facilities with seating for more than 2,000 spectators.

~~g.~~ e. Class III facilities consist of club, amateur league and high school facilities with seating for 2,000 or fewer spectators.

~~h.~~ f. Class IV facilities consist of elementary school and recreational facilities; and amateur league and high school facilities without provision for spectators.

TABLE C405.3.2(1) INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (w/ft^2)
Automotive facility	0.75
Convention center	0.64
Courthouse	0.79
Dining: bar lounge/leisure	0.80
Dining: cafeteria/fast food	0.76
Dining: family	0.71
Dormitory[a, b]	0.53
Exercise center	0.72
Fire station[a]	0.56
Gymnasium	0.76
Health care clinic	0.81
Hospital[a]	0.96
Hotel/Motel[a, b]	0.56
Library	0.83
Manufacturing facility	0.82
Motion picture theater	0.44
Multiple-family[c]	0.45
Museum	0.55

BUILDING AREA TYPE	LPD (w/ft)
Office	0.64
Parking garage	0.18
Penitentiary	0.69
Performing arts theater	0.84
Police station	0.66
Post office	0.65
Religious building	0.67
Retail	0.84
School/university	0.72
Sports arena	0.76
Town hall	0.69
Transportation	0.50
Warehouse	0.45
Workshop	0.91

For SI: 1 watt per square foot = 10.76 w/m^2.

a. ~~Where sleeping units are excluded from lighting power calculations by application of Section R404.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.~~

b. ~~Where dwelling units are excluded from lighting power calculations by application of Section R404.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.~~

c. ~~Dwelling units are excluded. Neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted~~.

C405.3.2.1 Building Area Method. For the Building Area Method, the interior lighting power allowance is calculated as follows:

1. For each building area type inside the building, determine the applicable building area type and the allowed lighting power density for that type from Table C405.3.2(1). For building area types not listed, select the building area type that most closely represents the use of that area. For the purposes of this method, an "area" shall be defined as all contiguous spaces that accommodate or are associated with a single building area type.
2. Determine the floor area for each building area type listed in Table C405.3.2(1) and multiply this area by the applicable value from Table C405.3.2(1) to determine the allowed lighting power (watts) for each building area type. *Sleeping units* and *dwelling units* are excluded from lighting power allowance calculations by application of Section C405.1.1. The area of *sleeping units* and *dwelling units* is not included in the calculation.
3. The total interior lighting power allowance (watts) for the entire building is the sum of the lighting power from each building area type.

C405.3.2.2 Space-by-Space Method. Where a building has unfinished spaces, the lighting power allowance for the unfinished spaces shall be the total connected lighting power for those spaces, or 0.2 watts per square foot (10.76 w/m^2), whichever is less. For the Space-by-Space Method, the interior lighting power allowance is calculated as follows:

1. For each space enclosed by partitions that are not less than 80 percent of the ceiling height, determine the applicable space type from Table C405.3.2(2). For space types not listed, select the space type that most closely represents the proposed use of the space. Where a space has multiple functions, that space may be divided into separate spaces.
2. Determine the total floor area of all the spaces of each space type and multiply by the value for the space type in Table C405.3.2(2) to determine the allowed lighting power (watts) for each space type. *Sleeping units* and *dwelling units* are excluded from lighting power allowance calculations by application of Section C405.1.1. The area of *sleeping units* and *dwelling units* is not included in the calculation.
3. The total interior lighting power allowance (watts) shall be the sum of the lighting power allowances for all space types.

C405.3.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-10.

$$TCLP = [LVL + BLL + LED + TRK + \text{Other}] \quad \textbf{(Equation 4-10)}$$

where:

TCLP = Total connected lighting power (watts).*LVL* = For luminaires with lamps connected directly to building power, such as line voltage lamps, the rated wattage of the lamp.*BLL* = For luminaires incorporating a ballast or transformer, the rated input wattage of the ballast or transformer when operating that lamp.*LED* = For light-emitting diode luminaires with either integral or remote drivers, the rated wattage of the luminaire.*TRK* = For lighting track, cable conductor, rail conductor, and plug-in busway systems that allow the addition and relocation of luminaires without rewiring, the wattage shall be one of the following:

1. The specified wattage of the luminaires, but not less than 8 W per linear foot (25 W/lin m).
2. The wattage limit of the permanent current-limiting devices protecting the system.
3. The wattage limit of the transformer supplying the system.

Other = The wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data supplied by the manufacturer or other *approved* sources.

The connected power associated with the following lighting equipment and applications is not included in calculating total connected lighting power.

1. Television broadcast lighting for playing areas in sports arenas.
2. Emergency lighting automatically off during normal building operation.
3. Lighting in spaces specifically designed for use by occupants with special lighting needs, including those with visual impairment and other medical and age-related issues.
4. Casino gaming areas.
5. Mirror lighting in dressing rooms.
6. Task lighting for medical and dental purposes that is in addition to general lighting.
7. Display lighting for exhibits in galleries, museums and monuments that is in addition to general lighting.
8. Lighting for theatrical purposes, including performance, stage, film production and video production.
9. Lighting for photographic processes.
10. Lighting integral to equipment or instrumentation and installed by the manufacturer.
11. Task lighting for plant growth or maintenance.
12. Advertising signage or directional signage.
13. Lighting for food warming.
14. Lighting equipment that is for sale.
15. Lighting demonstration equipment in lighting education facilities.
16. Lighting approved because of safety considerations.
17. Lighting in retail display windows, provided that the display area is enclosed by ceiling-height partitions.
18. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
19. Exit signs.
20. Antimicrobial lighting used for the sole purpose of disinfecting a space.
21. <u>Lighting in *sleeping units* and *dwelling units*</u>

C405.2.5 Specific application controls. Specific application controls shall be provided for the following:

1. The following lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a time-switch control complying with Section C405.2.2.1. In addition, a manual control shall be provided to control such lighting separately from the general lighting in the space:
    1.1. Luminaires for which additional lighting power is claimed in accordance with Section C405.3.2.2.1.
    1.2. Display and accent.
    1.3. Lighting in display cases.
    1.4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting.
    1.5. Lighting equipment that is for sale or demonstration in lighting education.
    1.6. Display lighting for exhibits in galleries, museums and monuments that is in addition to*general lighting*.

2. *Sleeping units* shall have control devices or systems that are configured to automatically switch off all permanently installed luminaires and switched receptacles within 20 minutes after all occupants have left the unit.

    Exceptions:

    1. Lighting and switched receptacles controlled by card key controls.
    2. Spaces where patient care is directly provided.

3. ~~Permanently installed luminaires within *dwelling units* shall be provided with controls complying with Section C405.2.1.1 or C405.2.3.1.~~
4. <u>3.</u> Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a time switch control complying with Section C405.2.2.1 that is independent of the controls for other lighting within the room or space.
5. <u>4.</u> Task lighting for medical and dental purposes that is in addition to*general lighting* shall be provided with a *manual control*.

Reason: For *sleeping units* the code currently allows the use of either the luminaire efficacy requirement (C405.1.1),**or** lighting power density (C405.3) to limit lighting power, and requires specific controls for *sleeping units* (C405.2.5 #2). The option to use lighting power density to comply with lighting power requirements is not needed, does nothing to improve energy efficiency, and adds unnecessary complexity. Designers and Engineers are always going to choose the luminaire efficacy requirement because it is simple and does not require any calculations.

For *dwelling units* the code currently allows the use of either the luminaire efficacy requirement (C405.1.1),**or** lighting power density (C405.3) and C405.2.5 #3 which requires occupancy sensors and light reduction controls (although it is not clear how this is to be applied to *dwelling units*). Designers/engineers/building owners will always choose the luminaire efficacy option because it is simple and does not require installation of lighting controls in the *dwelling unit*. The option is not necessary because it will never be used.

When the lighting power density option is removed, then the lighting power allowances for "Guestroom", "Dormitory -- living quarters", "Fire Station -- sleeping quarters" and "healthcare facility -- patient room" can be removed from Table C405.3.2 (2). All of these space types are by defintion either *sleeping units*, *dwelling units*, or both.

Five complicated footnotes to Tables C405.3.2(1) and C405.3.2(2) can also be removed and incorporated into C405.3.2.1 #2 and C405.3.2.2 #2 by adding one sentence. For clarity, "Lighting in *sleeping units* and *dwelling units*" is added to the list of lighting that is not included in lighting power calculations.

The clarifying word "allowed" is added to C405.3.2.1 #2 and C405.3.2.2 #2. You are calculating the lighting power allowance, not the lighting power.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This simplification of a the code will not require the use of more expensive equipment and does not eliminate a lower cost option

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Improves code language to more accurately depict dwelling and sleeping unit use.

Final Hearing Results

CEPI-135-21	AM

CEPI-137-21

Original Proposal

IECC®: C405.1.1

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

C405.1.1 Lighting for dwelling units. No less than 90 percent of the permanently installed lighting serving dwelling units~~, excluding kitchen appliance lighting,~~ shall be provided by lamps with an efficacy of not less than 65 lm/W or luminaires with an efficacy of not less than 45 lm/W, or shall comply with Sections C405.2.4 and C405.3.

Exceptions:

1. Lighting integral to a kitchen appliance or exhaust hood.
2. Antimicrobial lighting used for the sole purpose of disinfecting.

Reason: The efficacy requirements of Section C405.1.1 were developed to apply to lighting used for illumination. There are multiple exceptions to the requirements that should be recognized for dwelling units, similar to other spaces in other occupancies. Instead of continuing to expand the list of exceptions in C405.1.1 (which should include kitchen appliance lighting equipment and antimicrobial/germicidal lighting at a minimum), it is more reasonable to reference exceptions that are already itemized in Section C405.3.1. This proposal also improves organization of Section C405.3.1 by moving the exceptions to a subsection for clarity and ease of reference.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal clarifies the intent of this section, resulting in no increase or decrease in the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal clarifies exceptions to high-efficacy lighting requirements.

Final Hearing Results

CEPI-137-21	AM

CEPI-138-21

Original Proposal

IECC®: SECTION 202 (New), C405.12
Proponents: Kim Cheslak, NBI, NBI (kim@newbuildings.org)

2021 International Energy Conservation Code

Add new definition as follows:

COMMON AREA. All portions of Group R occupancies that are not dwelling units or sleeping units.

Revise as follows:

C405.12 Energy monitoring. ~~New buildings~~ Buildings ~~with a gross *conditioned floor area* of 25,000 square feet (2322 m^2) or larger~~ shall be equipped to measure, monitor, record and report energy consumption data in compliance with Sections C405.12.1 through C405.12.5.

~~Exception~~ **Exceptions:**

1. Buildings less than 10,000 square feet (929 m^2).
2. Existing buildings.
3. R-2 occupancies with less than 10,000 square feet (929 m^2) of *common area.*
4. ~~and individual~~ Individual tenant spaces ~~are not required to comply with this section provided that the space has its own utility services and meters and has~~ less than 5,000 square feet (464.5 m^2) ~~of *conditioned floor area*~~ with their own utility service and meter.

Reason: There are currently over 40 benchmarking regulations across the US (38 local jurisdictions and four states) – with size thresholds as low as 10,000 sf. These regulations require the reporting of energy use, and are being used as a steppingstone toward regulation of building performance – either through audit and retro-commissioning requirements or building performance standards. Ensuring that buildings are equipped to comply with these policies is a critical function of the code.

This change amends the structure of the code language slightly, but its primary focus is to drop the size threshold for compliance to 10,000 sqft – adding additional exceptions that align with similar language in ASHRAE 90.1-2019 under Section 8.4.3.

Bibliography: Benchmarking policy data: https://www.buildingrating.org/

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

A similar measure has proven cost effective in 90.1.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Based on the reason statement provided by the proponent, it improves the use of energy for buildings with a smaller overall size.

Final Hearing Results

CEPI-138-21 AM

CEPI-140-21

Original Proposal

IECC®: SECTION 202 (New), TABLE C405.12.2

Proponents: Sean Denniston, New Buildings Institute, New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Add new definition as follows:

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current. Plug-in hybrid electric vehicles are electric vehicles having a second source of motive power. Off-road, self-propelled electric mobile equipment, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats and the like, are not considered electric vehicles.

Revise as follows:

TABLE C405.12.2 ENERGY USE CATEGORIES

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	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 but not limited to data centers, manufacturing equipment and commercial kitchens.
Electric vehicle charging	*Electric vehicle* charging loads.
Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.

Reason:

As electric vehicles become more common place, even if not required by code, the electricity supplied to these chargers will increase the overall energy use when compared to the same building without EV charging. Combined with the increasing regulations from jurisdictions on benchmarking and building performance, it will be important that owners know and understand the EV charging use separate from the base building uses. It is far more cost-effective to sub-meter these loads during new construction than to try to isolate them and add additional sub-meters as part of a retrofit.

“Electrical Vehicle Supply Equipment is separately metered” is a requirement to deduct your EV electricity from Boston’s recent update to BERDO. Currently ENERGY STAR Portfolio Manager and most other BPS and benchmarking policies do not give explicit instructions on how to account for EV charging in reporting. By getting these loads sub-metered upfront, building owners will be better able to meet needs of local policies and their own energy planning.

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

Because electrical submetering is already required for many building systems in the code, the incremental cost for submetering an additional system is nominal. NBI and partners estimate based on cost-data from RS Means, estimated labor costs and indirect markups that separately metering Electric Vehicle equipment increases construction costs on the order of $0.02 per square foot for a 53,000 square foot office building.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Definition as no longer needed and electrical vehicle charging monitoring is needed separate from other monitored loads.

Final Hearing Results

CEPI-140-21	AM

CEPI-142-21

Original Proposal

IECC®: C405.13 (New), IEEE Chapter 06 (New), UL Chapter 06 (New)

Proponents: Kimberly Cheslak, NBI, NBI (kim@newbuildings.org); Josh Keeling, Cadeo Group, Cadeo Group (jkeeling@cadeogroup.com); Matthew Tidwell, Portland General Electric, Portland General Electric (matthew.tidwell@pgn.com)

2021 International Energy Conservation Code

Add new text as follows:

C405.13 Inverters. Direct-current-to-alternating-current inverters serving on-site renewable energy systems or on-site electrical energy storage systems shall be compliant with IEEE 1547-2018a and UL 1741-2021.

Add new standard(s) as follows:

IEEE

Institute of Electrical and Electronic Engineers
3 Park Avenue, 17th Floor
New York, NY 10016

1547-2018a — IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces

UL

UL LLC
333 Pfingsten Road
Northbrook, IL 60062

1741-2021 — UL Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources

Reason: IEEE 1547-2018a governs requirements for the interconnection of distributed energy resources that operate in parallel to the electric grid. This standard (and its implementation at the device level through (UL 1741) ensure that these resources can support and potentially enhance grid stability, thereby improving reliability, reducing curtailments, stabilizing voltage, and maintaining power quality. Requirements to implement IEEE 1547-2018 are being explored in several states and the standard is already required as a part of California's Rule 21 interconnection requirements. The National Association of Regulatory Utilities Commissioners (NARUC) has already recommended that state utility commissions require implementation of IEEE1547-2018a as a part of their interconnection requirements.

While commission rulemaking will help to accelerate adoption, codifying the requirement within building code will provide further clarity to DER installers and provide consistency across unregulated (consumer-owned/public) utility service areas. This will help to avoid inconsistency and requirements and/or potentially future retrofit costs if a non-compliant unit must be retrofitted later at interconnection.

Smart inverter functionality can provide several benefits, with potentially significant cost advantage over traditional solutions. While the primary purpose of smart inverter functionality is grid stability, there are several additional benefits to the grid and its stakeholders. When operating in volt-VAR mode supporting reactive power, these inverters can actually provide energy savings, particularly when operating within distribution networks already operating conservation voltage reduction schemes. Additionally, smart inverters can help to increase DER hosting capacity of distribution networks, enabling greater access to renewable energy systems while maintaining safety and reliability.

Bibliography: [1]IEEE 1547-2018 Status of Adoption across the U.S. (2021) https://sagroups.ieee.org/scc21/wp-content/uploads/sites/285/2021/09/IEEE-1547-2018_States-and-ISOs-RTOs-Adoption_IEEE-Format.pdf

[2] CPUC, Rule 21 Rulemaking, https://www.cpuc.ca.gov/Rule21/

[3] NARUC, Recommending State Commissions Act to Adopt and Implement Distributed Energy Resource Standard IEEE 1547-2018 (2021) https://pubs.naruc.org/pub/E86EF74B-155D-0A36-3138-B1A08D20E52B

[4] IEEE PES, Impact of IEEE 1547 Standard on Smart Inverters and the Applications in Power Systems (2020) https://www.nrel.gov/grid/ieee-standard-1547/assets/pdfs/smart-inverters-applications-in-power-systems.pdf

[5] EPRI, The Economic Impact of Real Power Management of Solar Photovoltaic Systems (2019) https://www.epri.com/research/products/000000003002013325

[6] NREL, Photovoltaic Impact Assessment of Smart Inverter Volt-VAR Control on Distribution System Conservation Voltage Reduction and Power Quality (2016) https://www.nrel.gov/docs/fy17osti/67296.pdf

[7] PG&E, EPIC 2.03A: Test Smart Inverter Enhanced Capabilities – Photovoltaics (PV): Smart Inverter Modeling Report (2019) https://www.pge.com/pge_global/common/pdfs/about-pge/environment/what-we-are-doing/electric-program-investment-charge/PGE-EPIC-Project-2.03A_Modeling-Report.pdf

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

In an economic assessment of 1547-2018 functionality, EPRI found that an increase of 25% in distribution hosting capacity for solar could be achieved at a savings of $20,000/year per feeder in the reference case and could reach as high as $100,000/year. In its assessment of smart inverter benefits in high DER areas, NREL found an additional energy savings of up to 1% from smart inverters when coupled with traditional conservation voltage regulation (baseline savings of 1.5%-3%) while also improving power quality scores by up to 0.26. A study by PG&E of a set of representative feeders found deferred distribution upgrade costs of up to $200,000 per feeder at the highest levels of DER penetration and that smart inverter functionality was cost-effective across a wide range of scenarios.

Given the growing prevalence of smart inverter requirements, this is likely to have a low to no incremental cost. While communication with utility and/or third-party systems is enabled by IEEE 1547-2018a, it is not required and smart inverters can provide much of their value autonomously based on their operating setpoint. Individual utilities or jurisdictions may dictate specific setpoints and/or communications integration with utility/third-party systems as they see fit based on the specific grid context, like how loads might be integrated for demand response programs. The physical communication pathway for smart inverters is typically wi-fi, which is standard for inverters already for the purposes of system monitoring and commissioning.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Based on the reason statement to make sure that inverters are in compliance with applicable standards.

Final Hearing Results

CEPI-142-21 AM

CEPI-147-21

Original Proposal

IECC®: C405.2

Proponents: Glenn Heinmiller, Lam Partners, International Association of Lighting Designers (glenn@lampartners.com)

2021 International Energy Conservation Code

Revise as follows:

C405.2 Lighting controls. Lighting systems shall be provided with controls that comply with~~one of the following.~~ Sections C405.2.1 through C405.2.8.

1. ~~Lighting controls as specified in Sections C405.2.1 through C405.2.8~~.
2. ~~Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, C405.2.5 and C405.2.6. The LLLC luminaire shall be independently capable of:~~
   - 2.1. ~~Monitoring occupant activity to brighten or dim lighting when occupied or unoccupied, respectively~~.
   - 2.2. ~~Monitoring ambient light, both electric light and daylight, and brighten or dim artificial light to maintain desired light level~~.
   - 2.3. ~~For each control strategy, configuration and reconfiguration of performance parameters including; bright and dim setpoints, timeouts, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configurations.~~

Exceptions: Lighting controls are not required for the following:

1. Areas designated as security or emergency areas that are required to be continuously lighted.
2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency egress lighting that is normally off.

Reason: The language that we propose to delete is completely unnecessary and does nothing to improve the energy efficiency of buildings. It just causes confusion and increases complexity with no benefit.

- LLLC's, as defined, are allowed by the code without this language. There is no regulatory hurdle that needs to be overcome for these products to be more widely used in the marketplace.
- There is no requirement in this proposal for LLLC's to be used. When this language was introduced in IECC 2018, it did not add a new requirement, or modify an existing requirement, so why is it in the code?
- This language does not provide clarification on the controls requirements in the code. It does the opposite -- it makes the code more complicated and confusing.

LLLC is not a term that 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 without this language 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.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal removes unnecessary language and does not modify a code requirement

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Removes an unnecessary compliance pathway.

Final Hearing Results	
CEPI-147-21	AS

CEPI-148-21

Original Proposal

IECC®: C405.2

Proponents: Jack Bailey, One Lux Studio, International Association of Lighting Designers (jbailey@oneluxstudio.com)

2021 International Energy Conservation Code

Revise as follows:

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

1. Lighting controls as specified in Sections C405.2.1 through C405.2.8.
2. Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, C405.2.5 and C405.2.6. The LLLC luminaire shall be independently capable of:
   2.1. Monitoring occupant activity to brighten or dim lighting when occupied or unoccupied, respectively.
   2.2. Monitoring ambient light, both electric light and daylight, and brighten or dim artificial light to maintain desired light level.
   2.3. For each control strategy, configuration and reconfiguration of performance parameters including; bright and dim setpoints, timeouts, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configurations.

Exceptions: Lighting controls are not required for the following:

1. Areas designated as security or emergency areas that are required to be continuously lighted.
2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency ~~egress~~ lighting that is normally off.
4. Emergency lighting required by the *International Building Code* in exit access components which are not provided with fire alarm systems.
5. Up to 0.02 watts per square foot (0.06 W/m^2)of lighting in exit access components which are provided with fire alarm systems.

Reason: A lot of energy is wasted in buildings by operating emergency lights as 24-hour "night lights" when buildings are unoccupied. There are a variety of reasons why this is done, but the most important is to prevent shared exit access components from being completely dark when spaces they serve may be occupied. A good example of this is an elevator lobby in a multi-story, multi-tenant building, where it may be desired to keep a light burning at all times so that the elevator lobby will never be completely dark when an elevator arrives at the floor.

Over the years, the lighting industry has developed a convention of leaving emergency lights operating continuously in commercial buildings, even though this is not currently permitted by the IECC. This proposal would call attention to the fact that this practice is not currently permitted by code, by adding exceptions allowing more limited night lighting than is common practice today.

But in doing this, we need to make sure that we are not creating unsafe conditions or violating requirements of the IBC/IFC, specifically the requirement that egress lighting be maintained in exit access components while the spaces they serve are occupied. This implies that occupant sensors could not be used to control minimum egress lighting in exit access components, and in fact it would be unsafe to use occupant sensors alone to turn off egress lighting in common exit access components since occupant sensors are not tested in smoke.

The solution for this is to provide a tie-in to fire alarm system, so that egress lighting can be automatically turned on when the premises fire alarm system is activated, ensuring that egress lighting is present during an emergency. This proposal therefore establishes a separate set of requirements for buildings provided with fire alarm systems, compared to those not provided with fire alarm systems.

The 0.02 watt/sf number is copied from other codes, and this is likely to be sufficient for emergency lighting that complies with the IBC, but not sufficient for egress lighting that complies with the IBC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

One the one hand, this proposal creates exceptions which don't currently exist in the code, so that compliance with the code will be easier and less expensive.

On the other hand, this limits the use of 24 hour night lighting in buildings, which will create additional costs for the vast majority of projects which are not currently complying with code.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies energy efficiency requirements for egress and emergency lighting.

Final Hearing Results

CEPI-148-21	AM

CEPI-150-21

Original Proposal

IECC®: C405.2

Proponents: JACK BAILEY, ONE LUX STUDIO, INTERNATIONAL ASSOCIATION OF LIGHTING DESIGNERS (jbailey@oneluxstudio.com)

2021 International Energy Conservation Code

Revise as follows:

C405.2 Lighting controls. Lighting systems <u>powered through the energy service for the building</u> shall be provided with controls that comply with one of the following.

1. Lighting controls as specified in Sections C405.2.1 through C405.2.8.
2. Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, C405.2.5 and C405.2.6. The LLLC luminaire shall be independently capable of:
   - 2.1. Monitoring occupant activity to brighten or dim lighting when occupied or unoccupied, respectively.
   - 2.2. Monitoring ambient light, both electric light and daylight, and brighten or dim artificial light to maintain desired light level.
   - 2.3. For each control strategy, configuration and reconfiguration of performance parameters including; bright and dim setpoints, timeouts, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configurations.

Exceptions: Lighting controls are not required for the following:

1. Areas designated as security or emergency areas that are required to be continuously lighted.
2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency egress lighting that is normally off.

Reason: The code is clear in C405.5.1 that the scope of exterior lighting power requirements is "all lighting that is powered through the energy service for the building". But the code is not clear about the scope of exterior lighting controls requirements. This proposal will clarify the scope of exterior lighting controls.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Mot users assume that the scope of lighting controls requirements matches the scope of lighting power requirements, so this proposal will not be likely to change the scope of the code in practice.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This change clarifies when lighting controls are required and is consistent with other provisions with the IECC

Final Hearing Results

CEPI-150-21	AS

CEPI-152-21

Original Proposal

IECC®: C405.2, C405.2.2

Proponents: Glenn Heinmiller, Lam Partners, International Association of Lighting Designers (glenn@lampartners.com)

2021 International Energy Conservation Code

Revise as follows:

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

1. Lighting controls as specified in Sections C405.2.1 through C405.2.8.
2. Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, C405.2.5 and C405.2.6. The LLLC luminaire shall be independently capable of:
   2.1. Monitoring occupant activity to brighten or dim lighting when occupied or unoccupied, respectively.
   2.2. Monitoring ambient light, both electric light and daylight, and brighten or dim artificial light to maintain desired light level.
   2.3. For each control strategy, configuration and reconfiguration of performance parameters including; bright and dim setpoints, timeouts, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configurations.

Exceptions: Lighting controls are not required for the following:

1. ~~Areas designated as security or emergency areas that are required to be continuously lighted~~. <u>Spaces where an automatic shutoff could endanger occupant safety or security</u>
2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency egress lighting that is normally off.

C405.2.2 Time-switch controls. Each area of the building that is not provided with*occupant sensor controls* complying with Section C405.2.1.1 shall be provided with *time-switch controls* complying with Section C405.2.2.1.

Exceptions:

1. Luminaires that are required to have specific application controls in accordance with Section C405.2.4.
2. Spaces where patient care is directly provided.
3. ~~Spaces where an automatic shutoff would endanger occupant safety or security~~.
4. ~~Lighting intended for continuous operation~~.
5. ~~Shop and laboratory classrooms~~.

Reason: The “safety” exception in C405.2 is quite important. If written too narrowly, it can compromise safety. But if written too broadly, it can become a loophole that creates unnecessary exceptions from the lighting controls requirements in the code. Let’s examine the current language.

Areas “designated as security or emergency areas”. Designated by whom? Such designations are shown on floor plans? Is this meant to be limited to 911 call centers and prisons? Or is this meant to include bank branches and fire stations?Refuge areas? Muster points?

“That are required to be continuously lighted”. Required by whom? What jurisdiction requires that lights operate continuously in buildings that are unoccupied? Jurisdictional lighting requirements are common – for bank ATM areas,Hospitals, swimming pools, kitchens, parking lots, etc. as well as for egress lighting required by IBC. But these requirements are almost always limited in duration – either while the space or building is occupied, while a certain activity is occurring, or after dark for exterior areas. There is almost never a requirement that lights operate continuously. So if this “requirement” that the space be continuously lighted does not come from the jurisdiction, does it come from the building owner?

It is also possible that the current exception does not cover all spaces where lighting controls could endanger occupants. For example, dangerous work is performed in some (but not all) laboratories and workshops.

The proposed language, “Spaces where an automatic shutoff would endanger occupant safety or security” is already an exception from the time-switch controls requirements in section C405.2.2, and it makes sense to apply this language more broadly as the exception from occupant sensor and daylight responsive controls requirements as well.

An “automatic shutoff” could be planned or unplanned, and could be the result of a malfunctioning control system (e.g. occupant sensors shut off lights in an occupied space).

“Would” endanger is strong language. There is no guarantee that any shutoff would endanger occupants, but this is better than the permissive language alternates "could", "may" etc.

And finally, it is the “occupants” who would need to be endangered. We are not using this as an excuse to leave lights burning continuously for “security” lighting to secure an empty room. In the 21st century we have better ways to secure spaces than leaving the lights on all the time and having a guard walk by occasionally to look in.

Once we have made this change in C405.2 then we can eliminate some additional exceptions in C405.2.2.

- “Lighting intended for continuous operation” has always been problematic. “Intended” by whom? Since it is quite rare for an authority to have such a requirement, this is usually interpreted to mean that a building owner “requires” (i.e.“wants”) the lighting to be operated continuously. If an authority has such a requirement, then that requirement would supercede this code (per C101.3). But even if this is an owner “requirement” at the time the space is built, requirements change over time. A store which is intended to be 24-hour operation may well change to 18-hour operation during an economic downturn, or close and be re-opened by someone else who runs a 12-hour operation.

- “Shop and laboratory classrooms” – if there is a safety concern then the proposed Exception 1 to C405.2 would provide an exemption. It should be noted, however, that in practice many spaces of this type are currently provided with occupant sensors.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This is a clarification and simplification that does not change code requirements

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This clarifies the exceptions to automatic control requirements related to safety and security.

Final Hearing Results

CEPI-152-21	AM

CEPI-154-21

Original Proposal

IECC®: C405.2.3

Proponents: Harold Jepsen, Legrand, Legrand (harold.jepsen@legrand.us)

2021 International Energy Conservation Code

Revise as follows:

C405.2.3 Light-reduction controls. Where not provided with occupant sensor controls complying with Section C405.2.1.1, general lighting shall be provided with light-reduction controls complying with Section C405.2.3.1.

Exceptions:

~~1. Luminaires controlled by daylight responsive controls complying with Section C405.2.4~~.

1 ~~2~~. Luminaires controlled by special application controls complying with Section C405.2.5.

2 ~~3~~. Where provided with manual control, the following areas are not required to have light-reduction control:

2.1. ~~3.1.~~ Spaces that have only one luminaire with a rated power of less than 60 watts.

2.2 ~~3.2.~~ Spaces that use less than 0.45 watts per square foot (4.9 W/m²).

2.3. ~~3.3.~~ Corridors, lobbies, electrical rooms and/or mechanical rooms.

Reason: This exception for daylight responsive controls is a hold over from the florescent lighting era. During that time, it was difficult and costly to have lighting controls properly coordinate both manual light reduction control devices with daylight responsive controls (manual or automatic). With the prevalence of LED light source and driver dimming capability as the default commercial lighting technology today, this exception no longer serves its intended purpose from when it was introduced into the code in 2012.

Removal of this exception aligns today's design practice and lighting controls that already coordinate the operation of light reduction control with daylight responsive controls. By removing the exception it further acknowledges the ability of users to have light reduction control across the entire space, inclusive of the daylight responsive zones. This makes far better design sense and promotes further energy efficiency when the user preference is to adjust space lighting down below the daylight responsive control setpoint.

There is no cost adder to construction since LED lighting is already controllable and the controls used for daylight responsive continuous dimming control in C405.2.4, already provide manual light reduction control dimming capability.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

As presented in the reason statement, today's LED lighting technology dimmability and accompanying controls already provide this capability at not added cost.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Deleted unnecessary exception based on current state of technology.

Final Hearing Results

CEPI-156-21

Original Proposal

IECC®: SECTION 202 (New), C405.2.3, C405.2.3.1, C408.3.1.4 (New)

Proponents: Jack Bailey, One Lux Studio, International Association of Lighting Designers (jbailey@oneluxstudio.com)

2021 International Energy Conservation Code

Add new definition as follows:

HIGH-END TRIM. A lighting control setting which limits the maximum power to individual luminaires or groups of luminaires in a space.

Revise as follows:

C405.2.3 ~~Light-reduction controls~~ Dimming controls.. ~~Where not provided with occupant sensor controls complying with Section C405.2.1.1, general lighting shall be provided with light-reduction controls complying with Section C405.2.3.1.~~ Dimming controls complying with Section C405.2.3.1 are required for general lighting in the following space types:

1. Classroom / lecture hall / training room.
2. Conference / multipurpose / meeting room.
3. In a dining area for bar/lounge or leisure, family dining.
4. Laboratory.
5. Lobby.
6. Lounge / Break Room.
7. Offices.
8. Gymnasium / fitness center.
9. Library reading room.
10. In a health care facility for imaging rooms, exam rooms, nursery, and nurses' station.
11. Spaces not provided with occupant sensor controls complying with Section C405.2.1.1.

Exceptions:

1. Luminaires controlled by daylight responsive controls complying with Section C405.2.4.
2. Luminaires controlled by special application controls complying with Section C405.2.5.
3. ~~Where provided with manual control, the following areas are not required to have light-reduction control~~:
   ~~3.1. Spaces that have only one luminaire with a rated power of less than 60 watts.~~
   ~~3.2. Spaces that use less than 0.45 watts per square foot (4.9 W/m²).~~
   ~~3.3. Corridors, lobbies, electrical rooms and/or mechanical rooms.~~

C405.2.3.1 ~~Light-reduction~~ Dimming control function. Spaces required to have ~~light-reduction controls shall have a *manual control* that allows the occupant to reduce the connected lighting load by not less than 50 percent in a reasonably uniform illumination pattern with an intermediate step in addition to full on or off, or with continuous dimming control, using one of the following or another *approved* method~~ dimming control shall be provided with *manual* controls that allow lights to be dimmed from full output to 10 percent of full power or lower with continuous dimming, as well as turning lights off. *Manual* control shall be provided within each room to dim lights.

Exception: *Manual* dimming control is not required where lighting controls have a high-end trim setting and have undergone functional testing in accordance with Section C408.3.1.4.

1. ~~Continuous dimming of all luminaires from full output to less than 20 percent of full power~~.
2. ~~Switching all luminaires to a reduced output of not less than 30 percent and not more than 70 percent of full power~~.
3. ~~Switching alternate luminaires or alternate rows of luminaires to achieve a reduced output of not less than 30 percent and not more than 70 percent of full power.~~

Add new text as follows:

C408.3.1.4 High-end trim. Where lighting controls are configured for*high-end trims*, verify the following:

1. That *high-end trim* has been set.
2. That the calibration adjustment equipment is located for *ready access* only by authorized personnel.
3. That lighting controls with *ready access* for users cannot increase the lighting power above the maximum level established by the *high-end trim* controls.

Reason: 1. Dimming lights saves energy, whether is done through dimmer switches that are accessible to users, or through central "task tuning" systems. California T24 has required dimming of most lights in commercial buildings for years.
~~2.~~ Almost all LED luminaires sold today are inherently dimmable at no additional cost. The daylight responsive controls section of the code already requires diming for lights in daylight zones, so this is not new, unfamiliar, or controversial.

~~3.~~ Realistically in 2025 no one will be switching alternate rows of luminaires or lamps because it will be less expensive to dim the lights. It is probably less expensive to dim lights today.

From an editorial standpoint this proposal streamlines a very clunky section of the code.

From an energy efficiency standpoint, this is one of the only remaining lighting controls strategies which can save meaningful amounts of energy.

From a practical standpoint, this is proven technology which is familiar to almost all designers, builders, and owners.

Cost Impact: The code change proposal will increase the cost of construction.
The changes in Section C405.2.3.1 will not increase the cost of construction.

The additional scope in Section C405.2.3 (items 1 through 9) will expand the scope of dimming controls and will therefore increase the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: To match current technology by providing dimming controls giving additional energy efficiency and controllability to general lighting.

Final Hearing Results

CEPI-156-21 AM

CEPI-161-21

Original Proposal

IECC®: C405.2.4

Proponents: Glenn Heinmiller, Lam Partners, International Association of Lighting Designers (glenn@lampartners.com); Michael Jouaneh, Lutron Electronics Co., Inc., Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

2021 International Energy Conservation Code

Revise as follows:

C405.2.4 Daylight-responsive controls. *Daylight-responsive controls* complying with Section C405.2.4.1 shall be provided to control the general lighting within *daylight zones* in the following spaces:

1. Spaces with a total of more than 150 watts of*gen eral lighting* within primary sidelit daylight zones complying with Section C405.2.4.2.
2. Spaces with a total of more than 300 watts of*general lighting* within sidelit daylight zones complying with Section C405.2.4.2.
3. Spaces with a total of more than 150 watts of*general lighting* within toplit daylight zones complying with Section C405.2.4.3.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Sidelit daylight zones on the first floor above grade in Group A-2 and Group M occupancies.
3. ~~New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power allowance (*LPA*~~$\cancel{_{adj}}$~~) calculated in accordance with Equation 4-9~~.

~~**(Equation 4-9)**~~

$$LPA_{adj} = [LPA_{norm} \times (1.0 - 0.4 \times UDZFA / TBFA)]$$

~~where:~~

~~*LPA*~~$\cancel{_{adj}}$ ~~= Adjusted building interior lighting power allowance in watts.*LPA*~~$\cancel{_{norm}}$ ~~= Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where Option 2 of Section C406.1 is used to comply with the requirements of Section C406.*UDZFA* = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.4.2 and C405.2.4.3, that do not have daylight responsive controls.*TBFA* = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.~~

Reason: Heinmiller: Exception #3 was added to IECC 2018. It created unnecessary complexity with no benefit. It does not improve energy efficiency or the usability of the code -- and actually does the opposite. Exception #4 attempts to solve a problem that does not exist. The “problem” is assumed to be that the installation of daylight responsive controls is an unreasonable burden. This was not the case three years ago, and is not the case today. Designers have not, and are not, asking for this exception. We believe that this exception will hurt energy efficiency in the long run by discouraging the use of daylight responsive controls. While designers welcome alternate paths around unreasonable requirements, we do not welcome alternate paths that provide no benefit and only make the code more complex and confusing.

Jouaneh: This proposal strikes an unnecessary and complicated exception to daylight responsive controls. The requirement to use daylight responsive controls already has a built-in wattage exception (i.e., spaces where lighting power less than 150 watts in all the daylight zones are already exempt from daylight responsive control). So, there is no need for this additional lighting power exception. What’s more is that this exception not likely get used as projects can simply with the wattage exception in the requirement. Thus, this proposal will simplify the language by eliminating these extra words.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Heinmiller: Because this proposal eliminates an option to avoid the small cost of installing daylight responsive controls (if certain power density limits are met), it could conceivably increase the cost of construction slightly. But this assumes that the option would commonly be taken. We believe that the option currently in the code is unlikely to be used. Daylight responsive controls are standard practice today and we believe will likely be installed anyhow, regardless of whether or not this option is available. Therefore a possible small increase in construction cost is only a hypothetical and not a given.

Jouaneh: Proposal is editorial. The exception is not needed since there already is a wattage exception in the requirement.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Removes an unneeded exception that is no longer needed due to lighting advances.

Final Hearing Results

CEPI-161-21	AS

CEPI-164-21

Original Proposal

IECC®: C405.2.4
Proponents: Megan Hayes, NEMA, NEMA (Megan.Hayes@nema.org)

2021 International Energy Conservation Code

Revise as follows:

C405.2.4 Daylight-responsive controls. *Daylight-responsive controls* complying with Section C405.2.4.1 shall be provided to control the general lighting within *daylight zones* in the following spaces:

1. Spaces with a total of more than 75 ~~150~~ watts of *general lighting* within primary sidelit daylight zones complying with Section C405.2.4.2.
2. Spaces with a total of more than 150 ~~300~~ watts of *general lighting* within sidelit daylight zones complying with Section C405.2.4.2.
3. Spaces with a total of more than75 ~~150~~ watts of *general lighting* within toplit daylight zones complying with Section C405.2.4.3.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Sidelit daylight zones on the first floor above grade in Group A-2 and Group M occupancies.
3. Enclosed office spaces less than 250 square feet(23.2 m^2).

~~3.~~ 4. New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power allowance (LPA_{adj}) calculated in accordance with Equation 4-9.

$$LPA_{adj} = [LPA_{norm} \times (1.0 - 0.4 \times UDZFA / TBFA)] \quad \textbf{(Equation 4-9)}$$

where:
LPA_{adj} = Adjusted building interior lighting power allowance in watts.LPA_{norm} = Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where Option 2 of Section C406.1 is used to comply with the requirements of Section C406.*UDZFA* = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.4.2 and C405.2.4.3, that do not have daylight responsive controls.*TBFA* = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.

Reason: This proposal reduces the daylight responsive control wattage threshold from 150W to 75W in primary toplight and sidelight daylight areas and 150 Watts of combined wattage for primary and secondary daylighting areas for sidelit areas. This will qualify more daylight areas for the energy efficiency and energy savings opportunity of daylight responsive controls. This proposal will:

1. Increase energy efficiency by expanding the number daylight responsive controlled areas2. Rely on the efficiency of readily available dimming technology

3. Maintain the same level of enforceability with the code

4. Coincide with amendments happening to current IECC versions and align with wattage threshold reduction of other standards: ASHRAE 90.1, CA Title 24.

The IECC daylighting threshold requirement was established and adopted in the 2015 IECC. It was based on the high cost of controlling and dimming fluorescent technology. The conversion to LED lighting technology has substantially reduced the cost for luminaire dimming controllability. LED luminaires now typically come standard with dimmable drivers without an added cost, where this was not the case with fluorescent lighting technology. As LED technology is a much more efficacious lighting source, maintaining a 150W threshold for daylight responsive control is now reducing the number of spaces where the requirement should apply and save energy.

Recognizing these facts, certain jurisdictions have amended the 2018 IECC daylight responsive control wattage threshold and other standards have or are changing to lower wattage thresholds as follows:

New York City – 100 Watts

Massachusetts – 100 Watts

Washington State – more than two luminaires in the daylight area

Washington DC – toplight 105 Watts, sidelight 150 Watts

Lower wattage thresholds in other standards:

California Title 24 Part 6 versions 2013, 2016, 2019, 2022 – 120 Watts

ASHRAE 90.1 - 2019 Addendum O – 75 Watts

ASHRAE 90.1 Addendum O forward stated:

"Costs have shifted since 2013. In 2013, the fluorescent system needed either a dimming ballast or multiple ballasts adding between ($30 - $100 per fixture adder). Dimming drivers are a standard no-cost feature of LED equipment. Other costs have changed between 2013 and now because of the advent of sensors that are integral to the fixtures."

Overall, the cost of construction will not increase as these spaces would have already qualified for daylight responsive controls with prior lighting technologies which consumed more power. As the efficacy of lighting has dropped considerably with LED lighting technology, this proposal adapts the code to this shift in more efficient and more controllable lighting.

We highly recommend the committee accept and adopt this shift to LED lighting efficacy and its effect on daylight responsive control in order to maintain the energy savings intended by the IECC.

Bibliography: *Daylighting Analysis for ASHRAE 90.1 Code Development – Final Results, March 29, 2012*, PNNL: Athalye, Xie, Rosenberg, Liu and Heschong Mahone Group: Saxena, Perry, Chappell.
"Daylighting Control Wattage Threshold", ASHRAE 90.1-2019 Motion 9, Addendum O, First Public Review, June 2020
California Title 24 Part 6 versions 2013, 2016, 2019, 2022

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
With the cost effective dimmability of LED sources, LED drivers, and widespread availability of daylight responsive controls, greater daylight areas and energy savings can be realized by reducing the daylight responsive control threshold from 150W to 120W.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The revised proposal more closely matches the daylighting requirements in ANSI/ASHRAE/IES Standard 90.1 and leads to more energy savings in IECC.

Final Hearing Results

CEPI-164-21 AM

CEPI-166-21

Original Proposal

IECC®: C405.2.4.2

Proponents: JACK BAILEY, ONE LUX STUDIO, INTERNATIONAL ASSOCIATION OF LIGHTING DESIGNERS (jbailey@oneluxstudio.com)

2021 International Energy Conservation Code

Revise as follows:

C405.2.4.2 Sidelit daylight zone. The sidelit daylight zone is the floor area adjacent to vertical *fenestration* that complies with all of the following:

1. Where the fenestration is located in a wall, the primary sidelit daylight zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 0.5 times the height from the floor to the top of the fenestration, whichever is less, as indicated in Figure C405.2.4.2(1).
2. Where the fenestration is located in a rooftop monitor, the primary sidelit daylight zone shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the fenestration, whichever is less, and longitudinally from the edge of the fenestration to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.25 times the height from the floor to the bottom of the fenestration, whichever is less, as indicated in Figures C405.2.4.2(2) and C405.2.4.2(3).
3. Where the fenestration is located in a wall, the secondary sidelit daylight zone is directly adjacent to the primary sidelit daylight zone and shall extend laterally to 2.0 times the height from the floor to the top of the fenestration or to the nearest full height wall, whichever is less, and longitudinally from the edge of the fenestration to the nearest full height wall, or up to 0.5 times the height from the floor to the top of the fenestration, whichever is less, as indicated in Figure C405.2.4.2(1). The area of secondary sidelit zones shall not be considered in the calculation of the daylight zones in Section C402.4.1.1.
4. The area of the fenestration is not less than 24 square feet (2.23 m^2).
5. The distance from the fenestration to any building or geological formation that would block *access to* daylight is greater than one-half of the height from the bottom of the fenestration to the top of the building or geologic formation.
6. The visible transmittance of the fenestration is not less than 0.20.
7. The projection factor (determined in accordance with Equation 4-5) for any overhanging projection that is shading the fenestration is not greater than 1.0 for fenestration oriented 45 degrees or less from true north and not greater than 1.5 for all other orientations.

Reason: The change clarifies the language describing the secondary daylight zone, which was added in the last code cycle.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There is no change to the technical content of the code.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Makes necessary editorial corrections in this section.

Final Hearing Results

CEPI-166-21	AS

CEPI-167-21

Original Proposal

IECC®: C405.2.4.2, C402.4.1.1

Proponents: JACK BAILEY, ONE LUX STUDIO, INTERNATIONAL ASSOCIATION OF LIGHTING DESIGNERS (jbailey@oneluxstudio.com)

2021 International Energy Conservation Code

Revise as follows:

C405.2.4.2 Sidelit daylight zone. The sidelit daylight zone is the floor area adjacent to vertical*fenestration* that complies with all of the following:

1. Where the fenestration is located in a wall, the sidelit daylight zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 0.5 times the height from the floor to the top of the fenestration, whichever is less, as indicated in Figure C405.2.4.2(1).
2. Where the fenestration is located in a rooftop monitor, the sidelit daylight zone shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the fenestration, whichever is less, and longitudinally from the edge of the fenestration to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.25 times the height from the floor to the bottom of the fenestration, whichever is less, as indicated in Figures C405.2.4.2(2) and C405.2.4.2(3).
3. The secondary sidelit daylight zone is directly adjacent to the primary sidelit daylight zone and shall extend laterally to 2.0 times the height from the floor to the top of the fenestration or to the nearest full height wall, whichever is less, and longitudinally from the edge of the fenestration to the nearest full height wall, or up to 0.5 times the height from the floor to the top of the fenestration, whichever is less, as indicated in Figure C405.2.4.2(1). ~~The area of secondary sidelit zones shall not be considered in the calculation of the daylight zones in Section C402.4.1.1.~~
4. The area of the fenestration is not less than 24 square feet (2.23 m^2).
5. The distance from the fenestration to any building or geological formation that would block*access to* daylight is greater than one-half of the height from the bottom of the fenestration to the top of the building or geologic formation.
6. The visible transmittance of the fenestration is not less than 0.20.
7. The projection factor (determined in accordance with Equation 4-5) for any overhanging projection that is shading the fenestration is not greater than 1.0 for fenestration oriented 45 degrees or less from true north and not greater than 1.5 for all other orientations.

C402.4.1.1 Increased vertical fenestration area with daylight responsive controls. In *Climate Zones* 0 through 6, not more than 40 percent of the gross above-grade wall area shall be vertical fenestration, provided that all of the following requirements are met:

1. In buildings not greater than two stories above grade, not less than 50 percent of the net floor area is within a<u>primary sidelit</u> *daylight zone* <u>or a toplit *daylight zone*</u>.
2. In buildings three or more stories above grade, not less than 25 percent of the net floor area is within a<u>primary sidelit</u> *daylight zone* <u>or a toplight *daylight zone*</u>.
3. *Daylight responsive controls* 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.

Reason: The description of how C402.4.1.1 counts daylight zones belongs in C402.4.1.1 not in C405.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The change is entirely editorial in nature.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Makes necessary editorial corrections in this section.

Final Hearing Results

CEPI-167-21	AS

CEPI-168-21

Original Proposal

IECC®: C405.2.5

Proponents: Glenn Heinmiller, Lam Partners, International Association of Lighting Designers (glenn@lampartners.com)

2021 International Energy Conservation Code

Revise as follows:

C405.2.5 Specific application controls. Specific application controls shall be provided for the following:

1. The following lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a time-switch control complying with Section C405.2.2.1. In addition, a manual control shall be provided to control such lighting separately from the general lighting in the space:
   1.1. Luminaires for which additional lighting power is claimed in accordance with Section C405.3.2.2.1.
   1.2. Display and accent~~.~~ <u>lighting, including lighting in display cases</u>.
   1.3. ~~Lighting in display cases~~.
   ~~1.4~~ <u>1.3</u>. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting.
   ~~1.5~~ <u>1.4</u>. Lighting equipment that is for sale or demonstration in lighting education.
   ~~1.6. Display lighting for exhibits in galleries, museums and monuments that is in addition to *general lighting*.~~
2. *Sleeping units* shall have control devices or systems that are configured to automatically switch off all permanently installed luminaires and switched receptacles within 20 minutes after all occupants have left the unit.

   Exceptions:

   1. Lighting and switched receptacles controlled by card key controls.
   2. Spaces where patient care is directly provided.
3. Permanently installed luminaires within *dwelling units* shall be provided with controls complying with Section C405.2.1.1 or C405.2.3.1.
4. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a time switch control complying with Section C405.2.2.1 that is independent of the controls for other lighting within the room or space.
5. Task lighting for medical and dental purposes that is in addition to *general lighting* shall be provided with a *manual control*.

Reason: This proposal simplifies and clarifies the requirements by eliminating redundancy and unclear terminology. Three related types of lighting are consolidated under one type: "Display lighting"

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This is a simplification for clarity and does not change code requirements.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal simplifies and clarifies requirements by eliminating redundancy.

Final Hearing Results

CEPI-168-21 AM

CEPI-169-21

Original Proposal

IECC®: C403.7.6, C405.2.5

Proponents: Michael Jouaneh, Lutron Electronics Co., Inc., Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

2021 International Energy Conservation Code

Revise as follows:

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

C405.2.5 Specific application controls. Specific application controls shall be provided for the following:

1. The following lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a time-switch control complying with Section C405.2.2.1. In addition, a manual control shall be provided to control such lighting separately from the general lighting in the space:
    1.1. Luminaires for which additional lighting power is claimed in accordance with Section C405.3.2.2.1.

    1.2. Display and accent.

    1.3. Lighting in display cases.

    1.4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting.

    1.5. Lighting equipment that is for sale or demonstration in lighting education.

    1.6. Display lighting for exhibits in galleries, museums and monuments that is in addition to *general lighting*.
2. *Sleeping units* shall have control devices or systems that are configured to automatically switch off all ~~permanently~~ installed luminaires and switched receptacles within 20 minutes after all occupants have left the unit.

    Exceptions:

    1. Lighting and switched receptacles controlled by card key controls <u>in buildings containing fewer than 50 *sleeping units*</u>.
    2. Spaces where patient care is directly provided.
3. Permanently installed luminaires within *dwelling units* shall be provided with controls complying with Section C405.2.1.1 or C405.2.3.1.
4. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a time switch control complying with Section C405.2.2.1 that is independent of the controls for other lighting within the room or space.
5. Task lighting for medical and dental purposes that is in addition to *general lighting* shall be provided with a *manual control*.

Reason: Captive card key controls should not be considered an equivalent compliance option to occupant sensing or automatic controls in hotel guestrooms. Captive card key controls are a manual control (not automatic) that are easily and often bypassed thereby negating any potential energy savings. If they are to remain as an option, then only permit them to comply in the smaller hotels/motels. The larger hotels should be required to use automatic guestroom controls that will guarantee the energy savings and provide guests with a more satisfactory experience.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Will not increase cost of construction. The removal of captive card option plus installation/wiring is roughly equivalent to if not more than the cost of guest room systems with occupancy detection.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal will increase the energy savings from guest rooms

Final Hearing Results

CEPI-169-21	AM

CEPI-172-21

Original Proposal

IECC®: C405.2.7.2, C405.2.7.3

Proponents: Glenn Heinmiller, Lam Partners, International Association of Lighting Designers (glenn@lampartners.com)

2021 International Energy Conservation Code

Revise as follows:

C405.2.7.2 Building facade and landscape lighting. *Building* facade and landscape lighting shall automatically shut off from not later than 1 hour after *building* or business closing to not earlier than 1 hour before *building* or business opening.

C405.2.7.3 Lighting setback. Lighting that is not controlled in accordance with Section C405.2.7.2 shall comply with the following:

1. Be controlled so that the total wattage of such lighting is automatically reduced by not less than 50 percent by selectively switching off or dimming luminaires at one of the following times:
    - 1.1. From not later than midnight to not earlier than 6 a.m.
    - 1.2. From not later than one hour after *building* or business closing to not earlier than one hour before *building* or business opening.
    - 1.3. During any time where activity has not been detected for 15 minutes or more.
2. Luminaires serving outdoor parking areas and having a rated input wattage of greater than 78 watts and a mounting height of 24 feet (7315 mm) or less above the ground shall be controlled so that the total wattage of such lighting is automatically reduced by not less than 50 percent during any time where activity has not been detected for 15 minutes or more. Not more than 1,500 watts of lighting power shall be controlled together.

Reason:

- As currently written, the code exempts any *buildings* that do not contain "businesses" such as schools, community centers, houses of worship, public/government buildings, university campuses, etc. We do not believe that this is the intent of this code provision.
- All of the "businesses" in an office building might be "closed" to visitors but the *building* would still be open so that workers could access the offices after the business is "closed". The C405.2.7.3 setback should not apply because the *building* is still open, even though the businesses are closed.
- The important criteria is whether the *building* is closed or open. This makes sense because the code is applicable to commercial *buildings* and their *building sites* (C405.1). *Building* is a defined term in the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is only a clarification of code requirements

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Adds clarification to the requirement that it applies to all occupancies (businesses and non-business [e.g., school or church, etc.]).

Final Hearing Results

CEPI-172-21 AS

CEPI-173-21

Original Proposal

IECC®: C405.2.7.3

Proponents: Mike Kennedy, Mike D Kennedy Inc, Northwest Energy Efficiency Alliance; Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

C405.2.7.3 Lighting setback. Lighting that is not controlled in accordance with Section C405.2.7.2 shall comply with the following:

1. Be controlled so that the total wattage of such lighting is automatically reduced by not less than 50 percent by selectively switching off or dimming luminaires at one of the following times:
   1.1. From not later than midnight to not earlier than 6 a.m.

   1.2. From not later than one hour after business closing to not earlier than one hour before business opening.

   1.3. During any time where activity has not been detected for 15 minutes or more.
2. Luminaires serving outdoor parking areas and having a rated input wattage of greater than40 ~~78~~ watts and a mounting height of 24 feet (7315 mm) or less above the ground shall be controlled so that the total wattage of such lighting is automatically reduced by not less than 50 percent during any time where activity has not been detected for 15 minutes or more. Not more than 1,500 watts of lighting power shall be controlled together.

Reason: Current language has little impact as most luminaires mounted under 24 feet use less than 78 watts. This proposal, by lowering the fixture wattage threshold to 40 watts, will result in greater applicability of this measure that has shown good energy savings potential.

Parking lot activity sensors were evaluated for California Title 24 with estimated costs and savings detailed in Nonresidential Outdoor Lighting Controls - Final Report from the California Codes and Standards Enhancement (CASE) Initiative (see Cost Impact).

The 2021 IECC base case control is a time clock reducing light from midnight to 6 am by 50%. The full load hours for this control are estimated to be 3285 full load hours. (6pm to midnight at 100%, midnight to 6 - 50% reduction). Table 16 of the California Title 24 CASE report determined the equivalent full load hours of various control strategies. For fixtures with activity sensors and no time clock they estimated full load hours at 2,874. This results in an estimated 40 watts / fixture * 411 full load hours / 1000 = 16 kWh / year savings for the lowest savings case of the current proposal.

In Californian and Washington the minimum wattage threshold was established based upon the limit of cost effectiveness. In California there is not minimum wattage. Looking at the distribution of light sources they determined to apply it to all parking lot lights. They also require time clock control with 75% turn down for the same fixtures. Washington applied a minimum wattage of 40 watts as proposed here. The cost effectiveness of this measure could warrant a lower minimum threshold or even eliminating the threshold.

Bibliography: Nonresidential Outdoor Lighting Controls - Final Report from the California Codes and Standards Enhancement (CASE) Initiative. Available online at: https://t24stakeholder.wpengine.com/wp-content/uploads/2017/09/2019-T24-CASE-Report_Outdoor-Ltg-Controls_Final_September-2017.pdf.

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

Parking lot activity sensors were evaluated for California Title 24 with estimated costs and savings detailed in Nonresidential Outdoor Lighting Controls - Final Report from the California Codes and Standards Enhancement (CASE) Initiative. Section 5.3.2 of the report found the cost of an integral activity sensor control of $59. Section 5.3.1 of the same report found an cost of wiring a control signal from a time clock, the baseline control, to each pole to be $53. Therefore the incremental cost for the proposed control is $7 per fixture. This cost data is from 2017. An 11.4% inflation factor was used to adjust the cost to year end 2021 for a cost of $7.80. Sales tax was not included in this because many states also tax commercial electricity consumption or utilities bills but if that is accounted for in the electric cost then tax should be added to this cost.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal aligns the code with efficacy improvements with LED lighting and is cost effective with simple payback under 5 years.

Final Hearing Results

CEPI-173-21	AS

CEPI-176-21

Original Proposal

IECC®: C405.2.9 (New), C406.1

Proponents: Michael Jouaneh, Lutron Electronics Co., Inc., Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

2021 International Energy Conservation Code

Add new text as follows:

C405.2.9 Demand responsive lighting controls. Buildings shall have controls that are capable of automatically reducing general lighting power not less than 15 percent in response to a demand response signal.

Exceptions:

1. Buildings with less than 4,000 watts of combined installed general lighting power in spaces that have more than 0.5 W/~~^{2}ft~~ (5.38 W/m^2) of general lighting power.
2. Buildings where demand response programs are not available.
3. I-2 and I-3 occupancies.

Revise as follows:

C406.1 Additional energy efficiency credit requirements. New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building and from credit calculations as specified in relevant subsections of Section C406. Where a building contains multiple-use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9
9. Where not required by Section C405.12, include an energy monitoring system in accordance with Section C406.10.
10. Where not required by Section C403.2.3, include a fault detection and diagnostics (FDD) system in accordance with Section C406.11.
11. Efficient kitchen equipment in accordance with Section C406.12.
12. Where not required by Section C405.2.9, include demand responsivelighting controls complaint with Section C405.2.9.

Reason: Demand responsive systems help projects savings on energy costs, especially peak demand charges, by helping to curtail/shift loads during times of peak electricity pricing or demand. Lighting is particularly well suited for demand response as lighting can often be adjusted without any disruption to the occupants (unlike cooling). Lights can gradually dim during a demand response event so that occupants don't notice the change in lighting (note that the first 20-25% of lighting dimming is undetectable by the human eye, yet that saves 20-25% in lighting energy). And after the DR event lighting can be brought back to previous levels quickly (unlike cooling loads which can take time for the space to be brought back to previous temperature).

What's more is that most networked lighting control (NLC) systems have native automated demand response capability. So, no new equipment is required.

Studies show that demand responsive lighting can save 30-50% of lighting power during peak periods (Newsham GR & Birt B. 2010. Demand-responsive lighting: a field study).

Lastly, demand responsive lighting has been in CA Title 24 since 2008 and in the ASHRAE 189.1 energy chapter since 2014. Plus, demand response is worth optional points in LEED v4 and demand response will be in the upcoming ASHRAE 90.1-2022 energy efficiency credits. Thus, the addition of demand responsive lighting will help bring the IECC inline with the other major building standards and rating systems.

Bibliography: Newsham GR & Birt B. 2010. Demand-responsive lighting: a field study. Leukos. 6(3) pg 203-225

Title 24 Stakeholders CASE report on demand response: https://title24stakeholders.com/wp-content/uploads/2020/08/NR-Grid-Integration_Final-CASE-Report_Statewide-CASE-Team.pdf

https://lightingcontrolsassociation.org/2014/05/20/lighting-control-and-demand-response/

https://www.energy.gov/sites/prod/files/2020/02/f71/ssl-rd2020-ghosh-market.pdf

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

The code change proposal may increase the cost of construction. However, savings from peak demand charges more than offsets any increased costs. Plus, most projects with over 4000 watts of lighting power will be using a networked lighting control system to comply with the mandatory lighting control provisions. And since most networked lighting control provisions have demand response built-in, no additional cost is incurred.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Provides a means to effectively reduce lighting during demand response requests or other signals and improve the effective use of energy.

Final Hearing Results

CEPI-176-21 AM

CEPI-177-21

Original Proposal

IECC®: C405.3.1, C405.5.1

Proponents: Glenn Heinmiller, Lam Partners, International Association of Lighting Designers (glenn@lampartners.com)

2021 International Energy Conservation Code

Revise as follows:

C405.3.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-10.

$$TCLP = [LVL + BLL + LED + TRK + \text{Other}] \quad \textbf{(Equation 4-10)}$$

where:

TCLP = Total connected lighting power (watts).*LVL* = For luminaires with lamps connected directly to building power, such as line voltage lamps, the rated wattage of the lamp.*BLL* = For luminaires incorporating a ballast or transformer, the rated input wattage of the ballast or transformer when operating that lamp.*LED* = For light-emitting diode luminaires with either integral or remote drivers, the rated wattage of the luminaire.*TRK* = For lighting track, cable conductor, rail conductor, and plug-in busway systems that allow the addition and relocation of luminaires without rewiring, the wattage shall be one of the following:

1. The specified wattage of the luminaires, but not less than 8 W per linear foot (25 W/lin m).
2. The wattage limit of the permanent current-limiting devices protecting the system.
3. The wattage limit of the transformer supplying the system.

Other = The wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data supplied by the manufacturer or other *approved* sources.

The connected power associated with the following lighting equipment and applications is not included in calculating total connected lighting power.

~~1. Television broadcast lighting for playing areas in sports arenas.~~

~~2~~ 1. Emergency lighting automatically off during normal building operation.

~~3~~ 2. Lighting in spaces specifically designed for use by occupants with special lighting needs, including those with visual impairment and other medical and age-related issues.

4 3. Casino gaming areas.

~~5~~ 4. Mirror lighting in makeup or dressing ~~rooms.~~ areas used for video broadcasting, video or film recording, or live theatrical and music performance.

~~6~~ 5. Task lighting for medical and dental purposes that is in addition to general lighting.

~~7~~ 6. Display lighting for exhibits in galleries, museums and monuments that is in addition to general lighting.

8 7. ~~Lighting for theatrical purposes, including performance, stage, film production and video production~~. Lighting in any location that is specifically used for video broadcasting, video or film recording, or live theatrical and music performance

~~9~~ 8. Lighting for photographic processes.

~~10~~ 9. Lighting integral to equipment or instrumentation and installed by the manufacturer.

~~11~~ 10. Task lighting for plant growth or maintenance.

~~12~~ 11. Advertising signage or directional signage.

~~13~~ 12. Lighting for food warming.

~~14~~ 13. Lighting equipment that is for sale.

~~15~~ 14. Lighting demonstration equipment in lighting education facilities.

~~16~~ 15. Lighting approved because of safety considerations.

~~17~~ 16. Lighting in retail display windows, provided that the display area is enclosed by ceiling-height partitions.

~~18~~ 17. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.

~~19~~ 18. Exit signs.

~~20~~ 19. Antimicrobial lighting used for the sole purpose of disinfecting a space.

C405.5.1 Total connected exterior building exterior lighting power. The total exterior connected lighting power shall be the total maximum rated wattage of all lighting that is powered through the energy service for the building.

Exception: Lighting used for the following applications shall not be included.

1. Lighting *approved* because of safety considerations.
2. Emergency lighting automatically off during normal business operation.
3. Exit signs.
4. Specialized signal, directional and marker lighting associated with transportation.
5. Advertising signage or directional signage.
6. Integral to equipment or instrumentation and installed by its manufacturer.
7. ~~Theatrical purposes, including performance, stage, film production and video production~~. Lighting in any location that is specifically used for video broadcasting, video or film recording, or live theatrical and music performance
8. Athletic playing areas.
9. Temporary lighting.
10. Industrial production, material handling, transportation sites and associated storage areas.
11. Theme elements in theme/amusement parks.
12. Used to highlight features of art, public monuments and the national flag.
13. Lighting for water features and swimming pools.
14. Lighting controlled from within dwelling units, where the lighting complies with Section R404.1.
15. Lighting of the exterior means of egress as required by the *International Building Code*.

Reason: This proposal clarifies the exemption from interior and exterior lighting power requirements for the lighting for dressing room mirrors and for video production and live performance.

- C405.3.1 #1 is consolidated into revised #8
- C405.3.1 #5 is revised to clarify that this only applies to mirror lighting in dressing areas used for video and performance, not mirrors in retail dressing/fitting rooms. Retail dressing room mirror lighting is covered by the lighting power allowance in Table C405.3.2(2)
- C405.3.1 #8 is revised to clarify the exemption by using more accurate terms and clear language
- C405.5.1 #7 is revised to clarify the exemption by using more accurate terms and clear language

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is a clarification of code requirements and does not change intent or stringency

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Aligns language with 90.1 and adds new language consistent with the International Building Code.

Final Hearing Results	
CEPI-177-21	AM

CEPI-181-21

Original Proposal

IECC®: C405.3.2.2

Proponents: Lisa Rosenow, Evergreen Technology Consulting, Self (lrosenow@evergreen-tech.net); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

C405.3.2.2 Space-by-Space Method. Where a building has unfinished spaces, the lighting power allowance for the unfinished spaces shall be the total connected lighting power for those spaces, or 0.1~~0.2~~ watts per square foot (~~10.76 w/m2~~ 1.08 w/m^2), whichever is less. For the Space-by-Space Method, the interior lighting power allowance is calculated as follows:

1. For each space enclosed by partitions that are not less than 80 percent of the ceiling height, determine the applicable space type from Table C405.3.2(2). For space types not listed, select the space type that most closely represents the proposed use of the space. Where a space has multiple functions, that space may be divided into separate spaces.
2. Determine the total floor area of all the spaces of each space type and multiply by the value for the space type in Table C405.3.2(2) to determine the lighting power (watts) for each space type.
3. The total interior lighting power allowance (watts) shall be the sum of the lighting power allowances for all space types.

Reason: Clarifies that the lighting power allowance and the total connected lighting power within an unfinished space cannot be included in the Space-by-space calculation for finished spaces. Prevents trading of lighting power between finished and unfinished areas.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal clarifies code intent. It does not increase code stringency.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Prevents the trading of lighting power between finished and unfinished areas of the building.

Final Hearing Results

CEPI-181-21	AM

CEPI-185-21

Original Proposal

IECC®: SECTION 202, SECTION 202 (New), C405.4

Proponents: Diana Burk, New Buildings Institute, New Buildings Institute (diana@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

GREENHOUSE. A structure or a thermally isolated area of a building that maintains a specialized sunlit environment<u>with a skylight roof ratio of 50% or more above the growing area</u> exclusively used for, and essential to, the cultivation, protection or maintenance of plants.*Greenhouses* are those that are erected for a period of 180 days or more.

Add new definition as follows:

<u>**HORTICULTURAL LIGHTING.**</u> <u>Electric lighting used for horticultural production, cultivation or maintenance</u>.

<u>**PHOTOSYNTHETIC PHOTON EFFICACY (PPE).**</u> <u>Photosynthetic photon flux emitted by a light source divided by its electrical input power in units of micromoles per second per watt, or micromoles per joule (μmol/J) between 400-700nm as defined by ANSI/ASABE S640.</u>

Revise as follows:

C405.4 ~~Lighting for plant growth and maintenance~~<u>Horticultural Lighting</u>. ~~Not less than 95 percent of the p~~<u>P</u>ermanently installed luminaires ~~used for plant growth and maintenance~~ shall have a ~~photon efficiency~~ <u>*photosynthetic photon efficacy*</u> of not less than ~~1.6~~ <u>1.7 μmol/J for *horticultural lighting* in *greenhouses* and not less than 1.9</u> μmol/J <u>for all other *horticultural lighting*.Luminaires for *horticultural lighting* in *greenhouses* shall be controlled by a device that automatically turns off the luminaire when sufficient daylight is available. Luminaires for *horticultural lighting* shall be controlled by a device that automatically turns off the luminaire at specific programmed times.</u> ~~μmol/J as defined in accordance with ANSI/ASABE S640~~.

Reason: Indoor agriculture energy usage is projected to grow substantially nationwide over the next several years, driven in large part (but not entirely) by the legalization of medical and recreational marijuana across the country. A total of 46 million square feet of grow area in the U.S. is lit by electric horticultural lighting, 58% of which was in supplemental greenhouses, 41% in non-stacked indoor farms, and 1% in vertical farms. Lighting in greenhouses operate on average 2,120 hours per year or 6 hours per day and lighting in non-stacked indoor operations were on 5,475 hours per year or 15 hours per day. Because of these long operating hours, lighting can account for 50 to 80% of a facilities energy use in indoor operations and 30% of energy use in greenhouses. Because sales of both recreational and medical marijuana are becoming legal across the country, it is critical to ensure these facilities are as efficient as possible.

Because of the large opportunity for energy savings, the 2021 IECC has already adopted requirements for lighting in these applications using the efficiency metric of μmol/J (micromoles per Joule) which was developed in collaboration with the American Society of Agricultural and Biological Engineers to measure the efficacy of lighting used for plant growth. A double-ended High Pressure Sodium (HPS) luminaire can meet the existing 2021 IECC standard of1.6 μmol/J.The proposed requirement increases the efficacy level required to 1.9 μmol/J. This new efficacy standard does not require a technology shift within indoor horticulture because slightly more efficient double-ended HPS lamps that meet the existing standard can also meet the proposed standard. Because a technology shift is not required, the additional energy savings from increasing the standard from 1.6 μmol/J to 1.9 μmol/J for indoor operations is very cost-effective. This proposed amendment also institutes a lower efficacy requirement of 1.7 μmol/J for greenhouses due to lower operating hours and thus longer payback periods in these applications.

This amendment also introduces requirements for lighting controls that are able to turn off the luminaire at specific times during the day and a lighting control requirement for greenhouses to ensure lights are off when sufficient daylight is available. Finally, the amendment clarifies these requirements by introducing horticultural lighting and photosynthetic photon efficacy as new definitions and by amending the definition for greenhouse.

These requirements are consistent with proposed Addendum ar-2019 recently released for public review to ASHRAE Standard 90.1 and with code requirements proposed for inclusion in Section 120.6(h)2 of California's Title 24-2022. The Technical Advisory Groups in Minnesota, Washington State, and Washington D.C. are also recommending these efficacy requirements as amendments to their local commercial energy codes.

Bibliography: *Energy Savings Potential of SSL in Horticultural Applications*. U.S. Department of Energy, Dec. 2017, https://www.energy.gov/sites/prod/files/2017/12/f46/ssl_horticulture_dec2017.pdf.

Schimelpfenig, Gretchen. *Energy Efficiency for Massachusetts Marijuana Cultivators*, Resource Innovation Institute, Sept. 2020, resourceinnovationinstitute.wildapricot.org/RII-REPORTS/.

Final CASE Report: Controlled Environment Horticulture, California Statewide Codes and Standards Enhancement (CASE) Program, Oct. 2020, https://title24stakeholders.com/wp-content/uploads/2020/10/2022-T24-NR-CEH-Final-CASE-Report.pdf.

15-Day Express Terms 2022 Energy Code - Residential and Nonresidentia,*l* California Energy Commission, 14 July 2021, https://efiling.energy.ca.gov/GetDocument.aspx?tn=238848.

Proposed Addendum ar to Standard 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings

, ASHRAE, Aug. 2021, http://osr.ashrae.org/Online-Comment-Database/ShowDoc2/Table/DocumentAttachments/FileName/3689-90.1(2019)ar%20PPR1%20Draft.pdf/download/false.

Morlino, Lauren, Emerging Technologies & Services Manager at Vermont Energy Investment Corporation . Re: Cost Information for VT Luminaires, 21 June 2021.

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

This proposal will result in no additional cost for growers using greenhouses because there is little to no cost difference between luminaires meeting the current 2021 IECC requirement of 1.6 µmol/J and the proposed requirement of 1.7 µmol/J and because lighting control requirements are already common practice for these applications. For indoor grow operations, the cost of purchasing a luminaire that meets a 1.9 µmol/J requirement vs a 1.6 µmol/J would result in increased costs of approximately $13/square foot. Assuming an electricity rate of 11.09 cents/kWh, annual energy cost savings from this code proposal is approximately $4.55/square foot resulting in a three-year simple payback period.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Cost effective increase in energy efficiency.

Final Hearing Results

CEPI-185-21 AS

CEPI-187-21

Original Proposal

IECC®: C405.5.1, C405.3.1, C405.2
Proponents: JACK BAILEY, ONE LUX STUDIO, INTERNATIONAL ASSOCIATION OF LIGHTING DESIGNERS (jbailey@oneluxstudio.com)

2021 International Energy Conservation Code

Revise as follows:

C405.5.1 Total connected exterior building exterior lighting power. The total exterior connected lighting power shall be the total maximum rated wattage of all lighting that is powered through the energy service for the building.

Exception: Lighting used for the following applications shall not be included.

1. Lighting *approved* because of safety considerations.
2. Emergency lighting that is automatically off during normal operations ~~automatically off during normal business operation~~.
3. Exit signs.
4. Specialized signal, directional and marker lighting associated with transportation.
5. Advertising signage or directional signage.
6. Integral to equipment or instrumentation and installed by its manufacturer.
7. Theatrical purposes, including performance, stage, film production and video production.
8. Athletic playing areas.
9. Temporary lighting.
10. Industrial production, material handling, transportation sites and associated storage areas.
11. Theme elements in theme/amusement parks.
12. Used to highlight features of art, public monuments and the national flag.
13. Lighting for water features and swimming pools.
14. Lighting controlled from within dwelling units, where the lighting complies with Section R404.1.

C405.3.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-10.

$$TCLP = [LVL + BLL + LED + TRK + \text{Other}]$$ **(Equation 4-10)**

where:

TCLP = Total connected lighting power (watts).*LVL* = For luminaires with lamps connected directly to building power, such as line voltage lamps, the rated wattage of the lamp.*BLL* = For luminaires incorporating a ballast or transformer, the rated input wattage of the ballast or transformer when operating that lamp.*LED* = For light-emitting diode luminaires with either integral or remote drivers, the rated wattage of the luminaire.*TRK* = For lighting track, cable conductor, rail conductor, and plug-in busway systems that allow the addition and relocation of luminaires without rewiring, the wattage shall be one of the following:

1. The specified wattage of the luminaires, but not less than 8 W per linear foot (25 W/lin m).
2. The wattage limit of the permanent current-limiting devices protecting the system.
3. The wattage limit of the transformer supplying the system.

Other = The wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data

supplied by the manufacturer or other *approved* sources.
The connected power associated with the following lighting equipment and applications is not included in calculating total connected lighting power.

1. Television broadcast lighting for playing areas in sports arenas.
2. Emergency lighting that is automatically off during normal operations ~~automatically off during normal building operation~~.
3. Lighting in spaces specifically designed for use by occupants with special lighting needs, including those with visual impairment and other medical and age-related issues.
4. Casino gaming areas.
5. Mirror lighting in dressing rooms.
6. Task lighting for medical and dental purposes that is in addition to general lighting.
7. Display lighting for exhibits in galleries, museums and monuments that is in addition to general lighting.
8. Lighting for theatrical purposes, including performance, stage, film production and video production.
9. Lighting for photographic processes.
10. Lighting integral to equipment or instrumentation and installed by the manufacturer.
11. Task lighting for plant growth or maintenance.
12. Advertising signage or directional signage.
13. Lighting for food warming.
14. Lighting equipment that is for sale.
15. Lighting demonstration equipment in lighting education facilities.
16. Lighting approved because of safety considerations.
17. Lighting in retail display windows, provided that the display area is enclosed by ceiling-height partitions.
18. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
19. Exit signs.
20. Antimicrobial lighting used for the sole purpose of disinfecting a space.

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

1. Lighting controls as specified in Sections C405.2.1 through C405.2.8.
2. Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, C405.2.5 and C405.2.6. The LLLC luminaire shall be independently capable of:
   2.1. Monitoring occupant activity to brighten or dim lighting when occupied or unoccupied, respectively.
   2.2. Monitoring ambient light, both electric light and daylight, and brighten or dim artificial light to maintain desired light level.
   2.3. For each control strategy, configuration and reconfiguration of performance parameters including; bright and dim setpoints, timeouts, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configurations.

Exceptions: Lighting controls are not required for the following:

1. Areas designated as security or emergency areas that are required to be continuously lighted.
2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency ~~egress~~ lighting that is ~~normally~~ automatically off during normal operations.

Reason: All three of these sections are trying to describe the same lighting, but each section uses different terminology.

The language proposed here clarifies that this is emergency lighting, not egress lighting, and leaves out the language about "business operation".

Per IBC, emergency lighting can be off at all times when there is no emergency, but egress lighting must be on whenever the space it is serving is occupied.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The proposed change is entirely editorial.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: provides clarification

Final Hearing Results

CEPI-187-21	AM

CEPI-188-21

Original Proposal

IECC®: C405.5.1

Proponents: JACK BAILEY, ONE LUX STUDIO, INTERNATIONAL ASSOCIATION OF LIGHTING DESIGNERS (jbailey@oneluxstudio.com)

2021 International Energy Conservation Code

Revise as follows:

C405.5.1 Total connected exterior building exterior lighting power. The total exterior connected lighting power shall be the total maximum rated wattage of all lighting that is powered through the energy service for the building.

Exception: Lighting used for the following applications shall not be included.

1. Lighting *approved* because of safety considerations.
2. Emergency lighting automatically off during normal business operation.
3. Exit signs.
4. Specialized signal, directional and marker lighting associated with transportation.
5. Advertising signage or directional signage.
6. Integral to equipment or instrumentation and installed by its manufacturer.
7. Theatrical purposes, including performance, stage, film production and video production.
8. Athletic playing areas.
9. Temporary lighting.
10. Industrial production, material handling, transportation sites and associated storage areas.
11. Theme elements in theme/amusement parks.
12. Used to highlight features of art, public monuments and the national flag.
13. Lighting for water features and swimming pools.
14. Lighting controlled from within *sleeping units* and *dwelling units*~~, where the lighting complies with Section R404.1~~.

Reason: This reference to R404.1 made sense in the 2018 code, where the commercial section referred to R404.1 for efficiency requirements in dwelling units. But now that the commercial chapter has its' own efficiency requirements for dwelling units, this requirement to also comply with R404.1 is confusing and irrelevant.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The change is editorial in nature.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: For consistency with previously approved proposal CEPI-135-21

Final Hearing Results

CEPI-188-21 AM

CEPI-189-21

Original Proposal

IECC®: TABLE C405.5.2(2), TABLE C405.5.2(3)

Proponents: Jeremy Williams, U.S. Department of Energy, U.S. Department of Energy (jeremy.williams@ee.doe.gov)

2021 International Energy Conservation Code

Revise as follows:

TABLE C405.5.2(2) LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

LIGHTING ZONES				
Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	
Base Site Allowance	~~350~~160 W	~~400~~280 W	~~500~~400 W	~~900~~560 W
Uncovered Parking Areas				
Parking areas and drives	~~0.03~~0.015 W/ft^2	~~0.04~~0.026 W/ft^2	~~0.06~~0.037 W/ft^2	~~0.08~~0.052 W/ft^2
Building Grounds				
Walkways and ramps less~~than 10 feet wide~~	0.50 W/linear foot	0.50 W/linear foot	~~0.60~~0.55 W/linear foot	~~0.70~~0.60 W/linear foot
~~Walkways and ramps 10 feet wide or greater~~,plaza areas~~, special feature areas~~	~~0.10~~ 0.028 W/ft^2	~~0.10~~ 0.049 W/ft^2	~~0.11~~ 0.070 W/ft^2	~~0.14~~0.098 W/ft^2
Roof terraces and special features	0.04 W/ft^2	0.07 W/ft^2	0.10 W/ft^2	0.14 W/ft^2
Dining areas	~~0.65~~ 0.156 W/ft^2	~~0.65~~ 0.273 W/ft^2	~~0.75~~ 0.390 W/ft^2	~~0.95~~ 0.546 W/ft^2
Stairways	~~0.60 W/ft^2~~ Exempt	~~0.70 W/ft^2~~ Exempt	~~0.70 W/ft^2~~ Exempt	~~0.70 W/ft^2~~ Exempt
Pedestrian tunnels	~~0.12~~ 0.063 W/ft^2	~~0.12~~ 0.110 W/ft^2	~~0.14~~ 0.157 W/ft^2	~~0.21~~ 0.220 W/ft^2
Landscaping	~~0.03~~ 0.014 W/ft^2	~~0.04~~ 0.025 W/ft^2	~~0.04~~ 0.036 W/ft^2	~~0.04~~ 0.050 W/ft^2
Building Entrances and Exits				
Pedestrian and vehicular entrances and exits	~~14~~ 5.6 W/linear foot of opening	~~14~~ 9.8 W/linear foot of opening	~~21~~ 14 W/linear foot of opening	~~21~~ 19.6 W/linear foot of opening
Entry canopies	~~0.20~~ 0.072 W/ft^2	~~0.25~~ 0.126 W/ft^2	~~0.40~~ 0.180 W/ft^2	~~0.40~~ 0.252 W/ft^2
Loading docks	~~0.35~~ 0.104 W/ft^2	~~0.35~~ 0.182 W/ft^2	~~0.35~~ 0.260 W/ft^2	~~0.35~~ 0.364 W/ft^2
Sales Canopies				
Free-standing and attached	~~0.40~~ 0.20 W/ft^2	~~0.40~~ 0.35 W/ft^2	~~0.60~~ 0.50 W/ft^2	0.70 W/ft^2
Outdoor Sales				
Open areas (including vehicle sales lots)	~~0.20~~ 0.072 W/ft^2	~~0.20~~ 0.126 W/ft^2	~~0.35~~ 0.180 W/ft^2	~~0.50~~ 0.252 W/ft^2
Street frontage for vehicle sales lots in addition to “open area” allowance	No allowance	7.2 W/linear foot	~~7~~ 10.3 W/linear foot	~~21~~ 14.4 W/linear foot

~~For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m^2.~~

~~W = watts.~~For SI: 1 foot = 304.8 mm, 1 watt per square foot = 10.76 W/m^2. W = watts.

TABLE C405.5.2(3) INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

LIGHTING ZONES				
Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	
Building facades	No allowance	0.075 W/ft^2 of gross above-grade wall area	0.113 W/ft^2 of gross above-grade wall area	0.15 W/ft^2 of gross above-grade wall area
Automated teller machines (ATM) and night depositories	~~135~~90 W per location plus ~~45~~35 W per additional ATM per location			
Uncovered entrances and gatehouse inspection stations at guarded facilities	~~0.50~~ 0.144 W/ft^2 of area	~~0.50~~0.252 W/ft^2 of area	~~0.50~~0.360 W/ft^2 of area	~~0.50~~0.504 W/ft^2 of area
Uncovered loading areas for law enforcement, fire, ambulance and other emergency service vehicles	~~0.35~~ 0.104 W/ft^2 of area	~~0.35~~0.182 W/ft^2 of area	~~0.35~~0.260 W/ft^2 of area	~~0.35~~0.364 W/ft^2 of area
Drive-up windows and doors	~~200~~53 W per drive through	~~200~~92W per drive through	~~200~~ 132 W per drive through	~~200~~185 W per drive through
Parking near 24-hour retail entrances.	~~400~~80 W per main entry	~~400~~140 W per main entry	~~400~~200 W per main entry	~~400~~280 W per main entry

For SI: For SI: 1 watt per square foot =10.76 W/~~0.0929~~ m^2.

W = watts.

Reason: Many elements in exterior lighting have changed since this section was last modified in the 2018 version. In 2018, lighting fixture device efficacy ranged ranged 80 - 100 lm/W. Since 2018, exterior lighting device efficacy has increased by 20 - 40%. Many exterior lighting devices now exceed 120 lm/W. It is very hard to purchase equipment with efficacy values that low. As a result, the lighting power density values can be reduced in response to the current technology available.

Design practices and research also changed since 2018. In 2018, lighting knowledge about LEDs was still somewhat unknown. At the time, practices were assuming significant degradation assumption in the calculations. Now, industry assumes a degradation of about 15%. This also allows for a reduction in lighting power density through newer guidance on design calculations.

In 2019, the Illuminating Engineering Society (IES) conducted research post 2018 related to exterior lighting. This proposal reflects the revised guidance developed from this new IES research. As a result of the new lighting guidance, certain levels that were previously recommended were now no longer recommended. This proposal aligns with new research from the IES and allows for lower lighting power density values.

Finally, this version first addresses lighting zones. The concept of a lighting zone is that less light is needed because of the adaption state of the eye. Lighting zone 1 is national parks, forest land, rural areas, etc. Lighting Zone 4 is heavy commercial districts like Times Square and the Las Vegas strip. More light is needed in lighting zone 4 than 1 to account for the ambient brightness of the environment. These changes provide values per lighting zone. For example, the previous version had the same value for drive-up windows independent of lighting zone. However, if following good lighting practices, less light (and thus less power) should be provided in lighting zone 1 than 4. This proposed change makes sure that the values ascend based on lighting zone.

This proposal also reflects changes in both lighting technology and practices that allow for lower lighting power density values. The proposed values are similar to those considered in ANSI/ASHRAE/IES Standard 90.1-2022 as well as Washington State Energy Code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is similar to an ANSI/ASHRAE/IES Standard 90.1 addendum. The 90.1 addendum met the Std. 90.1 scalar ratio. Exterior lighting fixture prices were surveyed. Prices were supplied by a third party and have remained relatively flat related over the last 5 years independent of the efficacy of the fixtures. Prices have remained flat while efficacy improved. Therefore, costs will not increase in response to this proposal.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Improves exterior lighting efficiency based on LED efficiency improvements and aligns with ASHRAE/IES Standard 90.1.

Final Hearing Results

CEPI-189-21	AM

CEPI-192-21

Original Proposal

IECC®: C405.7, TABLE C405.7

Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Revise as follows:

C405.7 Electrical transformers. Low-voltage dry-type distribution electric transformers shall meet the minimum efficiency requirements of Table C405.7 as tested and rated in accordance with the test procedure listed in DOE 10 CFR 431. The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the transformer manufacturer.

Exceptions: The following transformers are exemptin accordance with the DOE definition of Distribution Transformers found in 10 CFR 431.192:

~~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.~~ 1. Transformers ~~that meet the *Energy Policy Act of 2005* exclusions with multiple voltage taps where the highest tap is not less than~~ with tap range of 20 percent or more ~~than the lowest tap~~.

~~4.~~ 2. Drive (isolation) transformers.

~~5.~~ 3. Rectifier transformers.

~~6.~~ 4. Auto-transformers.

~~7.~~ 5. Uninterruptible power supply ~~system~~ transformers.

~~8.~~ 6. Special i ~~I~~mpedance transformers.

~~9.~~ 7. Regulating transformers.

~~10.~~ 8. Sealed ~~and nonventilating~~ transformers.

~~11.~~ 9. Machine~~-~~ tool (control) transformers.

~~12.~~ 10. Welding transformers.

~~13.~~ 11. Grounding transformers.

~~14.~~ 12. Testing transformers.

13. Nonventilated transformers.

TABLE C405.7 MINIMUM NOMINAL EFFICIENCY LEVELS FOR DOE 10 CFR 431 LOW-VOLTAGE DRY-TYPE DISTRIBUTION TRANSFORMERS

Portions of table not shown remain unchanged.

SINGLE-PHASE TRANSFORMERS[a]		THREE-PHASE TRANSFORMERS[a]	
kVA[ab]	Efficiency (%)[bc]	kVA[ab]	Efficiency (%)[bc]
15	97.70	15	97.89
25	98.00	30	98.23
37.5	98.20	45	98.40
50	98.30	75	98.60
75	98.50	112.5	98.74

SINGLE-PHASE TRANSFORMERS		THREE-PHASE TRANSFORMERS	
kVA	Efficiency (%)	kVA	Efficiency (%)
100	98.60	150	98.83
167	98.70	225	98.94
250	98.80	300	99.02
333	98.90	500	99.14
—	—	750	99.23
—	—	1000	99.28

a. A low-voltage dry-type distribution transformer with a kVA rating not listed in the table shall have its minimum efficiency level determined by linear interpolation of the kVA and efficiency values listed in the table immediately above and below its kVA rating. Extrapolation shall not be used below the minimum values or above the maximum values shown for single-phase transformers and three-phase transformers.

~~a.~~ b. kiloVolt-Amp rating.

~~b.~~ c. Nominal efficiencies shall be established in accordance with the DOE 10 CFR 431 test procedure for low-voltage dry-type transformers.

Reason: This section shows minimum efficiency requirements for low-voltage dry-type transformers that are used in commercial buildings. Federal efficiency standards were updated in 2016, and the revised values were incorporated into the Table.

However, in the federal requirements, there is language that provides information on the efficiency levels for transformers with kVA ratings that are not shown in the table. See the following web site links for the language: https://www.govinfo.gov/content/pkg/CFR-2016-title10-vol3/pdf/CFR-2016-title10-vol3-part431-subpartK.pdf Section 431.196, file page 4 of 18, document page 716

https://www.ecfr.gov/cgi-bin/text-idx?node=pt10.3.431&rgn=div5#se10.3.431_1196

This addendum updates the table to include this language in a footnote, along with language that is needed to show that there are no requirements for transformers below minimum kVA ratings or above maximum kVA ratings shown in the table.

As an example, for a single-phase dry-type transformer, the minimum efficiency requirement for a 15 kVA unit is 97.7% and the minimum efficiency requirement for a 25 kVA unit is 98.0%. If someone purchased a 20 kVA unit, then the minimum efficiency required for that transformer, using linear interpolation, would be 97.85%.

This addendum also updates the language in several places in section 8.4.4 to reference the Code of Federal Regulations (CFR) rather than the Energy Policy Act of 2005 and to align the list of exceptions to distribution transformers with the current regulatory language.

Bibliography: ANSI/ASHRAE/IES Standard 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings, Addendum ae.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is just an update to match the existing table of US federal minimum efficiency requirements that have been in place since 2016. It does not change any efficiency requirements, and therefore has no impact on construction costs.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This will update the language for transformers to align with ASHRAE 90.1 and includes a footnote to clarify efficiency requirements for other transformers.

Final Hearing Results

CEPI-193-21

Original Proposal

IECC®: SECTION C406, SECTION 406 (New), C406.1 (New), C406.1.1 (New), Table C406.1.1 (New), C406.1.1.1 (New), C406.1.2 (New), Table C406.1.2 (New), C406.1.3 (New), C406.1.4 (New), TABLE C406.2(1) (New), Table C406.2(2) (New), Table C406.2(3) (New), Table C406.2(4) (New), Table C406.2(5) (New), Table C406.2(6) (New), Table C406.2(7) (New), Table C406.2(8) (New), Table C406.2(9) (New), C406.2 (New), C406.2.1 (New), C406.2.1.1 (New), C406.2.1.2 (New), C406.2.1.3 (New), C406.2.1.4 (New), C406.2.1.5 (New), C406.2.1.6 (New), Table C406.2.1.6 (New), C406.2.2 (New), C406.2.2.1 (New), C406.2.2.2 (New), C406.2.2.3 (New), C406.2.2.4 (New), C406.2.2.5 (New), C406.2.3 (New), C406.2.3.1 (New), C406.2.3.3 (New), C406.2.3.4 (New), C406.2.3.5 (New), Table C406.2.3.5 (New), C406.2.3.6 (New), C406.2.4 (New), C406.2.5 (New), C406.2.5.1 (New), C406.2.5.2 (New), C406.2.5.3 (New), C406.2.5.4 (New), TABLE C406.2.5.4 (New), C406.2.5.5 (New), C406.2.5.6 (New), C406.2.7 (New), C406.2.7.1 (New), C406.2.7.2 (New), Table C406.2.7.2(1) (New), Table C406.2.7.2(2) (New), TABLE C406.2.7.2(3) (New), Table C406.2.7.2(4) (New), C406.2.7.3 (New), C406.2.7.4 (New), C406.3 (New), Table C406.3(1) (New), Table C406.3(2) (New), Table C406.3(3) (New), Table C406.3(4) (New), Table C406.3(5) (New), Table C403.6(6) (New), Table C406.3(7) (New), Table C406.3(8) (New), Table C406.3(9) (New), C406.3.1 (New), Table 406.3.1 (New), Table C406.3.1 (New), C406.3.2 (New), G406.3.3 (New), C406.3.4 (New), C406.3.5 (New), C403.6.6 (New), G406.3.7 (New), C406.3.8 (New), C407.2, TABLE C407.2, APPENDIX CD (New), CD101 (New), CD101.1 (New), CD101.2 (New), CD102 (New), CD102.1 (New), Table CD102.1 (New), ANSI Chapter 06 (New), IEC (New), IEC (New), OpenADR (New), SECTION 202 (New), TABLE C406.2.2.5 (New), C406.2.3.1.1 (New), C406.2.3.1.2 (New), C406.2.3.1.3 (New), C406.2.3.1.4 (New), C406.2.5.3.1 (New), C406.2.5.3.2 (New), C406.2.5.3.3 (New), ASTM Chapter 06, AERC (New), IES (New)

Proponents: Jeremy Williams, U.S. Department of Energy, U.S. Department of Energy (jeremy.williams@ee.doe.gov)

2021 International Energy Conservation Code

Delete without substitution:

~~SECTION C406~~
~~ADDITIONAL EFFICIENCY REQUIREMENTS~~

Add new text as follows:

SECTION 406
ADDITIONAL EFFICIENCY, RENEWABLE, and LOAD MANAGEMENT REQUIREMENTS

C406.1 Compliance. Buildings shall comply as follows:

1. *Buildings* with greater than 2000 square feet (190 m^2) of floor area shall comply with Section C406.1.1.
2. *Buildings* with greater than 5000 square feet (465 m^2) of *conditioned floor area* shall comply with Sections C406.1.1 and C406.1.2.
3. Build-out construction greater than 1000 square feet (93 m^2) of *conditioned floor area* that does not have final lighting or final HVAC systems installed under a prior building permit shall comply with Section C406.1.3.

Exception: Core and shell *buildings* where no less than 20 percent of the*net floor area* is without final lighting or final HVAC that comply with all of the following:

1. *Buildings* with greater than 5000 (465 m^2) of *conditioned floor area* shall comply with Section C406.1.2.
2. Portions of the *building* where the *net floor area* is without final lighting or final HVAC shall comply with Section C406.1.3
3. Portions of the *building* where the *net floor area* has final lighting and final HVAC systems shall comply with C406.1.1.

C406.1.1 Additional energy efficiency credit requirements. *Buildings* shall comply with measures from C406.2 to achieve not less than the number of required efficiency credits from Table C406.1.1 based on building occupancy group and climate zone. Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.

Exceptions:

1. Unconditioned parking garages that achieve 50% of the credits required for use groups S-1 and S-2 in Table C406.1.1.
2. Portions of buildings devoted to manufacturing or industrial use.

Table C406.1.1 Energy Credit Requirements by Building Occupancy Group

Building Occupancy Group	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	65	66	67	77	80	86	80	81	90	86	90	90	86	90	90	79	89	80	78
I-2	43	42	38	37	36	38	32	32	30	36	36	35	43	43	44	46	47	50	53
R-1	63	62	66	65	70	71	77	80	84	81	83	88	85	86	90	83	87	87	85
B	62	62	64	66	66	65	64	64	68	70	72	74	71	73	77	71	74	74	71
A-2	70	70	72	72	75	75	70	73	82	69	74	78	67	72	78	60	67	67	61
M	80	79	83	79	81	84	67	74	87	80	66	65	79	62	60	75	67	75	68
E	56	57	55	58	58	57	59	62	59	61	66	62	64	67	67	65	67	63	68
S-1 and S-2	61	60	61	60	58	57	44	54	62	85	68	75	90	82	72	90	89	90	90
All Other	31	31	31	32	32	33	30	32	36	35	35	35	37	36	36	36	37	36	34

C406.1.1.1 Building Core/Shell and Initial Build-Out Construction. Where separate permits are issued for core and shell *buildings* and build-out construction, compliance shall be in accordance with the following requirements.

1. Core and shell buildings or portions of *buildings* shall comply with one of the following:
   1.1 Where the permit includes a central HVAC system or service water heating system with chillers, heat pumps, boilers, service water heating equipment, or loop pumping systems with heat rejection, the project shall achieve not less than 50 percent of the energy credits required in Table C406.1.1 in accordance with Section C406.2.
   1.2 Alternatively, the project shall achieve not less than 33 percent of the energy credits required in Table C406.1.1.

2. For core and shell *buildings* or portions of *buildings* the energy credits achieved shall be subject to the following adjustments:
   2.1 Lighting measure credits shall be determined only for areas with final lighting installed.
   2.2 Where HVAC or service water heating systems are designed to serve the entire building, full HVAC or service water heating measure credits shall be achieved.
   2.3 Where HVAC or service water heating systems are designed to serve individual areas, HVAC or service water heating measure credits achieved shall be reduced in proportion to the floor area with final HVAC systems or final service water heating systems installed.
3. Build-out construction shall be deemed to comply with Section C406.1 where either:
   3.1 Where heating and cooling generation are provided by a previously installed central system, the energy credits achieved in accordance with Section C406.2 under the build-out project are not less than 33 percent of the credits required in Table C406.1.1.
   3.2 Where heating and cooling generation are provided by an HVAC system installed in the build out, the energy credits achieved in accordance with Section C406.2 under the build-out project are not less than 50 percent of the credits required in Table C406.1.1
   3.3 Where the core and shell building was approved in accordance with C407 under 2021 IECC or later.

C406.1.2 Additional renewable and load management credit requirements. Buildings shall comply with measures from C406.3 to achieve not less than the number of required renewable and load management credits from Table C406.1.2 based on building occupancy group and climate zone. Where a project contains multiple occupancies, credits in Table C406.1.2 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.

Table C406.1.2 Renewable and Load Management Credit Requirements by Building Occupancy Group

Building Occupancy Group	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B		
R-2, R-4, and I-1	64	59	70	69	73	39	72	90	90	63	90	70	51	75	66	48	58	0	2
I-2	31	32	33	32	33	36	31	40	34	32	43	32	29	37	33	34	33	7	3
R-1	41	40	48	44	48	58	54	61	63	50	61	47	42	55	50	41	51	0	2
B	63	64	74	75	78	39	33	90	90	77	90	36	68	90	33	72	31	8	8
A-2	12	12	13	13	12	17	13	17	17	12	17	13	12	12	12	12	12		
M	71	70	34	34	90	90	90	90	90	31	90	90	77	90	90	76	34	1	8
E	49	55	64	61	69	33	73	90	90	67	90	75	61	36	74	66	76	0	7
S-1 and S-2	90	90	90	90	90	90	90	90	90	90	90	90	70	90	90	61	35	1	3
All Other	56	55	66	63	69	30	69	37	38	59	36	68	51	72	66	51	60	8	0

C406.1.3 Substantial Alterations to Existing Buildings. The *building envelope*, *equipment*, and *systems* in *alterations* to *buildings* exceeding 5000 square feet (46.5 m^2) of *gross conditioned floor area* shall comply with the requirements of Section C406.1.1 and C406.1.2 where the alteration includes replacement of two or more of the following:

1. HVAC unitary systems or HVAC central heating or cooling equipment serving the alteration area, not including ductwork or *piping*
2. 80% or more of the lighting fixtures in the *alteration* area
3. Building envelope components in the *alteration* area including new exterior cladding, fenestration, or insulation.

C406.1.4 Energy Credits Achieved. Energy credits achieved for the project shall be the sum of measure energy credits for individual measures included in the project. Credits are available for the measures listed in Section C406.2. Base energy credits are shown in Tables C406.1.4(1) through C406.1.4(9) based on building occupancies and climate zones. Measure energy credits achieved shall be determined in one of three ways, depending on the measure:

1. The measure energy credit shall be the base energy credit for the measure where no adjustment factor or formula is shown in the measure description in Section C406.2.
2. The measure energy credit shall be the base energy credit for the measure adjusted by a factor or formula as stated in the measure description in Section C406.2. Where adjustments are applied, each measure energy credit shall be rounded to the nearest whole number.
3. The measure energy credit shall be by direct formula as stated in the measure description in Section C406.2, where each individual measure credit shall be rounded to the nearest whole number.

TABLE C406.2(1) Base Energy Credits for Group R-2, R-4, and I-1 Occupancies[a]

ID	Energy Credit Measure	Section	Climate Zone																		
0A			0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8	
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	8	13	7	11	6	8	9	6	1	24	8	9	30	15	5	32	28	31	36
E03	Envelope leak reduction	C406.2.1.3	15	10	12	8	6	16	13	5	1	47	7	9	65	16	1	73	43	52	26
E04	Add Roof Insulation	C406.2.1.4	1	1	1	1	1	1	4	3	1	5	3	4	6	5	1	7	7	6	8
E05	Add Wall Insulation	C406.2.1.5	10	10	6	8	5	6	8	4	1	8	3	4	11	7	1	14	12	13	13
E06	Improve Fenestration	C406.2.1.6	7	7	4	6	9	11	13	3	1	22	5	10	27	18	7	41	33	22	21
H01	HVAC Performance	C406.2.2.1	20	19	16	17	14	13	11	11	5	13	10	8	15	12	7	18	14	17	19
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	3	1	1	6	2	3	10	5	2	14	10	13	16
H03	Cooling efficiency	C406.2.2.3	7	6	4	4	3	3	1	1	1	1	1	1	1	1	x	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	9	10	8	22	20	25	16	17	32	21	24	17	23	27	16	21	24	18	18
H05	DOAS/fan control	C406.2.2.5	32	31	27	28	23	23	28	21	12	42	24	24	56	36	19	73	54	70	79
W01	SHW preheat recovery	C406.2.3.1 a	61	63	74	74	85	88	101	100	121	103	109	122	102	111	130	93	106	99	96
W02	Heat pump water heater	C406.2.3.1 b	50	52	62	61	72	74	86	85	104	88	94	106	88	96	112	81	92	87	84
W03	Efficient gas water heater	C406.2.3.1 c	38	39	46	46	53	55	63	62	76	64	68	76	64	69	81	58	66	62	60
W04	SHW pipe insulation	C406.2.3.2	7	7	8	7	8	8	8	9	10	8	9	9	7	8	9	6	7	6	6
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	3	3	3	3	3	3	3	3	4	3	3	4	3	3	4	3	3	3	2
W07	SHW heat trace system	C406.2.3.3 c	12	12	13	13	14	15	15	15	18	14	15	16	13	14	16	11	13	11	10

W08	SHW submeters	C406.2.3.4	11	11	13	13	15	16	18	18	22	19	20	22	19	20	24	17	20	18	18
W09	SHW distribution sizing	C406.2.3.5	45	46	55	54	63	65	74	73	89	75	80	89	74	81	95	68	77	72	70
W10	Shower heat recovery	C406.2.3.6	15	16	19	19	22	23	26	26	32	27	29	32	27	29	34	25	28	27	26
P01	Energy monitoring	C406.2.4	3	3	2	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2	3
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L03	Increase occp. sensor	C406.2.5.3	3	3	4	4	4	4	3	4	3	2	3	2	1	2	2	1	1	1	1
L04	Increase daylight area	C406.2.5.4	5	5	5	5	5	5	4	4	4	4	4	3	3	4	3	2	3	3	2
L05	Residential light control	C406.2.5.5	8	8	9	9	9	9	8	8	10	6	8	7	4	6	8	3	5	4	3
L06	Light power reduction	C406.2.5.7	2	2	2	2	2	2	2	2	2	1	2	1	1	1	1	1	1	1	1
Q01	Efficient elevator	C406.2.7.1	4	4	4	4	5	5	5	5	5	4	5	5	4	4	5	4	4	4	3
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	15	15	17	16	17	18	17	18	20	16	17	18	15	16	18	13	15	13	12
Q04	Fault detection	C406.2.7.4	3	3	2	3	2	2	2	2	1	2	2	1	2	2	1	3	2	3	3

a. "x" indicates credit is not available for that measure.

Table C406.2(2) Base Energy Credits for Group I-2 Occupancies[a]

ID	Energy Credit Measure	Section	Climate Zone																		
0A			0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8	
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	6	11	6	11	7	9	6	6	2	3	3	3	4	3	7	5	5	17	3
E03	Envelope leak reduction	C406.2.1.3	5	3	4	3	5	8	8	3	2	6	2	2	7	3	1	9	7	19	5
E04	Add Roof Insulation	C406.2.1.4	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	1	2	3
E05	Add Wall Insulation	C406.2.1.5	1	3	1	3	2	2	9	4	1	4	1	1	3	1	1	3	3	3	3
E06	Improve Fenestration	C406.2.1.6	1	1	1	1	1	1	1	1	1	4	3	5	5	1	1	5	5	2	2
H01	HVAC Performance	C406.2.2.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H02	Heating efficiency	C406.2.2.2	x	x	x	x	2	3	4	3	7	6	4	6	8	6	10	11	12	15	19
H03	Cooling efficiency	C406.2.2.3	6	6	4	4	3	3	2	2	1	1	1	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	41	41	40	40	42	36	42	37	39	49	40	46	56	46	61	65	68	82	93
W01	SHW preheat recovery	C406.2.3.1 a	4	4	4	4	5	5	5	5	6	6	6	6	6	6	6	6	5	5	5
W02	Heat pump water heater	C406.2.3.1 b	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3
W03	Efficient gas water heater	C406.2.3.1 c	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W04	SHW pipe insulation	C406.2.3.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
P01	Energy monitoring	C406.2.4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	5	5	5	5	5	6	5	6	6	5	6	6	5	5	5	4	4	3	2
L03	Increase occp. sensor	C406.2.5.3	5	5	5	5	5	5	5	5	6	5	5	6	5	5	5	4	4	3	2
L04	Increase daylight area	C406.2.5.4	7	7	7	7	7	7	7	7	8	6	6	6	6	6	5	5	5	5	4
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	7	7	7	7	7	7	7	7	9	7	7	8	6	7	7	5	5	4	3
Q01	Efficient elevator	C406.2.7.1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.7.4	3	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3	4	4

a. "x" indicates credit is not available for that measure.

Table C406.2(3) Base Energy Credits for Group R-1 Occupancies[a]

ID	Energy Credit Measure	Section	Climate Zone																		
0A			0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8	
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	4	7	4	7	3	4	7	2	1	7	2	3	10	6	4	12	9	19	11
E03	Envelope leakage reduction	C406.2.1.3	5	3	4	2	2	2	5	1	1	8	1	2	13	4	1	18	9	18	7
E04	Add Roof Insulation	C406.2.1.4	2	2	2	2	2	2	3	2	1	3	1	2	3	2	2	3	3	2	3
E05	Add Wall Insulation	C406.2.1.5	13	14	8	11	4	4	7	4	1	5	2	4	6	4	3	9	7	10	8
E06	Improve Fenestration	C406.2.1.6	5	5	4	5	7	7	8	2	1	8	2	4	10	5	1	21	17	10	9
H01	HVAC Performance	C406.2.2.1	21	20	17	18	16	13	12	12	11	11	11	8	11	11	8	13	11	14	16
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	1	1	6	2	1	1	3	2	2	6	4	8	11
H03	Cooling efficiency	C406.2.2.3	7	6	4	4	3	2	1	2	1	1	2	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	32	30	26	28	25	23	24	22	28	26	22	20	30	26	19	41	34	48	62
W01	SHW preheat recovery	C406.2.3.1 a	18	19	22	22	25	27	31	31	32	34	34	38	37	36	40	36	37	36	35

W02	Heat pump water heater	C406.2.3.1 b	14	15	18	17	20	22	25	25	27	29	29	32	31	31	34	30	32	31	30
W03	Efficient gas water heater	C406.2.3.1 c	11	12	14	14	16	17	19	19	20	21	21	24	23	23	25	22	23	23	22
W04	SHW pipe insulation	C406.2.3.2	3	3	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	1	1
W07	SHW heat trace system	C406.2.3.3 c	5	6	6	6	6	7	7	7	7	7	7	8	7	7	8	7	7	6	6
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	13	14	16	16	18	20	22	22	23	25	25	28	27	26	29	26	27	26	25
W10	Shower heat recovery	C406.2.3.6	4	5	5	5	6	7	8	8	8	9	9	10	10	9	10	9	10	10	9
P01	Energy monitoring	C406.2.4	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L03	Increase occp. sensor	C406.2.5.3	3	3	3	3	3	3	3	3	4	2	3	3	2	2	3	2	2	1	1
L04	Increase daylight area	C406.2.5.4	4	5	5	4	5	5	4	4	5	4	4	4	3	4	3	3	3	3	2
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	1	1	2	2	2	2	2	2	2	1	2	2	1	1	2	1	1	1	1
Q01	Efficient elevator	C406.2.7.1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	2	2	2	2
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	9	9	10	10	10	11	11	11	11	11	11	12	11	11	12	10	11	10	9
Q04	Fault detection	C406.2.7.4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	1	2	2	2	2

a. "x" indicates credit is not available for that measure.

Table C406.2(4) Base Energy Credits for Group B Occupancies[a]

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
0A			0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8	
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	4	7	4	7	3	4	7	2	0	7	2	3	10	6	4	12	9	19	11
E03	Envelope leak reduction	C406.2.1.3	5	3	4	2	2	2	5	1	0	8	0	2	13	4	0	18	9	18	7
E04	Add Roof Insulation	C406.2.1.4	2	2	2	2	2	2	3	2	1	3	1	2	3	2	2	3	3	2	3
E05	Add Wall Insulation	C406.2.1.5	13	14	8	11	4	4	7	4	1	5	2	4	6	4	3	9	7	10	8
E06	Improve Fenestration	C406.2.1.6	5	5	4	5	7	7	8	2	1	8	2	4	10	5	1	21	17	10	9
H01	HVAC Performance	C406.2.2.1	22	22	19	20	17	17	15	15	11	15	15	11	16	15	11	19	17	18	20
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	1	1	1	3	2	2	5	4	3	9	7	8	12
H03	Cooling efficiency	C406.2.2.3	7	6	4	5	3	3	1	2	1	1	2	1	1	1	1	x	x	x	x

H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	31	31	27	29	25	25	28	26	18	35	28	28	47	38	29	64	53	58	74
W01	SHW preheat recovery	C406.2.3.1 a	8	9	10	9	11	11	12	12	14	13	13	14	13	13	15	12	13	14	14
W02	Heat pump water heater	C406.2.3.1 b	3	3	3	3	4	4	5	4	5	5	5	6	5	5	6	5	5	6	6
W03	Efficient gas water heater	C406.2.3.1 c	5	5	6	6	7	7	8	7	8	8	8	9	8	8	9	8	8	9	8
W04	SHW pipe insulation	C406.2.3.2	3	3	4	4	4	4	4	4	5	4	4	5	4	4	5	4	4	4	4
W05	Point of use water heaters	C406.2.3.3 a	12	15	17	16	18	18	19	19	22	20	20	22	20	20	22	18	19	20	19
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	4	4	4	4	5	5	5	5	6	5	5	6	5	5	6	5	5	5	5
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P01	Energy monitoring	C406.2.4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	5	5	6	6	6	6	6	6	7	6	6	6	5	5	6	4	5	3	2
L03	Increase occp. sensor	C406.2.5.3	5	6	6	6	6	6	6	6	8	6	6	6	5	5	6	4	5	4	3
L04	Increase daylight area	C406.2.5.4	7	7	8	8	8	8	8	8	9	6	7	7	6	6	6	6	6	7	5
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	7	7	8	8	8	8	8	8	9	7	8	8	6	7	8	5	6	5	3
Q01	Efficient elevator	C406.2.7.1	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	4	5	4	4
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.7.4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	3	3	3	3

a. "x" indicates measure is not available for building occupancy in that climate zone

Table C406.2(5) Base Energy Credits for Group A-2 Occupancies[a]

Portions of table not shown remain unchanged.

ID	Energy Credit Measure	Section	Climate Zone																		
0A			0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8	
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	1	1	1	1	2	2	9	2	1	19	4	5	26	7	3	33	23	29	13
E03	Envelope leak reduction	C406.2.1.3	2	1	1	1	2	3	11	2	1	24	4	6	33	9	3	42	29	36	16
E04	Add Roof Insulation	C406.2.1.4	1	1	0	1	1	1	2	1	1	1	1	1	2	2	1	2	2	1	2
E05	Add Wall Insulation	C406.2.1.5	1	1	0	1	1	2	3	3	1	2	1	2	2	2	2	2	2	2	2

E06	Improve Fenestration	C406.2.1.6	1	1	1	1	1	1	2	2	1	1	2	2	3	2	1	4	4	1	1
H01	HVAC Performance	C406.2.2.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H02	Heating efficiency	C406.2.2.2	x	x	x	x	1	1	6	3	3	10	6	8	15	11	10	19	15	23	28
H03	Cooling efficiency	C406.2.2.3	6	5	3	4	3	2	1	1	1	1	1	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	29	27	20	25	24	21	36	27	15	51	35	38	67	53	45	84	70	97	115
W01	SHW preheat recovery	C406.2.3.1 a	24	26	31	29	33	35	37	38	45	38	41	44	37	40	44	34	38	33	30
W02	Heat pump water heater	C406.2.3.1 b	15	16	19	18	21	23	25	25	29	26	28	30	26	28	31	25	27	24	22
W03	Efficient gas water heater	C406.2.3.1 c	15	16	19	18	21	22	23	24	28	24	25	27	23	25	27	21	24	21	18
W04	SHW pipe insulation	C406.2.3.2	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3	2	2	2	2
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	3	3	3	3
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P01	Energy monitoring	C406.2.4	2	2	2	2	2	1	2	1	1	2	1	1	2	2	1	2	2	2	3
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1	1	1	0
L03	Increase occp. sensor	C406.2.5.3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0
L04	Increase daylight area	C406.2.5.4	3	3	3	3	3	3	2	2	2	2	2	2	1	2	1	1	1	1	1
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	1	2	1	1
Q01	Efficient elevator	C406.2.7.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Q02	Commercial kitchen equip.	C406.2.7.2	24	26	28	27	28	29	27	29	32	26	28	29	24	26	28	21	23	19	17
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.7.4	3	2	2	2	2	2	2	2	1	2	2	1	2	2	2	3	2	3	4

a. "x" indicates measure is not available for that measure.

Table C406.2(6) Base Energy Credits for Group M Occupancies[a]

ID	Energy Credit Measure	Section	Climate Zone																		
0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8			
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	2	2	2	2	2	3	15	2	1	36	5	9	45	11	5	51	36	35	15

E03	Envelope leak reduction	C406.2.1.3	3	3	2	2	3	3	19	3	1	44	6	11	56	13	6	64	44	43	19
E04	Add Roof Insulation	C406.2.1.4	8	6	5	7	7	7	18	16	4	19	18	20	21	22	23	24	26	24	30
E05	Add Wall Insulation	C406.2.1.5	64	65	48	62	13	15	23	18	4	27	21	27	25	24	25	23	24	24	16
E06	Improve Fenestration	C406.2.1.6	4	3	3	3	4	4	6	5	2	7	5	7	7	5	7	10	10	3	3
H01	HVAC Performance	C406.2.2.1	31	30	26	28	23	21	23	20	14	27	21	22	29	25	23	32	28	30	33
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	10	3	1	19	8	15	26	17	18	29	24	27	31
H03	Cooling efficiency	C406.2.2.3	10	9	7	7	5	4	2	2	1	1	2	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	48	48	42	47	40	38	66	46	31	98	61	82	120	91	90	134	115	125	141
W01	SHW preheat recovery	C406.2.3.1 a	12	13	16	15	18	20	19	21	26	17	21	21	16	19	21	13	16	15	13
W02	Heat pump water heater	C406.2.3.1 b	3	3	4	3	4	5	5	5	7	5	6	6	4	5	6	4	4	4	4
W03	Efficient gas water heater	C406.2.3.1 c	6	7	8	8	10	10	10	11	14	9	11	11	8	10	11	7	8	8	7
W04	SHW pipe insulation	C406.2.3.2	3	3	4	4	4	4	4	4	5	4	4	5	4	4	5	4	4	4	4
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	4	4	4	4	5	5	5	5	6	5	5	6	5	5	6	5	5	5	5
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P01	Energy monitoring	C406.2.4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	9	9	11	10	12	13	11	13	15	9	12	11	7	9	10	5	7	5	3
L03	Increase occp. sensor	C406.2.5.3	9	9	11	10	12	13	12	13	15	10	12	11	7	10	11	6	8	5	4
L04	Increase daylight area	C406.2.5.4	12	13	15	14	16	17	15	16	20	11	14	13	9	12	11	8	10	10	8
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	12	12	14	14	15	16	12	15	19	8	12	9	6	10	7	6	7	6	5
Q01	Efficient elevator	C406.2.7.1	3	3	4	3	4	4	4	4	5	3	4	4	3	4	4	3	3	3	2
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.7.4	3	2	2	2	2	2	2	2	1	2	2	1	2	2	2	3	2	3	4

a. "x" indicates credit is not available for that measure.

Table C406.2(7) Base Energy Credits for Group E Occupancies[a]

ID	Energy Credit Measure	Section	Climate Zone																	
0A			0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8

E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	9	22	8	20	9	12	5	11	3	4	9	2	3	6	0	4	3	4	3
E03	Envelope leakage reduction	C406.2.1.3	4	3	3	3	2	5	2	1	1	1	1	1	1	1	1	2	1	1	1
E04	Add Roof Insulation	C406.2.1.4	8	8	4	9	5	7	16	7	1	14	7	10	18	13	13	23	25	22	28
E05	Add Wall Insulation	C406.2.1.5	5	7	4	8	3	6	8	6	2	6	3	6	5	5	6	7	6	7	8
E06	Improve Fenestration	C406.2.1.6	8	10	6	9	11	11	15	9	1	16	8	15	22	18	19	33	29	19	18
H01	HVAC Performance	C406.2.2.1	30	28	25	26	23	21	20	18	15	19	18	17	19	20	15	23	20	25	29
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	4	3	3	5	5	10	9	11	6	15	11	18	26
H03	Cooling efficiency	C406.2.2.3	9	8	6	7	5	4	2	2	1	1	1	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	45	42	37	41	36	34	41	39	30	43	46	58	57	65	40	79	63	88	117
W01	SHW preheat recovery	C406.2.3.1 a	7	7	9	8	10	11	13	13	15	14	15	15	15	14	17	13	15	14	12
W02	Heat pump water heater	C406.2.3.1 b	4	4	6	5	7	7	9	9	10	10	10	11	11	10	12	10	11	10	9
W03	Efficient gas water heater	C406.2.3.1 c	4	4	6	5	6	7	8	8	9	9	9	10	9	9	11	8	10	9	7
W04	SHW pipe insulation	C406.2.3.2	3	3	4	4	4	4	4	5	6	5	5	6	5	5	7	4	5	4	4
W05	Point of use water heaters	C406.2.3.3 a	3	4	4	4	4	5	5	5	6	5	5	5	5	5	6	4	5	4	3
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	1	2	1	1
W07	SHW heat trace system	C406.2.3.3 c	4	4	4	4	5	5	5	6	7	6	6	7	6	6	8	5	7	5	5
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW distribution sizing	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	2	2	2	2	3	3	3	3	4	3	3	4	3	3	4	3	3	3	3
P01	Energy monitoring	C406.2.4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	5	5	5	6	6	6	5	6	7	6	6	6	5	5	6	4	4	3	2
L03	Increase occp. sensor	C406.2.5.3	4	4	5	5	5	6	6	6	7	6	6	5	4	4	5	3	4	3	2
L04	Increase daylight area	C406.2.5.4	6	6	7	7	7	7	7	7	8	6	6	6	5	5	6	5	5	5	4
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	6	7	7	7	8	8	8	8	10	7	8	7	6	7	8	5	6	4	2
Q01	Efficient elevator	C406.2.7.1	3	4	4	4	4	5	5	5	5	5	5	5	5	5	5	4	5	4	3
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.7.4	4	4	4	4	3	3	3	3	2	3	3	3	3	3	2	4	3	4	4

a. "x" indicates measure is not available for that measure.

Table C406.2(8) Base Energy Credits for Group S-1 and S-2 Occupancies[a]

ID	Energy Credit Measure	Section	Climate Zone																		
0A			0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8	
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	1	2	1	1	1	2	25	2	1	62	11	14	74	21	6	75	57	56	21
E03	Envelope leak reduction	C406.2.1.3	2	2	1	2	1	3	31	3	1	77	14	17	92	25	8	95	71	69	26
E04	Add Roof Insulation	C406.2.1.4	13	12	10	11	10	11	18	17	7	14	19	18	14	20	22	10	14	12	19
E05	Add Wall Insulation	C406.2.1.5	19	23	13	21	7	10	15	12	3	10	12	13	9	12	12	7	9	9	8
E06	Improve Fenestration	C406.2.1.6	7	5	8	7	6	6	2	4	2	4	1	6	5	1	7	3	4	4	7
H01	HVAC Performance	C406.2.2.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	16	3	1	33	17	22	41	31	21	44	38	43	43
H03	Cooling efficiency	C406.2.2.3	7	7	4	5	3	3	1	1	1	1	1	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	35	37	26	33	24	27	77	35	14	141	83	96	168	132	90	180	157	177	178
W01	SHW preheat recovery	C406.2.3.1 a	8	7	9	8	10	10	8	10	12	5	8	8	4	6	9	3	4	3	3
W02	Heat pump water heater	C406.2.3.1 b	2	2	2	2	2	2	2	2	3	1	2	2	1	2	2	1	1	1	1
W03	Efficient gas water heater	C406.2.3.1 c	4	4	5	4	5	5	4	5	6	3	4	4	2	3	5	2	2	2	2
W04	SHW pipe insulation	C406.2.3.2	3	3	4	3	3	3	2	3	4	2	2	3	1	2	3	1	1	1	1
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	4	4	4	3	4	4	3	4	5	2	3	3	2	2	4	2	2	2	2
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P01	Energy monitoring	C406.2.4	5	5	6	6	6	6	5	6	6	5	5	5	5	5	6	5	5	5	5
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	10	10	12	11	12	14	9	12	14	6	9	9	3	6	9	3	5	3	2
L03	Increase occp. sensor	C406.2.5.3	12	12	14	13	15	14	12	14	17	7	11	11	5	7	11	4	6	3	3
L04	Increase daylight area	C406.2.5.4	15	14	18	16	18	17	13	16	21	7	12	11	5	8	10	4	6	6	5
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	14	14	17	16	17	17	13	17	19	8	13	12	5	8	12	4	6	4	2
Q01	Efficient elevator	C406.2.7.1	15	14	18	16	18	18	15	18	21	9	14	14	7	10	14	5	7	5	5
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.7.4	3	3	2	3	2	2	3	2	1	5	3	3	5	4	3	6	5	6	6

a. "x" indicates measure is not available for building occupancy in that climate zone

Table C406.2(9) Base Energy Credits for Other Occupancies[a,b]

ID	Energy Credit Measure	Section	Climate Zone																		
0A			0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8	
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	5	9	5	8	5	6	10	5	2	20	6	6	25	10	4	28	22	26	16
E03	Envelope leakage reduction	C406.2.1.3	6	4	5	4	3	7	12	3	2	28	5	6	36	9	3	41	27	33	15
E04	Add Roof Insulation	C406.2.1.4	4	4	3	4	4	4	8	6	2	7	6	7	9	8	9	9	10	9	12
E05	Add Wall Insulation	C406.2.1.5	16	19	11	17	5	6	10	7	2	9	6	8	9	7	7	9	9	10	8
E06	Improve Fenestration	C406.2.1.6	4	4	3	4	5	6	6	4	1	9	4	7	11	7	6	16	14	8	8
H01	HVAC Performance	C406.2.2.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	6	2	3	11	6	8	15	11	9	18	15	19	23
H03	Cooling efficiency	C406.2.2.3	7	7	5	5	4	3	1	2	1	x	x	x	x	x	x	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	37	36	31	34	30	28	43	32	23	61	42	49	75	61	49	90	77	93	90
W01	SHW preheat recovery	C406.2.3.1 a	18	19	22	21	25	26	28	29	34	29	31	34	29	31	35	26	29	27	26
W02	Heat pump water heater	C406.2.3.1 b	12	12	15	14	17	17	20	20	24	21	22	25	21	23	26	20	22	21	20
W03	Efficient gas water heater	C406.2.3.1 c	11	11	13	13	15	16	17	17	21	18	19	21	18	19	22	16	18	17	16
W04	SHW pipe insulation	C406.2.3.2	3	3	4	4	4	4	4	4	5	4	4	5	4	4	5	3	4	3	3
W05	Point of use water heaters	C406.2.3.3 a	8	10	11	10	11	12	12	12	14	13	13	14	13	13	14	11	12	12	11
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	2	1	1	2	1	1	2	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	5	5	5	5	6	6	6	6	7	6	6	7	5	6	7	5	5	5	5
W08	SHW submeters	C406.2.3.4	11	11	13	13	15	16	18	18	22	19	20	22	19	20	24	17	20	18	18
W09	SHW distribution sizing	C406.2.3.5	29	30	36	35	41	43	48	48	56	50	53	59	51	54	62	47	52	49	48
W10	Shower heat recovery	C406.2.3.6	6	6	7	7	8	9	10	10	11	10	11	12	10	11	12	10	11	10	10
P01	Energy monitoring	C406.2.4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	5	5	5	5	6	6	5	6	7	5	5	5	4	4	5	3	4	3	2
L03	Increase occp. sensor	C406.2.5.3	5	6	6	6	7	7	6	7	8	5	6	6	4	5	6	3	4	3	2
L04	Increase daylight area	C406.2.5.4	7	8	9	8	9	9	8	8	10	6	7	7	5	6	6	4	5	5	4
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	7	7	8	7	8	8	7	8	9	5	7	6	4	5	6	4	4	3	2
Q01	Efficient elevator	C406.2.7.1	4	4	5	4	5	5	5	5	6	4	5	5	4	4	5	3	4	3	3
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Q04	Fault detection	C406.2.7.4	3	3	3	3	3	2	3	2	2	3	3	2	3	3	2	4	3	4	4

a. "x" indicates measure is not available for that measure

b. Other occupancy groups include all Groups except for Groups A-2, B, E, I, M, and R.

C406.2 Additional Energy Efficiency Credits Achieved. Each energy efficiency credit measure used to meet credit requirements for the project shall have efficiency that is greater than the requirements in Sections C402 through C405. Measures installed in the project that meet the requirements in Sections C406.2.1 through C406.2.7 shall achieve the base credits listed for the measure and occupancy type in Tables C406.2(1) through C406.2(9) or, where calculations required by Sections C406.2.1 through C406.2.7 create or modify the table credits, the credits achieved shall be based upon the calculations. Energy credits achieved for measures shall be determined by one of the following, as applicable:

1. The measure's energy credit shall be the base energy credit for the measure where no adjustment factor or calculation is included in the description of the measure in Section C406.2.
2. The measure's energy credit shall be the base energy credit for the measure adjusted by a factor or equation as stated in the description of the measure in Section C406.2. Where adjustments are applied, each measure's energy credit shall be rounded to the nearest whole number.
3. The measure's energy credit shall be calculation as stated in the measures description in Section C406.2, where each individual measure credit shall be rounded to the nearest whole number.

Energy credits achieved for the project shall be the sum of the individual measure’s energy credits. Credits are available for the measures listed in this Section. Where a project contains multiple building occupancy groups:

1. Credits achieved for each occupancy group shall be summed and then weighted by the floor area of each occupancy group to determine the weighted average project energy credits achieved.
2. Credits for improved envelope efficiency and lighting reduction (L06) shall be determined for the building or permitted floor area as a whole. Credits for other measures shall be taken from applicable tables or calculations weighted by the building occupancy group floor area.

C406.2.1 More Efficient Building Envelope. A project shall achieve credits for improved envelope performance by complying with one of the following measures:

1. Section C406.2.1.1: E01
2. Section C406.2.1.2: E02
3. Section C406.2.1.3: E03
4. Both E02 and E03
5. Any combination of
   - 5.1 Section C406.2.1.3: E03
   - 5.2 Section C406.2.1.4: E04
   - 5.3 Section C406.2.1.5: E05
   - 5.4 Section C406.2.1.6: E06

C406.2.1.1 EO1 Improved envelope performance 90.1 Appendix C. *Building* envelope measures shall be installed to improve the energy performance of the project. The achieved energy credits shall be determined using Equation 4-13.

$EC_{ENV} = 1000 \times (EPF_B - EPF_P)/EPF_B$ **(Equation 4-13)**

where: EC_{ENV} = E01 measure energy credits EPF_B = base envelope performance factor calculated in accordance with ASHRAE 90.1-2019-Appendix C. EPF_P = proposed envelope performance factor calculated in accordance with ASHRAE 90.1-2019-Appendix C.

C406.2.1.2 E02 Total UA envelope reduction. Energy credits shall be achieved where the total UA of the *building thermal envelope* as designed is not less than 15 percent below the total UA of the *building thermal envelope* in accordance with Section C402.1.5.

C406.2.1.3 E03 Reduced air leakage. Energy credits shall be achieved where tested building air leakage is not less than 10 percent less than the maximum leakage permitted by Section C402.5.2 provided the building is tested in accordance with the applicable method in Section C402.5.2. Energy credits achieved for measure E03 shall be determined as follows:

$EC_{E03} = EC_B \times EC_{adj}$ **(Equation 4-14)**

where: EC_{E03} = Energy efficiency credits achieved for envelope leakage reduction EC_B = C406.2.1.3 credits from Tables C406.2(1) through C406.2(9) $EC_{adj} = Ls/EC_a$ Ls = Leakage savings fraction: the lessor of [(Lr-Lm)/Lr] or 0.8 Lr = Maximum leakage permitted for tested *buildings*, by occupancy group, in accordance with Secction C402.5.2 Lm = Measured leakage in accordance with Section C402.5.2.1 or C402.5.2.2 EC_a = Energy Credit alignment factor: 0.37 for whole building tests in accordance with Section C402.5.2.1 or 0.25 for dwelling and sleeping unit enclosure tests in accordance with Section C402.5.2.2

C406.2.1.4 E04 Add Roof Insulation. Energy credits shall be achieved for insulation that is in addition to the required insulation in Table C402.1.3.

All roof areas in the project shall have additional R-10 continuous insulation included in the roof assembly. For attics this is permitted to be achieved with fill or batt insulation rated at R-10 that is continuous and not interrupted by ceiling or roof joists. Where interrupted by joists, the added insulation shall be not less than R-13. Alternatively, one-half of the base credits shall be achieved where the added R-value is one-half of the additional R-value required by this section.

C406.2.1.5 E05 Added wall insulation. Energy credits shall be achieved for insulation applied to not less than 90 percent of all opaque wall area in the project that is in addition to the required insulation in Table C402.1.3.Opaque walls shall have additional R-5 continuous insulation included in the wall assembly. Alternatively, one-half of the base credits shall be achieved where the added R-value is R-2.5.

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C406.2.1.6 E06 Improve fenestration.. Energy credits for one selected fenestration energy credit ID shall be achieved for improved energy characteristics of all vertical fenestration in the project meeting the requirements in one of the rows of Table C406.2.1.6. The area-weighted average U-factor and SHGC of all vertical fenestration shall be equal to or less than the value shown in the selected table row. The area-weighted average visible transmittance (VT) of all vertical fenestration shall be equal to or greater than the value shown in the selected table row.

Table C406.2.1.6 VERTICAL FENESTRATION REQUIREMENTS FOR ENERGY CREDIT E06

Applicable Climate Zones -	Maximum U-Factor -		Maximum SHGC -	Minimum VT -
	Fixed	Operable		
0-2	0.45	0.52	0.21	0.28

3	0.33	0.44	0.23	0.30
4-5	0.31	0.38	0.34	0.41
6-7	0.26	0.32	0.38	0.44
8	0.24	0.28	0.38	0.44

C406.2.2 More Efficient HVAC Equipment Performance. All heating and cooling systems shall meet the minimum requirements of Section C403 and efficiency improvements shall be referenced to minimum efficiencies listed in Tables referenced by Section C403.3.2. Where multiple efficiency requirements are listed, equipment shall meet the seasonal or part-load efficiencies including SEER, EER/integrated energy efficiency ratio (IEER), integrated part load value (IPLV), or AFUE. Equipment that is larger than the maximum capacity range indicated in Tables referenced by Section C403.3.2 shall utilize the values listed for the largest capacity equipment for the associated equipment type shown in the table. Where multiple individual heating or cooling systems serve the project, the improvement shall be the weighted average improvement based on individual system capacity.Systems are permitted to achieve HVAC energy credits by meeting the requirements of either:

1. C406.2.2.1 H01
2. C406.2.2.2 H02
3. C406.2.2.3 H03
4. C406.2.2.4 H04
5. C406.2.2.5 H05
6. Any combination of H02, H03, H04 and H05
7. The combination of H01 and H04

C406.2.2.1 H01 HVAC Performance (TSPR). H01 energy credits shall be achieved for systems allowed to use Section C403.1.3, HVAC total system performance ratio, where the proposed TSPR exceeds the minimum TSPR requirement by 5 percent. If improvement is greater, base energy credits from Table C406.2(1) through C406.2(9) are permitted to be prorated up to a 20 percent improvement using Equation 4-15. Energy credits for H01 may not be combined with energy credits from HVAC measures H02, H03 and H05.

H01 energy credit = H01 base energy credit x TSPRs / 0.05 **(Equation 4-15)**

where:TSPRs = the lessor of 0.20 and (1-(TSPRp/TSPRt))where:

TSPRt = TSPRr / MPF

TSPRp = HVAC TSPR of the proposed design calculated in accordance with Sections C409.4, C409.5 and C409.6.

TSPRr = HVAC TSPR of the reference building design calculated in accordance with Sections C409.4, C409.5 and C409.6.

MPF = Mechanical Performance Factor from Table C409.4 based on climate zone and building use type

Where a building has multiple building use types, MPF shall be area weighted in accordance with Section C409.4

C406.2.2.2 H02 More efficient HVAC equipment heating performance. No less than 90 percent of the total HVAC capacity serving the total *conditioned floor area* of the entire building, or tenant space in accordance with Section C406.1.1, shall comply with the requirements of this Section.

1. Equipment installed shall be types that are listed in Tables referenced by Section C403.3.2. Electric resistance heating capacity shall be limited to 20 percent of system capacity, with the exception of heat pump supplemental heating.

2. Equipment shall exceed the minimum heating efficiency requirements listed in Tables referenced by Section C403.3.2 by at least 5 percent. Where equipment exceeds the minimum annual heating efficiency requirements by more than 5 percent, energy efficiency credits for heating shall be determined using Equation 4-16 rounded to the nearest whole number.

$EEC_{HEH} = EEC_{H5} \times (HEI / 0.05)$ **(Equation 4-16)**

where:EEC_{HEH} = energy efficiency credits for heating efficiency improvementEEC_{H5} = C406.2.2.2 credits from Tables C406.2(1) through C406.2(9)
HEI = the lesser of: the improvement (as a fraction) above minimum heating efficiency requirements, or 20 percent(0.20). Where heating equipment with different minimum efficiencies are included in the building, a heating capacity weighted average improvement shall be used. Where electric resistance primary heating or reheat is included in the building it shall be included in the weighted average improvement with an HEI of 0. Supplemental gas and electric heat for heat pump systems shall be excluded from the weighted HEI. For heat pumps rated at multiple ambient temperatures, the efficiency at 47ºF (8.3ºC) shall be used. For metrics that increase as efficiency increases, HEI shall be calculated as follows:$HEI = (HM_{DES}/HM_{MIN})-1$Where:$HM_{DES}$ = Design heating efficiency metric, part-load or annualized where availableHM_{MIN} = Minimum required heating efficiency metric, part-load or annualized where available from Section C403.3.2

Exception: In low energy spaces complying with Section C402.1.1, no less than 90 percent of the installed heating capacity is provided by electric infrared or gas-fired radiant heating equipment for localized heating applications. Such spaces shall only achieve energy credits for EEC_5.

C406.2.2.3 H03 More efficient HVAC equipment cooling and fan performance . No less than 90 percent of the total HVAC cooling capacity serving the total conditioned floor area of the entire building or tenant space in accordance with Section C406.1.1, shall comply with all of the requirements of this section.

1. Equipment installed shall be types that are listed in Tables referenced by Section C403.3.2.
2. Equipment shall exceed the minimum cooling efficiency requirements listed in Tables referenced by Section C403.3.2 by at least 5 percent. For water-cooled chiller plants, heat rejection equipment efficiency shall also be increased by at least the chiller efficiency improvement. Where equipment exceeds the minimum annual cooling efficiency and heat rejection efficiency requirements by more than 5 percent, energy efficiency credits for cooling shall be determined using Equation 4-17, rounded to the nearest whole number.
3. Where fan energy is not included in packaged equipment rating or it is and the fan size has been increased from the as-rated equipment condition, fan power or horsepower shall be less than 95 percent of the allowed fan power in Section C403.8.1.

   $EEC_{HEC} = EEC_5 \times (CEI / 0.05)$ **(Equation 4-17)**

   where:EEC_{HEC} = energy efficiency credits for cooling efficiency improvementEEC_5= C406.2.2.3 base energy credits from Tables C406.2(1) through C406.2(9)EEC_5 CEI = the lesser of: the improvement above minimum cooling and heat rejection efficiency requirements expressed as a fraction, or 0.20 (20 percent). Where cooling equipment with different minimum efficiencies are included in the *building*, a cooling capacity weighted average improvement shall be used. Where multiple cooling performance requirements are provided, the *equipment* shall exceed the annualized energy or part-load requirement. Meeting both part-load and full-load efficiencies is not required. For metrics that increase as efficiency increases, CEI shall be calculated as follows:$CEI = (CM_{DES}/CM_{MIN}) - 1$For metrics that decrease as efficiency increases, CEI shall be calculated as follows:$CEI = (CM_{MIN}/CM_{DES}) - 1$Where:$CM_{DES}$ = Design cooling efficiency metric, part-load or annualized where availableCM_{MIN} = Minimum required cooling efficiency metric, part-load or annualized where available from Section C403.3.2For Data Centers using ASHRAE Standard 90.4, CEI shall be calculated as follows:$CEI = (AMLC_{MAX}/AMLC_{DES}) - 1$Where:$AMLC_{DES}$ = As-Designed Annualized Mechanical Load Component calculated in accordance with ASHRAE Standard 90.4, Section 6.5$AMLC_{MAX}$ = Maximum Annualized Mechanical Load Component from ASHRAE Standard 90.4, Table 6.5

C406.2.2.4 H04 Residential HVAC control.. HVAC systems serving *dwelling units* or *sleeping units* shall be controlled to automatically activate a setback at least 5°F (3°C) for both heating and cooling. The temperature controller shall be configured to provide setback during occupied sleep periods. The unoccupied setback mode shall be configured to operate in conjunction with one of the following:

1. A manual main control device by each *dwelling unit* main entrance that initiates setback and non-ventilation mode for all HVAC units in the dwelling unit and is clearly identified as "Heating/Cooling Master Setback."
2. Occupancy sensors in each room of the *dwelling unit* combined with a door switch to initiate setback and non-ventilation mode for all HVAC units in the dwelling within 20 minutes of all spaces being vacant immediately after a door switch operation. Where separate room HVAC units are used, an individual occupancy sensor on each unit that is configured to provide setback shall meet this requirement.
3. An advanced learning thermostat or controller that recognizes occupant presence and automatically creates a schedule for occupancy and provides a dynamic setback schedule based on when the spaces are generally unoccupied.
4. An automated control and sensing system that uses geographic fencing connected to the *dwelling unit* occupants' cell phones and initiates the setback condition when all occupants are away from the building.

C406.2.2.5 H05 Dedicated Outdoor Air System. Credits for this measure are only allowed where single zone HVAC units are not required to have multi-speed or variable-speed fan control in accordance with Section C403.8.6.1. HVAC controls and ventilation systems shall include all of the following:

1. Zone controls shall cycle the heating/cooling unit fans off when not providing required heating and cooling or shall limit fan power to 0.12 watts/cfm of zone outdoor air.
2. Outdoor air shall be supplied by an independent ventilation system designed to provide no more than 110 percent of the minimum outdoor air to each individual occupied zone, as specified by the *International Mechanical Code*.
3. The ventilation system shall have energy recovery with an *enthalpy recovery ratio* of 65 percent or more at heating design conditions in climate zones 3 through 8 and an enthalpy recovery ratio of 65 percent or more at cooling design conditions in climate zones 0, 1, 2, 3A, 3B, 4A, 4B, 5A, and 6A. In "A" climate zones, energy recovery shall include latent recovery. Where no humidification is provided, heating energy recovery effectiveness is permitted to be based on *sensible energy recovery ratio*. Where energy recovery effectiveness is less than the 65 percent required for full credit, adjust the credits from Section C406.2 by the factors in Table C406.2.2.5.
4. Where the ventilation system serves multiple zones and the system is not in a latent recovery outside air dehumidification mode. partial economizer cooling through an outdoor air bypass or wheel speed control shall automatically do one of the following:
   4.1. Set the energy recovery leaving-air temperature 55°F (13°C) or 100 percent outdoor air bypass when a majority of zones require cooling and outdoor air temperature is below 70°F (21°C).

   4.2 The HVAC ventilation system shall include supply-air temperature controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperatures. The controls shall reset the supply-air temperature not less than 25 percent of the difference between the design supply-air temperature and the design room-air temperature.

5. Ventilation systems providing mechanical dehumidification shall use recovered energy for reheat within the limits of item 4. This shall not limit the use of latent energy recovery for dehumidification.

Where only a portion of the building is permitted to be served by constant air volume units or the *enthalpy recovery ratio* or *sensible energy recovery ratio* is less than 65 percent, the base energy credits shown in Section C406.2 shall be prorated as follows:

$$EC_{DOAS} = EC_{BASE} \times FLOOR_{CAV} \times ERE_{ADJ}$$ **(Equation 4-18)**

where:EC_{DOAS} = Energy credits achieved for H06EC_{base} = H06 base energy credits in Section C406.2$FLOOR_{CAV}$ = Fraction of whole project *gross conditioned floor area* not required to have variable speed or multi-speed fan airflow control in accordance with Section C403.8.6.ERE_{adj} = The energy recovery adjustment from Table C406.2.2.5 based on the lower of actual cooling or heating *enthalpy* *recovery ratio* or *sensible energy recovery ratio* where required for the climate zone. Where recovery ratios vary, use a weighted average by supply airflow.

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C406.2.3 Reduced Energy Use In-service Water Heating. Projects with service water-heating equipment that serves the whole building, a building addition or a tenant space shall achieve credits through compliance with the requirements of this section. Systems are permitted to achieve energy credits by meeting the requirements of either:

1. C406.2.3.1 by selecting one allowed measure W01, W02 or W03
2. C406.2.3.2 W04
3. C406.2.3.3 by selecting one allowed measure W05, W06, or W07
4. C406.2.3.4 W08
5. C406.2.3.5 W09
6. C406.2.3.6 W10
7. Any combination of measures in C402.2.3.1 through C402.2.3.6 as long no more than one allowed measure from C406.2.3.1 and C406.2.3.3 are selected.

C406.2.3.1 Service water-heating system efficiency. A project is allowed to achieve energy credits from only one of Sections C406.2.3.1.1 through C406.2.3.1.4.

C406.2.3.3 Water-heating distribution temperature maintenance. A project is allowed to claim energy credits from only one of the following SHW distribution temperature maintenance measures.

1. **W04: Service Hot Water Piping Insulation Increase.** Where service hot water is provided by a central water heating system, the hot water pipe insulation thickness shall be at least 1.5 times the thickness required in Section C404.4. All service hot water piping shall be insulated from the hot water source to the fixture shutoff. Where no more than 50 percent of hot water piping does not have increased insulation due to installation in partitions, the credit shall be prorated as a percentage of lineal feet of piping with increased insulation.
2. **W05 Point of use water heaters**. Credits are available for office or school buildings larger than 10,000 ft^2 (930 m^2). Fixtures requiring hot water shall be supplied from a localized source of hot water with no recirculating system or heat trace piping. Supply piping from the water heater to the termination of the fixture supply pipe shall be insulated to the levels shown in Table C403.12.3 without exception. The volume from the water heater to the termination of the fixture supply pipe shall be limited as follows:

   1.1 Non-residential lavatories: not more than 2 oz (60 mL)

   1.2 All other plumbing fixtures or appliances: not more than 0.25 gallons (0.95 L)

   Exception: Where all remotely located hot water uses meet the requirements for measure W05, separate water heaters serving commercial kitchens or showers in locker rooms shall be permitted to have a local recirculating system or heat trace piping.

3. **W06 Thermostatic balancing valves.** Credits are available where service water heating is provided centrally and distributed throughout the building. Each recirculating system branch return connection to the main SHW supply piping shall have an automatic thermostatic balancing valve set to a minimal return water flow when the branch return temperature is greater than 115°F (46°C).

4. **W07 Heat trace system.** Credits are available for projects with gross floor area greater than 10,000 square feet (930 m^2) and a central water-heating system. The energy credits achieved shall be from Tables C406.1.2(1) through C406.1.2(9). This system shall include self-regulating electric heat cables, connection kits, and electronic controls. The cable shall be installed directly on the hot water supply pipes underneath the insulation to replace standby losses.

C406.2.3.4 W08 Water-heating system submeters. Each individual *dwelling unit* in a Group R-2 occupancy served by a central service water-heating system shall be provided with a service hot water meter connected to a reporting system that provides individual *dwelling unit* reporting of actual domestic hot water use. Preheated water serving the cold water inlet to showers need not be metered.

C406.2.3.5 W09 Service hot water flow reduction. Dwelling unit, sleeping unit, and guest room plumbing fixtures that are connected to the service water-heating system shall have a flow or consumption rating less than or equal to the values shown in Table C406.2.3.5.

Table C406.2.3.5 Maximum Flow Rating for Residential Plumbing Fixtures with Heated Water

Plumbing Fixture	Maximum Flow Rate
Faucet for private lavatory,[a] hand sinks, or bar sinks	1.50 gpm at 60 psi (0.095 L/s at 410 kPa)
Faucet for residential kitchen sink[a, b, c]	1.8 gpm at 60 psi 0.11 L/s at 410 kPa)
Shower head (including hand-held shower spray)[a, b, d]	2.0 gpm at 80 psi (0.13 L/s at 550 kPa)

a. Showerheads, lavatory faucets and kitchen faucets are subject to U.S. Federal requirements listed in 10 CFR 430.32(o)-(p).

b. Maximum flow allowed is less than required by flow rates listed in U.S. 10 CFR 430.32(o)-(p) for showerheads and kitchen faucets.

c. Residential kitchen faucet may temporarily increase the flow above the maximum rate, but not above 2.2 gallons per minute at 60 psi (0.14 L/s at 410 kPa) and must default to the maximum flow rate listed.

d. When a shower is served by multiple shower heads, the combined flow rate of all shower heads controlled by a single valve shall not exceed the maximum flow rate listed or the shower shall be designed to allow only one shower head to operate at a time.

C406.2.3.6 W10 Shower drain heat recovery. Cold water serving *building* showers shall be preheated by shower drain heat recovery units that comply with Section C404.7. The efficiency of drain heat recovery units shall be 54 percent or greater measured in accordance with CSA B55.1. Full credits are applicable to the following *building* uses: I-2, I-4, R-1, R-2 and also group E where there are more than eight showers. Partial credits are applicable to *buildings* where all but ground floor showers are served where the base energy credit from Section C406.2 is adjusted by Equation 4-21.

W10 credit = W10 base energy credit X (showers with drain heat recovery / total showers in building) **(Equation 4-21)**

C406.2.4 P01 Energy Monitoring. A project not required to comply with C405.12 can achieve energy credits for installing an energy monitoring system that complies with all the requirements of C405.12.1 through C405.12.5.

C406.2.5 Energy Savings in Lighting Systems. Projects are permitted to achieve energy credits for increased lighting system performance by meeting the requirements of either:

1. C406.2.5.2 L02
2. C406.2.5.3 L03
3. C406.2.5.4 L04
4. C406.2.5.5 L05
5. C406.2.5.6 L06
6. Any combination of L03, L04, L05 and L06
7. Any combination of L02, L03 and L04

Where lighting energy credit measures include reductions in lighting power, the lighting shall achieve ANSI/IES recommended practice for minimum illuminance levels as referenced at “The Interactive Illuminance Selector,” which includes minimum recommended illuminance levels from various ANSI/IES RP-## standards.

C406.2.5.1 L01 Lighting system performance (reserved). *Reserved for future use*

C406.2.5.2 L02 Enhanced digital lighting controls . Measure credits shall be achieved where no less than 50 percent of the gross floor area within the project shall comply with the requirements of this section.

1. Lighting controls function. Interior general lighting shall be located, scheduled and operated in accordance with Section C405.2 and shall be configured with the following enhanced control functions:
   - 1.1. Luminaires shall be configured for continuous dimming.
   - 1.2 Each luminaire shall be individually addressed.

     Exceptions:

     1. Multiple luminaires mounted on no more than 12 linear feet (3.66 m) of a single lighting track and addressed as a single luminaire.
     2. Multiple linear luminaires that are ganged together to create the appearance of a single longer fixture and addressed as a single luminaire, where the total length of the combined luminaires is not more than 12 feet (3.66 m).
   - 1.3 No more than eight luminaires within a daylight zone are permitted to be controlled by a single*daylight responsive control*.
2. Luminaires shall be controlled by a digital control system configured with the following capabilities:
   - 2.1. Sheduling and illumination levels of individual luminaires and groups of luminaires are capable of being reconfigured through the system.
   - 2.2 Load shedding.
   - 2.3 Occupancy sensors and daylight responsive controls are capable of being reconfigured through the system.
3. Construction documents shall include submittal of a Sequence of Operations, including a specification outlining each of the functions required by this section.

4. High-end trim. Luminaires shall be initially configured with the following:
   4.1. High-end trim, setting the maximum light output of individual luminaires or groups of luminaires to support visual needs of a space or area, shall be implemented and construction documents shall state that maximum light output or power of controlled lighting shall be initially reduced by at least 15 percent from full output. The average maximum light output or power of the controlled lighting shall be documented without high-end trim and with high-end trim to verify reduction of light output or power by at least 15 percent when tuned.
   4.2 Where lumen maintenance control is used, controls shall be configured to limit the initial maximum lumen output or maximum lighting power to 85 percent or less of full light output or full power draw and lumen maintenance controls shall be limited to increasing lighting power by 1 percent per year.
   4.3 High-end trim and lumen maintenance controls shall be accessible only to authorized personnel.

Where *general lighting* in more than 50 percent of the*gross lighted floor area* receives *high-end trim*, the base credits from Tables C406.1.2(1) through C406.1.2(9) shall be prorated as follows:*[Tuned lighted floor area,%] × [Base energy credits for C406.2.5.2] / 50%*

C406.2.5.3 L03 Increase occupancy sensor. To achieve this credit, automatic partial OFF or automatic full OFF occupancy sensors shall be installed in all space types not required by C405.2.1 and shall be installed as follows:

C406.2.5.4 L04 Increase daylight area. The total daylight area of the project (DLA_{BLDG}) with continuous daylight dimming meeting the requirements of C405.2.4 shall be at least 5 percent greater than the typical daylit area (DLA_{TYP}). Credits for measure L04 shall be determined based on Equation 4-23:

$EC_{DL} = EC_{DL5}$ x 20 x[(DLA_{BLDG}/GLFA) - DLA_{TYP}] **(Equation 4-23)**

where:EC_{DL} = The lesser of actual area of*daylight zones* in the *building* with continuous daylight dimming, ft^2 or m^2 and (GLFA x DLA_{max}) see Table C406.2.5.4. *Daylight zones* shall meet the criteria in Sections C405.2.4.2 and C405.2.4.3 for primary sidelit *daylight zones*, secondary sidelit *daylight zones*, and toplit *daylight zones*.GLFA = Project gross lighted floor area, f^2t or $m^2$$DLA_{TYP}$ = Typical % of *building* area with daylight control (as a fraction) from Table C406.2.5.4:EC_{DL5} = C406.2.5.4 L04 base energy credits from Section C406.2

TABLE C406.2.5.4 ADDED DAYLIGHTING PARAMETERS

***Building* use type**	**DLA_{TYP}**	**DLA_{max}**
Group B; Office ≤ 5000 ft^2 (460 m^2)	10%	20%
Group b; Office > 5000 ft^2 (460 m^2)	21%	31%
Group M; Retail with ≤ 1000 f^2t (900 m^2) *roof* area	0%	20%
Group M; Retail >1000 ft^2 (900 m^2) *roof* area	60%	80%
Group E; Education	42%	52%
Groups S-1 and S-2; Warehouse	50%	70%
Group I-2, R, and other; Medical, hotel, multifamily, dormitory, and other	NA	NA

C406.2.5.5 L05 Residential light control. In *buildings* with Group R-2 occupancy spaces, interior lighting systems shall comply with the following:

1. Common area Restrooms, laundry rooms, storage rooms, and utility rooms shall have automatic full OFF occupancy sensor controls that comply with the requirements of C405.2.1.1. Each additional control device shall control no more than 5,000 sq.ft (464 m^2).
2. Each dwelling unit shall have a main control by the main entrance that turns off all the lights and all switched receptacles in the dwelling unit. Two switched receptacles shall be provided in living and sleeping rooms or areas and clearly identified. All switched receptacles shall be located within 12 inches (30 cm) of an unswitched receptacle. The main control shall be permitted to have two controls, one for permanently wired lighting and one for switched receptacles. The main controls should be clearly identified as “lights master off” and “switched outlets master off.”

C406.2.5.6 L06 Reduced lighting power.. Interior lighting within the whole building shall comply with all the requirements of this section. The net connected interior lighting power (LPn) shall be 95 percent or less than the net interior lighting power allowance (LPAn) determined in accordance with Section C405.3.2.2. In R-1 and R-2 occupancies the credit is calculated for all common areas other than dwelling units and sleeping units. No less than 95 percent of the permanently installed light fixtures in *dwelling units* and *sleeping units*, excluding kitchen appliance lighting, shall be provided by high efficacy lamps with a minimum efficacy of 90 lumens per watt or high efficacy luminaires that have a minimum efficacy of 55 lumens per watt. Energy credits shall not be greater than four times the L06 base credit from Section C406.2 and shall be determined using Equation 4-24:

$EC_{LPA} = EC_5 \text{ X } 20 \text{ X } (LPA_n - LP_n)/LPA_n$ **(Equation 4-24)**

where: EC_{LPA} = additional energy credit for lighting power reduction LP_n = net connected interior lighting power calculated in accordance with Section C405.3.1, watts, excluding any additional lighting power allowed in Section C405.3.2.2.1 LPA_n = interior lighting power allowance calculated in accordance with the requirements of Section C405.3.2.2, watts, less any additional interior lighting power allowed in Section C405.3.2.2.1 EC5 = L06 base credit from Section C406.2

C406.2.7 Efficient Equipment Credits. Projects are permitted to achieve energy credits using any combination of Efficient Equipment Credits Q01 through Q04.

C406.2.7.1 Q01 Efficient Elevator Equipment. Qualifying elevators in the *building* shall be Energy efficiency class A per ISO 25745-2, Table 7. Only *buildings* 3 or more floors above grade may use this credit. Credits shall be prorated based on Equation 4-25, rounded to the nearest whole credit. Projects with a compliance ratio below 0.5 do not qualify for this credit.

$EC_e = EC_t \text{ x } CR_e$ **(Equation 4-25)**

where: EC_e = Elevator energy credit achieved for the *building* EC_t = C406.2.7.1 Table energy credit CR_e = Compliance Ratio = (F_A / F_B) F_A = Sum of floors served by class A elevators F_B = Sum of floors served by all *building* elevators and escalators

C406.2.7.2 Q02 Efficient Commercial Kitchen Equipment.. For *buildings* and spaces designated as Group A-2, or facilities whose primary business type involves the use of a commercial kitchen where at least one gas or electric fryer is installed before the issuance of the Certificate of Occupancy all fryers, dishwashers, steam cookers and ovens installed before the issuance of the Certificate of Occupancy shall comply with all of the following:

1. Achieve performance levels in accordance with the equipment specifications listed in Tables C406.2.7.2 (1) through C406.2.7.2 (4) when rated in accordance with the applicable test procedure.
2. Have associated performance levels listed on the construction documents submitted for permitting.

Table C406.2.7.2(1) Minimum Efficiency Requirements: Commercial Fryers

Heavy-Load Cooking Energy Efficiency	Idle Energy Rate	Test Procedure	
Standard Open Deep-Fat Gas Fryers	≥ 50%	≤ 9,000 Btu/hr (≤ 2,600 watts)	ASTM F1361
Standard Open Deep-Fat Electric Fryers	≥ 83%	≤ 800 watts	
Large Vat Open Deep-Fat Gas Fryers	≥ 50%	≤ 12,000 Btu/hr (≤ 3,500 watts)	ASTM F2144
Large Vat Open Deep-Fat Electric Fryers	≥ 80%	≤ 1,100 watts	

For SI: BTU/h =
0.293W

Table C406.2.7.2(2) Minimum Efficiency Requirements: Commercial Steam Cookers

Fuel Type	Pan Capacity	Cooking Energy Efficiency[a]	Idle Energy Rate	Test Procedure
Electric Steam	3-pan	50%	400 W	ASTM F1484
	4-pan	50%	530 W	
	5-pan	50%	670 W	
	6-pan and larger	50%	800 W	
Gas Steam	3-pan	38%	6,250 Btu/h 1.83 kw	
	4-pan	38%	8,350 Btu/h 2.45 kW	
	5-pan	38%	10,400 Btu/h 3.05 kW	
	6-pan and larger	38%	12,500 Btu/h 3.66 kW	

a. Cooking Energy Efficiency is based on heavy-load (potato) cooking capacity

TABLE C406.2.7.2(3) MINIMUM EFFICIENCY REQUIREMENTS: COMMERCIAL DISHWASHERS

Machine Type	High Temperature Efficiency Requirements			Low Temperature Efficiency Requirements			Test Procedure
	Idle Energy Rate[a]	Washing Energy	Water Consumption[b]	Idle Energy Rate[a]	Washing Energy	Water Consumption[b]	

Under Counter	≤ 0.50 kW	≤0.35 kWh/rack	≤ 0.86 GPR (≤3.3 LPR)	≤ 0.25 kW	≤0.15 kWh/rack	≤ 1.19 GPR (≤4.5 LPR)	ASTM F1696 ASTM F1920
Stationary Single Tank Door	≤ 0.55 kW	≤0.35 kWh/rack	≤ 0.89 GPR (≤3.4 LPR)	≤ 0.30 kW	≤0.15 kWh/rack	≤ 1.18 GPR (≤4.47 LPR)	
Pot, Pan , and Utensil	≤ 0.90 kW	kWh/rack≤ 0.55 + 0.05 x SF_{rack}[c] (≤ 0.55 + 0.0046 x SM_{rack}[c])	≤ 0.58 GPR (≤2.2 LPSM)	N/A	N/A	N/A	
Single Tank Conveyor	≤ 1.20 kW	≤0.36 kWh/rack	≤ 0.70 GPR (≤2.6 LPSM)	≤ .85 kW	≤0.16 kWh/rack	≤ 0.79 GPR (≤ 3.0 LPR)	
Multiple Tank Conveyor	≤ 1.85 kW	≤0.36 kWh/rack	≤ 0.54 GPR (≤2.0 LPSM)	≤ 1.00 kW	≤0.22 kWh/rack	≤ 0.54 GPR (≤ 2.0 LPR)	
Single Tank Flight Type	Reported	Reported	GPH ≤ 2.975cx + 55.00 (LPH ≤ 0.276d + 208)	N/A	N/A	N/A	
Multiple Tank Flight Type	Reported	Reported	GPH ≤ 4.96c + 17.00 (LPH ≤ 0.461d + 787)	N/A		N/a	

a. Idle results should be measured with the door closed and represent the total idle energy consumed by the machine including all tank heaters and controls. The most energy consumptive configuration in the product family shall be selected to test the idle energy rate. Booster heater (internal or external) energy consumption shall be measured and reported separately, if possible, per ASTM F1696 and ASTM F1920 Sections 10.8 and 10.9, respectively. However, if booster energy cannot be measured separately it will be included in the idle energy rate measurements.

b. GPR = gallons per rack, LPR = Liters per rack, GPSF = gallons per square foot of rack, LPSM = liters per square meter of rack, GPH = gallons per hour, c = [maximum conveyor belt speed (feet/minute)] × [conveyor belt width (feet)], LPH = liters per hour, d = [maximum conveyor belt speed (m/minute)] × [conveyor belt width (m)]

c. PPU Washing Energy is still in format kWh/rack when evaluated; SFrack (SMrack) is Square Feet of rack area (square meters of rack area), same as in PPU water consumption metric.

Table C406.2.7.2(4) Minimum Efficiency Requirements: Commercial Ovens

Fuel Type	**Classification**	**Idle Rate**	**Cooking Energy Efficiency, %**	**Test Procedure**
Convection Ovens				
Gas	Full-Size	≤ 12,000 Btu/h	≥ 46	ASTM F1496
Electric	Half-Size	≤ 1.0 Btu/h	≥ 71	
	Full-Size	≤ 1.60 Btu/h		
Combination Ovens				
Gas	Steam Mode	≤ 200P^a + 6,511 Btu/h (≤ 0.059 P^a + 1.9 kW)	≥ 41	ASTM F2861
	Convection Mode	≤ 150P^a + 5,425 Btu/h (≤ 0.044 P^a + 1.6 kW)	≥ 56	

Electric	Steam Mode	≤ 0.133P^{a} + 0.6400 kW	≥ 55	
	Convection Mode	≤ 0.080P^{a} + 0.4989 kW	≥ 76	
Rack Ovens				
Gas	Single	≤ 25,000 Btu/h (7.3 kW)	≥ 48	ASTM F2093
	Double	≤ 30,000 Btu/h (8.8 kW)	≥ 52	

a. P = Pan Capacity: the number of steam table pans the combination oven is able to accommodate in accordance with ASTM F1495

C406.2.7.3 Q03 Efficient Residential Kitchen Equipment **.** For projects with Group R-1 and R-2 occupancies, energy credits shall be achieved where all dishwashers, refrigerators, and freezers comply with all of the following:

1. Achieve the Energy Star Most Efficient 2021 label in accordance with the specifications current as of:
   - 1.1 Refrigerators and freezers 5.0, 9/15/2014
   - 1.2 Dishwashers 6.0, 1/29/2016
2. Be installed before the issuance of the certificate of occupancy.

For Group R-1 where only some guest rooms are equipped with both refrigerators and dishwashers, the table credits shall be prorated as follows:

[Section C406.2 base credits] × [floor area of guest rooms with kitchens] / [total guest room floor area] **(Equation 4-26)**

C406.2.7.4 Q04 Fault detection and diagnostics system.. A project not required to comply with C403.2.3 can achieve energy credits for installing a fault detection and diagnostics system to monitor the HVAC system's performance and automatically identify faults. The installed system shall comply with items 1 through 6 in Section C403.2.3.

C406.3 Renewable and Load Management Credits achieved **.** Renewable energy and load management measures installed in the *building* that comply with Sections C406.3.1 through C406.3.8 shall achieve the credits listed for the occupancy group in Tables C406.3(1) through C406.3(9) or where calculations are required in Sections C406.3 to determine credits or modify the table credits, the credits achieved shall be based upon the Section C406.3 calculations. Measure credits achieved shall be determined in one of two ways, depending on the measure:

1. The measure credit shall be the base energy credit for the measure where no adjustment factor or formula is shown in the description of the measure in Section C406.3.
2. The measure credit shall be the base energy credit for the measure adjusted by a factor or formula as stated in the description of the measure in Section C406.3. Where adjustments are applied, each energy credit shall be rounded to the nearest whole number.

Load management and renewable credits achieved for the project shall be the sum of credits for individual measures included in the project. Credits are available for the measures listed in this Section. Where a project contains multiple building use groups credits achieved for each building use group shall be summed and then weighted by the gross floor area of each building use group to determine the weighted average project energy credits achieved. The load management measures in Sections C406.3.2 (G01) through C406.3.7 (G06) require load management control sequences that are capable of and configured to automatically provide the load management operation specified based on indication of a peak period related to high short-term electric prices, grid condition, or peak building load. Such a peak period shall, where possible, be initiated by a demand response signal from the controlling entity, such as a utility or service operator.

When communications are disabled or unavailable, all demand responsive controls shall continue backup demand response based on a local schedule or building demand monitoring. The local building schedule shall be adjustable without programming and reflect the electric rate peak period dates and times. The load management control sequences shall be activated for peak period control by either:

1. A certified OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in the applicable OpenADR 2.0 Specification, or
2. A device certified by the manufacturer as being capable of responding to a demand response signal from a certified OpenADR 2.0b VEN by automatically implementing the control functions requested by the VEN for the equipment it controls, or
3. A device that complies with IEC 62726-10-1, an international standard for the open automated demand response system interface between the appliance, system, or energy management system and the controlling entity, or
4. An interface that complies with the communication protocol required by a controlling entity, to participate in an automated demand response program, or
5. Where the controlling entity does not have a demand response program or protocol available, local demand response control shall be provided based on either:
   5.1. Building demand management controls that monitor building electrical demand and initiate controls to minimize monthly or peak time period demand charges, or,
   5.2 Where buildings are less than 25,000 gross square feet, a local building schedule that reflects the electric rate peak period dates and times. In this case a binary input to the control system shall be provided that activates the demand response sequence.

Table C406.3(1) Renewable and Load Management Credits for Group R-2, R-4, and I-1 Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	9	15	11	17	18	20	19	21	13	10	13	9	9	11	10	9	10	9	7
G01	Lighting load management	C406.3.2	16	7	9	12	12	16	11	14	12	11	16	14	8	11	14	5	7	7	11
G02	HVAC load management	C406.3.3	42	41	21	35	23	37	30	28	28	17	33	24	20	22	23	10	13	15	17
G03	Automated shading	C406.3.4	11	x	7	18	10	13	5	13	12	2	14	7	10	13	11	1	8	8	16
G04	Electric energy storage	C406.3.5	10	10	10	11	10	13	13	14	17	16	13	17	14	13	17	14	14	14	15
G05	Cooling energy storage	C406.3.6	28	6	31	13	22	21	21	37	11	12	22	11	9	17	9	7	17	2	3
G06	SHW energy storage	C406.3.7	17	17	19	18	19	19	20	20	22	19	19	21	19	19	20	18	19	18	17
G07	Building thermal mass	C406.3.8	7	2	11	5	16	28	22	27	60	19	43	46	32	58	37	27	45	40	19

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(2) Renewable and Load Management Credits for Group I-2 Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8

R01	Renewable Energy	C406.3.1	6	6	6	6	6	8	7	9	8	6	8	6	6	7	7	6	7	5	4
G01	Lighting load management	C406.3.2	11	12	13	13	13	12	12	12	6	13	16	12	13	14	15	14	14	12	12
G02	HVAC load management	C406.3.3	10	11	10	10	8	21	10	10	13	11	18	11	12	14	13	12	11	9	7
G03	Automated shading	C406.3.4	1	1	1	1	x	x	x	1	x	x	2	x	x	2	x	x	1	1	x
G04	Electric energy storage	C406.3.5	13	13	13	13	14	15	14	15	15	14	15	15	14	15	15	13	14	13	12
G05	Cooling energy storage	C406.3.6	25	6	33	14	25	19	27	37	27	16	22	19	14	18	11	11	20	2	3
G06	SHW energy storage	C406.3.7	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	4
G07	Building thermal mass	C406.3.8	6	2	10	4	15	25	20	24	57	18	39	44	31	53	33	26	40	34	14

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(3) Renewable and Load Management Credits for Group R-1 Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	9	8	12	9	11	11	10	12	13	9	12	8	9	11	9	8	9	7	5
G01	Lighting load management	C406.3.2	12	12	11	12	12	14	14	13	15	14	13	11	10	11	14	9	11	8	8
G02	HVAC load management	C406.3.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
G03	Automated shading	C406.3.4	2	2	2	3	1	2	3	2	4	3	2	1	1	1	3	1	2	1	1
G04	Electric energy storage	C406.3.5	9	9	10	10	9	13	13	15	13	14	13	14	14	12	16	13	12	12	13
G05	Cooling energy storage	C406.3.6	31	7	38	17	29	24	31	44	26	18	26	16	15	21	11	12	24	2	4
G06	SHW energy storage	C406.3.7	25	25	28	26	28	29	29	30	31	29	30	31	28	29	31	26	28	25	24
G07	Building thermal mass	C406.3.8	6	1	10	4	14	24	19	23	53	17	38	41	30	52	33	26	42	37	17

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(4) Renewable and Load Management Credits for Group B Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	14	14	17	15	17	19	18	22	24	17	22	16	14	18	18	14	17	14	11
G01	Lighting load management	C406.3.2	10	11	11	12	11	11	11	12	9	10	11	10	10	11	10	10	11	10	9
G02	HVAC load management	C406.3.3	x	10	10	9	9	3	8	12	7	12	8	11	9	10	12	8	9	10	2
G03	Automated shading	C406.3.4	4	7	7	8	7	8	5	6	6	4	6	5	4	5	5	5	5	4	7
G04	Electric energy storage	C406.3.5	14	15	14	14	16	16	17	16	18	17	16	18	17	17	18	16	15	17	18

G05	Cooling energy storage	C406.3.6	28	7	36	16	27	24	28	5	7	7									
G06	SHW energy storage	C406.3.7	5	5	6	6	6	6	7												
G07	Building thermal mass	C406.3.8	3	1	5	2	6	9	[illegible]		4										

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(5) Renewable and Load Management Credits for Group A-2 Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	2	2	2	2	2	2	2	3	4	2	3	2	2	3	2	2	2	2	1
G01	Lighting load management	C406.3.2	4	4	5	5	4	5	5	5	5	4	5	5	4	4	5	4	5	4	1
G02	HVAC load management	C406.3.3	32	26	37	28	31	26	27	22	23	20	17	14	19	14	10	16	14	14	1
G03	Automated shading	C406.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
G04	Electric energy storage	C406.3.5	4	4	4	4	5	5	5	5	4	4	4	4	3	4	4	4	3	3	2
G05	Cooling energy storage	C406.3.6	15	4	17	8	12	10	10	16	6	5	7	3	3	4	1	2	4	x	x
G06	SHW energy storage	C406.3.7	13	13	15	14	15	16	16	17	19	16	17	19	16	17	18	15	16	14	13
G07	Building thermal mass	C406.3.8	3	1	5	2	7	12	8	10	21	6	15	14	8	18	10	6	12	8	3

x = Credits excluded from this *building* use type and climate zone.

Table C403.6(6) Renewable and Load Management Credits for Group M Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	8	8	12	9	11	12	12	17	17	11	13	9	10	11	10	9	10	9	6
G01	Lighting load management	C406.3.2	16	16	18	19	17	19	19	21	17	18	21	21	18	21	22	18	22	18	16
G02	HVAC load management	C406.3.3	x	x	16	15	15	6	15	21	13	23	15	23	17	19	26	14	17	18	3
G03	Automated shading	C406.3.4	7	11	11	12	11	13	10	11	11	7	11	11	8	10	11	8	9	8	12
G04	Electric energy storage	C406.3.5	6	10	8	10	11	12	11	10	14	11	10	12	10	11	12	11	9	10	8
G05	Cooling energy storage	C406.3.6	40	9	51	22	35	31	34	53	21	17	28	10	11	19	4	9	18	2	2
G06	SHW energy storage	C406.3.7	3	3	4	3	4	4	4	4	5	4	4	5	4	4	5	4	4	4	3
G07	Building thermal mass	C406.3.8	5	1	6	3	8	12	10	10	20	7	17	15	14	24	10	13	20	24	12

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(7) Renewable and Load Management Credits for Group E Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	10	11	13	12	13	16	15	21	22	15	19	15	14	17	16	13	16	12	10
G01	Lighting load management	C406.3.2	7	12	12	13	13	15	14	16	13	12	16	16	10	14	18	16	13	14	14
G02	HVAC load management	C406.3.3	18	22	32	23	25	31	26	26	20	23	31	24	20	31	12	18	27	16	9
G03	Automated shading	C406.3.4	7	13	16	12	18	17	17	18	13	12	17	17	10	15	13	14	10	16	17
G04	Electric energy storage	C406.3.5	16	16	18	17	19	21	21	23	26	22	24	24	23	24	24	20	22	19	19
G05	Cooling energy storage	C406.3.6	36	9	46	21	36	32	39	62	39	24	37	22	20	28	13	16	31	3	4
G06	SHW energy storage	C406.3.7	5	5	6	5	6	6	7	7	8	7	7	8	7	7	8	7	7	7	6
G07	Building thermal mass	C406.3.8	7	2	11	5	17	28	23	27	63	21	44	48	37	60	38	31	50	47	21

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(8) Renewable and Load Management Credits for Group S-1 and S-2 Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	38	37	55	45	53	53	49	58	66	36	56	38	29	41	36	24	32	23	16
G01	Lighting load management	C406.3.2	13	26	32	28	32	35	36	33	36	31	27	37	32	23	28	36	22	25	22
G02	HVAC load management	C406.3.3	18	46	37	37	28	36	29	26	22	23	17	12	16	13	5	14	8	10	3
G03	Automated shading	C406.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
G04	Electric energy storage	C406.3.5	40	40	47	41	47	44	40	44	42	30	38	31	21	31	26	24	29	23	21
G05	Cooling energy storage	C406.3.6	20	5	21	11	14	14	11	21	5	5	9	2	2	5	1	1	3	x	x
G06	SHW energy storage	C406.3.7	3	3	3	3	4	3	4	4	4	3	4	4	3	3	4	2	2	2	2
G07	Building thermal mass	C406.3.8	7	2	12	5	17	29	23	28	66	18	44	47	28	56	37	20	39	29	13

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(9) Renewable and Load Management Credits for Other[a] Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone

			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	12	13	16	14	16	18	17	20	21	13	18	13	12	15	14	11	13	10	8
G01	Lighting load management	C406.3.2	11	13	14	14	14	16	15	16	14	14	16	16	13	14	16	14	13	12	12
G02	HVAC load management	C406.3.3	24	24	23	22	20	23	21	21	18	18	20	17	16	18	14	13	14	13	6
G03	Automated shading	C406.3.4	5	6	7	9	8	9	7	9	8	5	9	7	5	8	7	5	6	6	9
G04	Electric energy storage	C406.3.5	14	15	16	15	16	17	17	18	19	16	17	17	15	16	17	14	15	14	14
G05	Cooling energy storage	C406.3.6	28	7	34	15	25	22	25	39	20	14	22	12	11	17	7	9	18	2	3
G06	SHW energy storage	C406.3.7	9	9	11	10	11	11	11	12	13	11	12	13	11	11	12	10	11	10	9
G07	Building thermal mass	C406.3.8	6	2	9	4	13	21	16	20	44	14	31	33	24	42	25	20	33	29	13

a. Other occupancy groups include all Groups except for Groups A-2, B, E, I, M, and R.

C406.3.1 R01 Renewable Energy. Projects installing on-site renewable energy systems with a capacity of at least 0.1 watts per gross square foot (1.08 W/m2) of building area or securing off-site renewable energy shall achieve energy credits for this measure calculated as follows:

$EC_R = EC_{0.1} \times (R_t + R_{off} - R_{ex}) / (0.1 \times PGFA)$ **(Equation 4-27)**

where: EC_R = C406.3.1 R01 energy credits achieved for this project

R_t = Actual total rating of on-site renewable energy systems (W)

PGFA = Project gross floor area, ft^2

$EC_{0.1}$ = C406.3.1 R01 base credits from Tables C406.3(1) through C406.3(9)

R_{off} = Actual total equivalent rating of off-site renewable energy contracts (W), calculated as follows: R_{OFF} = TRE/(REN X 20) where: TRE = Total off-site renewable electrical energy in kilowatt-hours (kWh) that is procured in accordance with Sections C405.13.2.1 through C405.13.4

REN = Annual off-site renewable electrical energy from Table C405.13.2, in units of kilowatt-hours per watt of array capacity R_{ex} = Rating (W) of renewable energy resources capacity excluded from credit calculated as follows:

$R_{ex} = RR_r + RR_x + RR_c$ where: RR_r = Rating of on-site renewable energy systems required by Section C405.13.1, without exception (W).

RR_x = Rating of renewable energy resources used to meet any exceptions of this code (W).

RR_c = Rating of renewable energy resources used to achieve other energy credits in Section C406 (W).

Where renewable requirements, exceptions, or credits are expressed in annual kWh or Btu rather than Watts of output capacity, they shall be converted as 3413 Btu = 1 kWh and converted to W equivalent capacity as follows:

RR_W = Actual total equivalent rating of renewable energy capacity (W), calculated as follows: $RR_W = TRE_x / (REN \times PGFA)$ where: TRE_x = Total renewable energy in kilowatt-hours (kWh) that is excluded from R01 energy credits

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Table 406.3.1 Renewable Capacity Limits (RA_L) without Electric Storage, W/ft^2

Building Occupancy Group	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
RA_{L1}: R-2, R-4, and I-1 with gas water heat[a]	1.3	1.3	1.0	1.0	1.0	0.9	0.9	0.8	0.7	0.9	0.8	0.9	0.9	0.9	0.9	1.0	0.9	1.0	1.3

RA_{L2}: R-2, R-4, and I-1 with electric or solar water heat[a]	7.6	6.8	5.9	5.1	4.2	4.2	4.2	3.4	2.5	4.2	3.4	3.4	3.4	3.4	3.4	4.2	3.4	4.2	5.1
I-2	10.3	9.7	8.2	8.2	8.2	7.3	7.2	6.2	6.2	7.5	6.2	7.3	7.5	6.5	7.3	7.3	7.2	7.2	8.8
R-1	4.1	3.8	3.4	2.9	3.1	2.7	2.6	2.3	2.2	2.7	2.0	2.7	2.7	2.1	1.9	2.6	2.2	2.7	3.2
RA_{L3}: B with IT & phone equip. > 0.5 W/ft[2,b]	5.2	5.2	4.6	4.6	4.3	4.0	4.0	3.8	3.5	3.8	3.8	4.0	4.0	4.0	4.0	4.0	4.0	4.3	5.2
RA_{L4}: B with IT & phone equip. ≤ 0.5 W/ft[2,b]	2.7	2.7	2.1	2.1	2.1	1.9	1.9	1.6	1.6	1.8	1.6	1.8	1.8	1.8	1.8	1.9	1.9	2.0	2.6
A-2	26.9	26.3	19.4	20.0	18.0	14.9	14.9	13.9	12.7	14.8	12.5	14.0	13.7	13.1	13.2	14.4	13.6	14.4	16.5
M	6.5	6.4	4.5	4.8	4.3	3.5	3.5	3.0	2.9	3.2	2.9	3.2	3.2	2.9	2.8	3.1	2.9	3.1	3.3
E	3.9	4.2	2.8	3.0	2.6	2.1	2.0	1.7	1.6	1.9	1.4	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.4
S-1 and S-2	1.3	1.3	1.0	1.0	0.7	0.7	0.7	0.7	0.6	0.7	0.6	0.7	0.7	0.7	0.7	0.9	0.9	0.9	1.0
All Other	3.4	3.3	2.6	2.5	2.9	2.7	2.7	2.1	2.3	2.6	2.3	2.7	2.7	2.5	3.1	3.1	2.8	3.2	3.2

a. For buildings that include residential occupancy (Group R-2, R-4 and I-1), RA_L shall be adjusted as follows:

1. Where 70% or more of service water-heating capacity is gas, $RA_L = RA_{L1}$
2. Where 70% or more of service water-heating capacity is electric resistance or solar water/pool heating is included with electric resistance backup, use RA_{L2}
3. Where 70% or more of service water-heating capacity is heat pump water heating, adjust as follows: $RA_L = RA_{L1} + \{ (RA_{L2} - RA_{L1}) / 3 \}$
4. Where solar water/pool heating is included with gas backup, prorate based on relative capacity as follows: RA_L = [% gas peak capacity] · RA_{L1} + [% solar peak capacity] · RA_{L2}
5. Where electric water heating is mixed with gas water heating, prorate based on relative capacity as follows: RA_L = [% gas peak capacity] · RA_{L1} + [% electric peak capacity] · RA_{L2}

b. Office (Group B) IT & phone equipment density is calculated based on total building area, not just server and equipment room area, and power for distributed computers or terminals in office areas is not included. Where the total building density of IT & phone equipment is greater than 0.5 W/sf, $RA_L = RA_{L3}$, otherwise $RA_L = RA_{L4}$.

Table C406.3.1 Renewable Capacity LImits (RA_L) without Electric Storage, W/m^2

Building Occupancy Group	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
RA_{L1}: R-2, R-4, and I-1 with gas water heat[a]	14	14	11	11	11	10	10	9	8	10	9	10	10	10	10	11	10	11	14
RA_{L2}: R-2, R-4, and I-1 with electric or solar water heat[a]	82	73	64	55	45	45	45	37	27	45	37	37	37	37	37	45	37	45	55
I-2	111	104	89	88	88	78	78	67	67	81	67	78	81	70	79	78	78	78	94
R-1	44	40	36	31	33	29	28	24	24	29	22	29	29	23	21	28	24	29	34
RA_{L3}: B with IT & phone equip. > 0.5 W/ft[2,b]	56	56	50	50	46	43	43	41	38	41	41	43	43	43	43	43	43	46	56
RA_{L4}: B with IT & phone equip. ≤ 0.5 W/ft[2,b]	29	29	23	23	23	20	20	17	17	19	17	19	19	19	19	20	20	22	27
A-2	289	283	209	215	193	160	160	150	136	159	135	150	147	141	142	155	147	155	178
M	70	68	48	51	46	38	38	32	31	35	31	35	35	31	30	34	31	33	36
E	42	45	31	32	28	23	22	18	17	21	15	21	21	21	20	21	20	20	26

S-1 and S-2	14	14	11	11	8	8	8	8	6	8	6	8	8	8	8	10	10	10	11
All Other	36	35	28	27	32	29	29	23	24	28	25	29	29	27	34	33	30	35	34

[same footnotes as IP version]

C406.3.2 G01 Lighting Load Management. Luminaires shall have dimming capability and automatic load management controls that shall gradually reduce *general lighting* power during peak periods. The load management controls shall reduce lighting power in 75 percent of the building area by at least 20 percent with *continuous dimming* over a period no longer than 15 minutes. Where less than 75 percent, but at least 50 percent of the project *general lighting* is controlled, the credits from Tables C406.3 shall be prorated as follows:

[building area with lighting load management, %] x [table credits for C406.3.2] / 75% **(Equation 4-28)**

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> **Exception:** Warehouse or retail storage building areas shall be permitted to achieve this credit by switching off at least 25 percent of lighting power in 75 percent of the building area without dimming, or as adjusted by Equation 4-28.

G406.3.3 G02 HVAC Load Management. Automatic load management controls shall be configured:

1. Where electric cooling is in use to gradually increase the cooling setpoint by at least 3°F (1.7°C) over a minimum of three hours or reduce effective cooling capacity to 60% of installed capacity during the peak period.
2. Where electric heating is in use to gradually decrease the heating setpoint by at least 3°F (1.7°C) over a minimum of three hours or reduce effective heating capacity to 60% of installed capacity during the peak period.
3. Where HVAC systems are serving multiple zones and have less than 70 percent outdoor air required, include controls that provide excess outdoor air preceding the peak period and reduce outdoor air by at least 30 percent during the peak period, in accordance with ASHRAE Standard 62.1 Section 6.2.5.2 Short Term Conditions or provisions for *approved* engineering analysis in the International Mechanical Code Section 403.3.1.1, Outdoor Airflow Rate.

C406.3.4 G03 Automated Shading Load Management. Where fenestration on east, south, and west exposures exceeds 20 percent of wall area, load management credits shall be achieved as follows:

1. Automatic exterior shading devices or dynamic glazing that are capable of reducing solar gain (SHGC) through sunlit fenestration by at least 50 percent when fully closed shall receive the full credits in Tables C406.3(1) through C406.3(9). The exterior shades shall have fully open and fully closed SHGC determined in accordance with AERC 1.
2. Automatic interior shading devices with a minimum solar reflectance of 0.50 for the surface facing the fenestration shall receive 40 percent of the credits in Tables C406.3(1) through C406.3(9).
3. All shading devices, dynamic glazing, or shading attachments shall:
   3.1. Provide at least 90 percent coverage of the total fenestration on east, south, and west exposures in the*building.*
   3.2 Be automatically controlled and shall modulate in multiple steps or continuously the amount of solar gain and light transmitted into the space in response to peak periods and either daylight levels or solar intensity
   3.3. Include a manual override located in the same enclosed space as the shaded vertical fenestration that shall override operation of automatic controls no longer than four hours. Such override shall be locked out during peak periods.

For this section, directional east, south, or west exposures shall exclude fenestration that is plus or minus 45 degrees of facing true north in the northern hemisphere. In the southern hemisphere, where the south exposure is referred to, it shall be replaced by the north exposure and the referenced south exposure shall be replaced by the north exposure.

C406.3.5 G04 Electric Energy Storage. Electric storage devices shall be charged and discharged by automatic load management controls to store energy during non-peak periods and use stored energy during peak periods to reduce *building* demand. Electric storage devices shall have a minimum capacity of 1.5 Wh/ft^2 (87 Wh/m^2) of gross *building* area. Base credits in Tables C406.3-1 through C406.3-8 are based on installed electric storage of 5 Wh/ft^2 (54 Wh/m^2) and shall be prorated for actual installed storage capacity between 1.5 and 15 Wh/ft^2 (16 to 160 Wh/m^2), as follows:

[Installed electric storage capacity, Wh/ft^2 (Wh/m^2)]] / 5 (54) × [C406.3.5 Credits from Tables] **(Equation 4-29)**

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Larger energy storage shall be permitted however, credits are limited to the range of 1.5 to 15 Wh/f~~t~~^{2} (16 to 160 Wh/m^2).

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C403.6.6 G05 Cooling Energy Storage. Automatic load management controls shall be capable of activating ice or chilled water storage *equipment* to reduce demand during summer peak periods. Storage tank standby loss shall be demonstrated through analysis to be no more than 2 percent of storage capacity over a 24 hour period for the cooling design day.
Base credits in Section C406.3 are based on storage capacity of the design peak hour cooling load with a 1.15 sizing factor. Credits shall be prorated for installed storage systems sized between 0.5 and 4.0 times the design day peak hour cooling load, rounded to the nearest whole credit. Larger storage shall be permitted but the associated credits are limited to the range above. Energy credits shall be determined as follows:

ECs = EC1.0 x (1.44 X SR + 0.71) / 2.15 **(Equation 4-30)**

where:
ECs = Cooling Storage credit achieved for Project

EC1.0 = G05 base energy credit for building use type and climate zone based on 1.0 ton-hours storage per design day ton (kWh/kW) of cooling load
SR = Storage ratio in ton-hours storage per design day ton (kWh/kW) of cooling load where 0.5 ≤ SR ≤ 4.0

G406.3.7 G06 SWH Energy Storage. Where SHW is heated by electricity, automatic load management controls comply with ANSI/CTA-2045-B shall preheat stored SHW before the peak period and suspend electric water heating during the peak period. Storage capacity shall be provided by either:

1. Preheating water above 140°F (60°C) delivery temperature with at least 1.34 kWh of energy storage per kW of water-heating capacity. Tempering valves shall be provided at the water heater delivery location.
2. Providing additional heated water tank storage capacity above peak SHW demand with equivalent peak storage capacity to item 1. Where heat pump water heating is used, the credits achieved shall be 1/3 of the credits in Tables C406.3(1) through C406.3(9).

C406.3.8 G07 Building Thermal Mass. The project shall have additional passive interior mass and a night flush control of the HVAC system. The credit is available to projects that have at least 80 percent of gross floor area unoccupied between midnight and 6:00 a.m. The project shall meet the following requirements:

1. Interior to the *building envelope* insulation, provide 10 lb/ft^2 (50 kg/m^2) of project *conditioned floor area* of passive thermal mass in the *building* interior *wall*, the inside of the *exterior wall*, or interior floor construction. Mass *construction* shall have mass surfaces directly contacting the air in *conditioned spaces* with directly attached gypsum panels allowed. Mass with carpet or furred gypsum panels or *exterior wall* mass that is on the exterior of the insulation layer (e.g., the portion of CMU block on the exterior of insulation filled cell cavities) shall not be included toward the *building* mass required.

2. HVAC units for 80 percent or more of the supply airflow in the project shall be equipped with outdoor air economizers and fans that have variable or low speed capable of operating at 66 percent or lower airflow and be included in the night flush *control* sequence.

3. Night flush controls shall be configured with the following sequence or another night flush strategy shall be permitted where demonstrated to be effective, avoids added morning heating, and is approved by the *authority having jurisdiction*.

   3.1. Summer mode shall be activated when outdoor air temperature exceeds 70ºF (21ºC) and shall continue uninterrupted until deactivated when outdoor air temperature falls below 45ºF (7ºC). During summer mode, the occupied cooling *set point* shall be set 1ºF (0.6ºC) higher than normal and the occupied heating *set point* shall be reset 2ºF (1.1ºC) lower than normal.

   3.2. When all the following conditions exist, night flush shall be activated:

      3.2.1. Summer mode is active in accordance with item 3.1.

      3.2.2. Outdoor air temperature is 5ºF (2.8ºC) or more below indoor average zone temperature.

      3.2.3. Indoor average zone temperature is greater than morning occupied heating*set point*.

      3.2.4. In climate zones 0A through 3A, outdoor dewpoint is below 50ºF (10ºC) or outdoor air enthalpy is less than indoor air enthalpy.

      3.2.5. Local time is between 10:00 pm and 6:00 am.

   3.3. When night flush is active, *automatic* night flush controls shall operate outdoor air *economizers* at low fan speed not exceeding 66 percent during the unoccupied period with *mechanical cooling* and heating locked out.

Revise as follows:

C407.2 Mandatory requirements. Compliance based on total building performance requires that a proposed design meet all of the following:

1. The requirements of the sections indicated within Table C407.2.
2. An annual energy cost that is less than or equal to ~~80~~ the percentage of the annual energy cost (PAEC) of the *standard reference design* calculated in Equation 4-31. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's *State Energy Data System Prices and Expenditures* reports. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

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

PAEC = 100 x (0.85 + 0.025 - ECr/1000) **(Equation 4-31)**

where: *PAEC* = *Percentage of annual energy cost applied to standard reference design* EC_r = Energy efficiency credits required for the *building* in accordance with Section C406.1 (do not include load management and renewable credits)

TABLE C407.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION [a]	TITLE
Envelope	
C402.5	Air leakage–thermal envelope
Mechanical	
C403.1.1	Calculation of heating and cooling loads

C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies
C403.4, except C403.4.3, C403.4.4 and C403.4.5	Heating and cooling system controls
C403.5.5	Economizer fault detection and diagnostics
C403.7, except C403.7.4.1	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.11, except C403.11.3	Refrigeration equipment performance
C403.12	Construction of HVAC system elements
C403.13	Mechanical systems located outside of the building thermal envelope
C404	Service water heating
C405, except C405.3	Electrical power and lighting systems
C406.1.2	Additional renewable and load management credit requirements
C408	Maintenance information and system commisioning

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

Add new text as follows:

APPENDIX CD
ENERGY CREDITS

CD101
General

CD101.1 Purpose. This purpose of this Appendix is to supplement the *International Energy Conservation Code and* requires projects to comply with Advanced Energy Credit Package requirements.

CD101.2 Scope. This Appendix applies to all buildings, in accordance with Section C406.1, required to comply with, either Section C406.1.1 or Section C406.1.3.

CD102
Advanced Energy Credit Package

CD102.1 Advanced Energy Credit Package requirements. The requirements of this Section supercede the requirements of Section C406.1.1. Projects shall comply with measures from C406.2 to achieve the minimum number of required efficiency credits from Table CD102.1 based on building occupancy group and climate zone. Projects with multiple occupancies, unconditioned parking garages, *alterations*, and *buildings* with separate shell-and- core and build-out construction permits shall comply as follows:
Where a project contains multiple occupancies, credits in Table CD102.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406 and Appendix CD.

Exceptions:

1. Unconditioned parking garages that achieve 50 percent of the credits required for use groups S-1 and S-2 in Table CD102.1.

2. Portions of buildings devoted to manufacturing or industrial use.

Table CD102.1 Energy Credit Requirements by Building Occupancy Group

Building Occupancy Groups	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	179	174	188	197	200	200	200	200	200	200	200	200	193	200	200	200	200	200	200
I-2	78	75	73	71	80	90	100	85	90	97	83	90	99	90	96	107	106	130	117
R-1	106	100	110	105	109	122	123	125	131	137	129	136	157	139	147	171	158	180	176
B	114	110	112	115	108	107	116	111	114	126	118	123	135	125	125	152	142	153	141
A-2	83	81	82	82	86	86	108	91	97	126	99	111	147	117	113	160	143	163	151
M	113	113	121	118	123	127	116	116	133	109	100	92	99	134	125	171	146	150	137
E	91	95	91	100	96	100	105	104	101	113	110	110	120	117	122	131	132	126	131
S-1 and S-2	108	106	111	109	109	108	89	106	108	134	100	130	200	143	123	200	190	189	148
All Other	54	53	55	56	57	60	61	60	63	68	60	65	73	68	69	84	79	84	78

Add new standard(s) as follows:

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

ANSI/CTA-2045-B – 2018 Modular Communications Interface for Energy Management

IEC International Electrotechnical Commission. IEC 62746-10-1 - 2018 Systems interface between customer energy management system and the power management system - Part 10-1: Open automated demand response

OpenADR OpenADR Alliance. OpenADR 2.0a and 2.0b – 2019: Profile Specification Distributed Energy Resources

Add new definition as follows:

SENSIBLE ENERGY RECOVERY RATIO. change in the dry-bulb temperature of the outdoor air supply divided by the difference between the outdoor air and entering exhaust air dry-bulb temperatures, expressed as a percentage.

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Add new text as follows:

TABLE C406.2.2.5 DOAS ENERGY RECOVERY ADJUSTMENTS

ERE_{adj} based on lower of actual heating or cooling energy recovery effectiveness where required		
Cooling ERR is ≥	Heating enthalpy recovery ratio or sensible energy recovery ratio is ≥	Energy Recovery Effectivness Adjustment (ERE_{adj})
65%	65%	1.00
60%	60%	0.67
55%	55%[a]	0.33
50%	50%[a]	0.25

a. In climate zones where heating recovery is required for this measure, for dwelling units a heating recovery effectiveness below 60 percent is not allowed.

C406.2.3.1.1 W01 Recoverd or renewable water heating. The *building* service water-heating system shall have one or more of the following that are sized to provide not less than 30 percent of the *building's* annual hot water requirements, or sized to provide not less than 70 percent of the *building's* annual hot water requirements if the *building* is required to comply with Section C403.10.5:

1. Waste heat recovery from SHW, heat recovery chillers, *building* equipment, or process equipment.
2. A water-to-water heat pump that precools chilled water return for *building* cooling.
3. On-site renewable energy water-heating systems.

C406.2.3.1.2 W02 Heat pump water heater. Air-source heat pump *water heaters* shall be installed according to manufacturer's instructions and at least 30 percent of design end use service water heating requirements shall be met using only heat pump heating at an ambient condition of 67.5**[I)**F, db without supplemental electric resistance or fossil fuel heating. For a heat pump water heater with supplemental electric resistance heating, the heat pump only capacity shall be deemed at 40 percent of first hour draw. Where the heat pump only capacity exceeds 50 percent of the design end use load excluding *recirculating* system losses, the credits from the Section C406.2 tables shall be prorated as follows:

$EC_{HPWH} = (EC_{BASE}/0.5) \times \{(CAP_{HPWH})/(ENDLOAD)$ [not greater than 2]$\}$ **(Equation 4-19)**

where: EC_{HPWH} = Energy credits achieved for W02 EC_{BASE} = W02 base energy credits Section 13.5.3 ENDLOAD = End use peak hot water load, excluding load for heat trace or recirculation, Btu/hr or kW
CAP_{HPWH} = the heat pump only capacity at 50ºF (10ºC) entering air and 70ºF (21ºC) entering potable water without supplemental electric resistance or fossil fuel heat, Btu/hr or kW

The heat pump service water heating system shall comply with the following requirements:

1. For systems with an installed total output capacity of more than 100,000 Btu/hr (30 kW) at an ambient condition of 67.5ºF (19.7ºC), db a preheat storage tank with greater than or equal 0.75 gallons per 1000 Btu/hr (≥9.7 L/kW) of design end use service water heating requirements shall be heated only with heat pump heating when the ambient temperature is greater than 45ºF (7.2ºC)
2. For systems with piping temperature maintenance, either a heat trace system or a separate water heater in series for recirculating system and final heating shall be installed.
3. Heat pump *water heater* efficiency shall meet or exceed one of the following:
   - 3.1 Output-capacity-weighted-average UEF of 3.0 in accordance with 10 CFR 430 Appendix E.
   - 3.2 Output-capacity-weighted-average COP of not less than 4.0 tested at 50ºF (10ºC) entering air and 70ºF (21ºC) entering potable water in accordance with AHRI standard 1300.

Where the heat pump capacity at 50°F (10°C) entering air and 70°F (21°C) entering water exceeds 50 percent of the design end-use load excluding recirculating system losses, the base credits from Section C406.2 shall be prorated based on Equation 4-20.

W02 credit = base W02 table credit x $(HP_{LF}/50\%)$ **(Equation 4-20)**

where: HP_{LF} = Heat pump capacity as a fraction of the design end-use SHW requirements excluding recirculating system losses, not to exceed 80 percent.

C406.2.3.1.3 W03 Efficient fossil fuel water heater. The combined input-capacity-weighted-average equipment rating of all gas water-heating equipment in the *building* shall be not less than 95 percent Et or 0.93 UEF. This measure shall receive only thirty percent of the listed energy credits for *buildings* required to comply with C404.2.1. Projects where the installed*building* service water heating capacity is less than 200,000 Btu/hr (59 kW) and weighted UEF is not less than 0.82 shall achieve 25 percent of the base table W03 credit.

C406.2.3.1.4 Combination service water heating systems. shall achieve credits using one of the measure combinations as follows:

1. (W01 + W02) Where service water heating employs both energy recovery and heat pump water heating, W01 may be combined with W02 and receive the sum of both credits.
2. (W01 + W03) Where service water heating employs both energy recovery and efficient gas water heating, W01 may be combined with W03 and receive the sum of the W01 credit and the portion of the W03 credit based on item 4.
3. (W02 + W03) Where service water heating employs both heat pump water heating and efficient gas water heating, W02 may be combined with W03 and receive the sum of the W02 credit and the portion of the W03 credit based on item 4.

For items 2 and 3, the achieved W03 credit shall be the Section C406.2.3.1.3 W03 credit multiplied by the fractional share of total water heating installed capacity served by gas water heating that is not less than 95 percent Et or 0.93 UEF. In no case shall the achieved W03 credit exceed 60 percent of the W03 credit in Section C406.2 tables. In *Buildings* that have a service water heating design generating capacity greater than 900,000 Btu/h that proportioned W03 credit shall be further multiplied by 30 percent.

C406.2.5.3.1 Occupant sensor controls. *Occupant sensor controls* shall be installed to control lights in the following space types:

1. Courtroom
2. Electrical/mechanical room
3. Food preparation area
4. Laboratory
5. Elevator lobby
6. Pharmacy area
7. Vehicular maintenance area
8. Workshop
9. Chapel in a facility for the visually impaired
10. Recreation room in a facility for the visually impaired
11. Exercise area in a fitness center
12. Playing area in a fitness center
13. Exam/treatment room in a healthcare facility
14. Imaging room in a healthcare facility
15. Physical therapy room in a healthcare facility
16. Library reading area
17. Library stacks
18. Detailed manufacturing area
19. Equipment room in a manufacturing facility
20. Low-bay area in a manufacturing facility
21. Post office sorting area
22. Religious fellowship hall
23. Religious worship/pulpit/choir area

24. Hair salon
25. Nail salon
26. Banking activity area
27. Computer room, data center
28. Laundry/washing area
29. Medical supply room in a healthcare facility
30. Telemedicine room in a healthcare facility
31. Museum restoration room

C406.2.5.3.2 Occupant sensor control function. *Occupant sensor controls* shall automatically turn lights off within 10 minutes after all occupants have left the space. A manual control complying with C405.2.6 shall allow occupants to turn off lights. *Time-switch controls* are not required.

Exception:In spaces where an automatic shutoff could endanger occupant safety or security*occupant sensor controls* shall uniformly reduce lighting power to not more than 20 percent of full power within 10 minutes after all occupants have left the space. *Time-switch controls* complying with C405.2.2.1 shall automatically turn lights off.

C406.2.5.3.3 Occupant sensor time function. *Occupant sensor controls* installed in accordance with Sections C405.2.1.1, C405.2.1.2, C405.2.1.3, and C405.2.1.4 shall automatically turn lights off or reduce lighting power within 10 minutes after all occupants have left the space. Where lighting power is reduced, the unoccupied setpoint shall be 20 percent of full power or in egress areas to the power level required to meet egress light levels.

Revise as follows:

ASTM

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

F1696-~~2018~~ 2020	Standard Test Method for Energy Performance of Stationary-Rack, Door-Type Commercial Dishwashing Machines
F1920-~~2015~~2020	Standard Test Method for Performance of Rack Conveyor Commercial Dishwashing Machines

Add new text as follows:

AERC AERC 1-2017. Procedures for Determining Energy Performance Properties of Fenestration Attachments

IES Illuminating Engineering Society. ANSI/IES RP-1-2020 Recommended Practice: Lighting Office Spaces
ANSI/IES RP-2-2020 Recommended Practice: Lighting Retail Spaces
ANSI/IES RP-3-2020 Recommended Practice: Lighting Educational Facilities
ANSI/IES RP-4-2020 Recommended Practice: Lighting Library Spaces
ANSI/IES RP-6-2020 Recommended Practice: Lighting Sports and Recreational Areas
ANSI/IES RP-7-2020 Recommended Practice: Lighting Industrial Facilities
ANSI/IES RP-8-2021 Recommended Practice: Lighting Roadway and Parking Facilities
ANSI/IES RP-9-2020 Recommended Practice: Lighting Hospitality Spaces
ANSI/IES RP-10-2020 Recommended Practice: Lighting Common Applications
ANSI/IES RP-11-2020 Recommended Practice: Lighting for Interior and Exterior Residential Environments
ANSI/IES RP-27-2020 Recommended Practice: Photobiological Safety for Lighting Systems
ANSI/IES RP-29-2020 Recommended Practice: Lighting Hospital and Healthcare Facilities

ANSI/IES RP-30-2020 Recommended Practice: Lighting Museums
ANSI/IES RP-41-2020 Recommended Practice: Lighting Theaters and Worship Spaces

-

Reason: In the 2021 IECC, energy credit measures were expanded from 8 alternate options to 15 measures that can be flexibly selected to achieve a 2.5% level of building energy cost savings. A similar package of measures has been proposed for ASHRAE Standard 90.1-2022, with 32 energy efficiency, renewable energy, and load management measures available. Building-type-specific targets were developed with a goal of 5% total energy cost savings.

This proposal includes 40 energy efficiency measures and builds on the former energy credit approaches with a base goal of around 7% energy savings. The energy efficiency credits here are based on site energy use and each credit represents 1/10 of 1% building energy use. Renewable and Load Management measures add cost savings based on grid cost impact represented by a time-of-use electric price structure. While measure goals vary by building type and climate zone, a national weighted goal is as follows:

- The package of cost effective measures achieves a weighted national average of 7.0% site energy savings
- The package of cost effective load management and renewable measures achieves an average of 7.3% utility cost savings

If these measures were adopted nationally into building codes, potential national savings for expected new construction using various metrics would be as given in Table 1 while the impact of renewable and selected load management measures is shown in Table 2.

Table 1. Impact of Energy Credit Measures

Metric[a]	Units	Base Package
National Annual Site Energy Savings	million Btu	7,760,000
Consumer Annual Energy Cost Savings	million $US	$154.0m
Annual Emission Reductions, CO_2	metric tons	995,000

(a) The values shown here are based on national average values. Custom results can be generated for states and local jurisdictions to support adoption of advanced code concepts.

Table 2. Impact of Renewable and Load Management Credit Measures

Metric	Units	Base Package
Consumer Annual Energy Cost Savings	million $US	$158.2m

1. The Code Approach

Energy codes include mandatory requirements that all buildings must fulfill prescriptive requirements that can be used without following a performance path, or whole-building performance paths where equivalent energy performance to the prescriptive path is demonstrated. To fit into the existing code structure, additional energy credits constitute a new prescriptive requirement; however, instead of all measures being required, the building designer can select from various options to achieve a defined level of energy performance. To maintain equivalent energy impact, whole-building performance paths must be adjusted to reflect the impact of the required energy credits.

2. Energy Credit Development Energy credits have been developed from typical measures used in green building programs, new construction utility incentive programs, and Advanced Energy Design Guidelines (ASHRAE 2019b). A detailed discussion of the methodology used to develop individual credits can be found in the published Energy Credit Tech Brief at https://www.energycodes.gov/stretch-codes

Referenced Standards.

ANSI/CTA-2045-B-2018 Modular COmmunications Interface for Energy Management: https://shop.cta.tech/products/modular-communications-interface-for-energy-management

OpenADR 2.0a and 2.0b – 2019: Profile Specification Distributed Energy Resources : https://www.openadr.org/specification-download

The following notes should be included in the Commentary:

Section C406.2.3.5 *Note to adopting jurisdictions, consider including the following commentary to clarify the requirements of C406.2.3.5 Where low water supply pressures are anticipated, user satisfaction may be enhanced if flow restrictors are specified to provide ≥80% of the rated flow at 20 psi (140 kPa).Where the distribution sizing protocol is applied to other than multifamily residential buildings, a variance to the plumbing code may be needed.*

Section C406.2.5.4 *Note to adopting jurisdictions, consider including the following informative note to clarify the requirements of C406.2.5.4. In IES LM83, spatial daylight autonomy (sDA) means the amount of daylight received in a space over a portion of operating hours each year. It is written as sDA###,YY% where the ### indicates the desired lux provided by the daylight. The YY% indicates the portion of operating hours per year to receive that daylight. It also includes an area requirement or statement. For example, sDA200,60% for 30% of regularly occupied spaces means that 30% of regularly occupied spaces receive at least 200 lux for at least 60% of the operating hours each year.*

Section C406.3.1 *On-site renewable energy may include thermal service water heating or pool water heating in which case ratings in Btu/h can be converted to W where W = Btu/h / 3.413.*

Section C406.3.4 *This credit can be met by exterior roller, movable blind, or movable shutter shading devices; however fixed overhang, screen or shutter shading will not meet the requirement. Roller shades that reject solar gain but still allow a view are allowed as long as they provide an effective 50% reduction in net solar gain, e.g., have a shading coefficient of less than 0.5 for the shading material itself. Interior shading devices will not meet the requirement. Electrochromatic windows that achieve 50% of SHGC would qualify.*

Section C406.3.8 *The simplified night flush sequence described will operate in “Summer Mode” below the 70F OA trigger temperature down until OA of 45F is hit when the “Summer Mode” is deactivated until the OA rises above 70F again. Other strategies may be implemented that cool the space below the heating setpoint and adjust the morning heating setpoint to avoid morning reheating.*

Section C407.2
The formula above allows adjustment for the current energy credits required in the IECC (2.5% or 0.025) and the new energy efficiency credit requirements that come from Section C406.1.1.

Coordination with Proposal CEPI-76-21

This proposal includes language that coordinates with proposal CEPI-76-21 HVAC Total System Performance Ratio. Energy Credit H01 described in Section C406.2.2.1 allows projects using TSPR an easy way to document energy credits and is contingent on the approval of CEPI-76-21. The proposed coordinating language includes:

1. Section 406.2.2 numbered list items 1 and 7.

2. Section C406.2.2.1,

3. the base energy credits for H01 in Tables C406.1.4(1) through C406.1.4(9).

If Proposal CEPI-76-21 is not approved for publication in the 2024 IECC then the coordinating language for energy credit H01 needs to be removed from this proposal prior to publication.

Bibliography: Hart, R, J. McNeil, M. Tillou, E. Franconi, C. Cejudo, C. Nambiar, H. Nagada, D. Maddox, J. Lerond, M.

Rosenberg. 2021. Expanded Energy and Load Management Credits in Energy Codes. PNNL-32001, Pacific Northwest National Laboratory, Richland, WA. https://www.energycodes.gov/sites/default/files/2021-07/TechBrief_EnergyCredits_July2021.pdf

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

While baseline prescriptive requirements usually undergo individual review for cost effectiveness, the approach to energy credit measures is different. Each measure can be selected for a particular building; however, not all measures are required, so the approach is to find at least one package of measures that are shown to be cost effective.

The energy credit requirements are justified based on a selection of a package of measures that meet the requirement and are cost effective for each building use type and climate zone. About one quarter of the measures were selected for inclusion in the cost effectiveness analysis, based on their general applicability and reliable savings. Two requirement packages were determined for evaluation of cost effectiveness:· The package included standard efficiency measures with a cap of 10% for required credits to allow for measure selection flexibility. While the energy credits are limited to 10% whole-building savings, in many cases the selected measures that were cost effective exceeded that savings level. Table 8 provides an overview of measures selected for inclusion in the package. Measures are selected with the goal of 7% savings or 70 credits for this package. Measure selection may be climate zone specific. For example, cooling efficiency only makes sense in warm climate zones. The climate zones (CZ) or application of measures is shown along with individual measure lives shown for determining cost effectiveness.

Based on this selection of measures, the scalar value or payback for each building type for the selected group of measures is given in Table 9. This represents the cost for all measures included in the package divided by the annual consumer energy cost savings. Note that for multifamily buildings and hotels, the SHW distribution redesign results in a significant cost reduction, so the overall package cost is less than the baseline and the “CE” indicates that the packages in those buildings are immediately cost effective. A scalar limit or threshold is developed for each combination of climate zone and building type based on the individual measure lives shown in Table 7, weighted by the measure cost savings. The measures included in the base package and therefore credits required are adjusted so that all building types in all climate zones have a consumer payback that is less than the scalar limit, indicating cost effectiveness for the efficiency credit requirements.

Table 7. Scalar Ratio Method Economic Parameters and Scalar Ratio Limit

Input Economic Variables	Heating (gas) SRh	Cooling (electricity) SRc
Economic Life – Years (example)	40	40
Down Payment - $	0.00	0.00
Energy Escalation Rate - %[a]	2.90	2.25
Nominal Discount Rate - %[b]	8.1	8.1
Loan Interest Rate - %	5.0	5.0
Federal Tax Rate - %[b]	NA[b]	NA[b]
State Tax Rate - %[b]	NA[b]	NA[b]
Heating – Natural Gas Price, $/therm	0.983	
Cooling - Electricity Price $/kWh		0.1099
Scalar Ratio Limit (weight: 0.25/0.75)	**25.4**	**22.0**

(a) The energy escalation rate used in the scalar calculation for 90.1-2022 includes inflation, so it is a nominal rather than a real escalation rate.
(b) Beginning with addenda for 90.1-2016, SSPC 90.1 eliminated tax analysis from the Scalar Method by using a pre-tax discount rate.

Table 8. Matrix of Base Package Efficiency Measures

ID	Energy Credit Abbreviated Title	Measure Life, yr	Multifamily /Dormitory	Health Care	Hotel/Motel	Office	Restaurant	Retail	School/ Education	Warehouse/ Semiheated
E01	Glazing U & SHGC reduction	40	CZ 0A-1A	all CZ	all CZ	all CZ			all CZ	
E02	UA Reduction (15%)	40						All CZ		
H02	Heating efficiency	18		CZ 5-8	CZ 5-8	CZ 5-8	CZ 5-8	CZ 5B-8	CZ 5-8	CZ 4C-8
H03	Cooling efficiency.	15	CZ 0-2	CZ 0-2	CZ 0-3B	CZ 0-3B	CZ 0-3B	CZ 0-3B	CZ 0-3B	CZ 0-3B
H04	Residential HVAC control.	15	CZ 0-3, 6-8							
W02	Heat pump water heater	19					30% all CZ	CZ0, 4B-5		
W03	Efficient gas water heater	15	all CZ	all CZ	all CZ	all CZ	70% all CZ		all CZ	
W06	Thermostatic balancing valves	15	all CZ	all CZ	all CZ	all CZ			all CZ	
W08	SHW distribution sizing	15	all CZ		all CZ					
L03	Increase occupancy sensor	15		all CZ						all CZ
L04	Increase daylighting area	15						CZ 0-5		all CZ
L06	Light power reduction	20	5% all CZ	15% all CZ	15% all CZ	15% all CZ	10% all CZ	10% all CZ	15% all CZ	10-15% all CZ
Q02	Efficient kitchen equipment	15	(a)		(a)		all CZ		(a)	
Q04	Fault detection	15		all CZ	all CZ	CZ 0-4			all CZ	

[a] Dining areas and kitchens in dormitories, hotels, and schools treated as a separate area where efficient kitchen equipment credits apply

Table 9. Scalar Ratios for Base Package Efficiency Measures by Climate Zone and Building Type

	Climate Zone																		
Building Use Type	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Multifamily/Dormitory	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE
Health Care	3.0	3.3	3.3	3.3	3.2	3.6	2.7	2.8	2.4	2.5	2.6	2.3	2.6	2.6	2.0	2.6	2.5	2.3	2.3
Hotel/Motel	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE
Office	11.7	12.1	13.1	12.7	13.2	13.6	13.3	13.1	12.6	11.0	10.7	11.7	10.9	10.7	11.8	9.6	10.0	9.8	9.1
Restaurant	3.2	3.5	4.2	3.9	4.3	4.7	4.9	4.9	4.9	4.7	4.7	4.7	3.5	3.8	4.0	3.1	3.4	2.8	2.4
Retail Buildings	4.0	4.3	4.8	4.6	5.4	5.5	6.1	6.2	4.9	4.4	5.0	5.3	4.3	4.6	5.2	3.4	4.5	5.1	5.0
School/Education	6.5	7.3	8.5	7.8	8.8	9.8	9.1	9.0	8.0	7.1	7.1	7.8	6.6	6.1	7.2	5.4	6.1	5.2	4.4
Warehouse	8.3	8.1	9.4	8.9	9.8	9.5	8.0	7.7	2.7	2.8	2.7	2.9	1.8	2.4	3.0	1.4	1.8	1.5	1.5

Public Hearing Results

Committee Action **As Modified**

Committee Reason: CEPI-193-21 expands the number of energy savings options compared to IECC-2021 and more than doubles the additional energy saving requirement on average. The proposal also customizes the additional efficiency requirements by building type and climate zone to better match individual building energy savings potential. The proposal puts renewable energy into a separate category with load management measures to encourage preparation of buildings to meet the future needs of the electric grid. Renewable requirements can also be met with off-site renewable contracts.

Final Hearing Results

CEPI-193-21 AM

CEPI-203-21

Original Proposal

IECC®: C405.12, C405.12.1, C405.12.2, TABLE C405.12.2, C405.12.3, C405.12.4, C405.12.5, C405.12.6 (New), C405.12.7 (New), C405.12.8 (New)

Proponents: Helen Sanders, Facade Tectonics Institute/Technoform North America, Facade Tectonics Institute

2021 International Energy Conservation Code

Revise as follows:

C405.12 Energy monitoring. New buildings with a gross *conditioned floor area* of 25,000 square feet (2322 m^2) or larger shall be equipped to measure, monitor, record and report energy consumption data in compliance with Sections C405.12.1 through C405.12.5. A plan for quantifying annual energy type and use disclosure in compliance with Sections C405.12.1 through C405.12.8 shall be submitted with the construction documents.

Exception: R-2 occupancies and individual tenant spaces are not required to comply with this section provided that the space has its own utility services and meters and has less than 5,000 square feet (464.5 m^2) of *conditioned floor area*.

C405.12.1 Electrical energy metering. For all electrical energy supplied to the building and its associated site, including but not limited to site lighting, parking, recreational facilities and other areas that serve the building and its occupants, meters or other measurement devices shall be provided to collect energy consumption data for each end-use category required by Section C405.12.2.

Revise as follows:

C405.12.2 End-use electric metering categories. Meters or other approved measurement devices shall be provided to collect energy use data for each end-use category indicated in Table C405.12.2. Where multiple meters are used to measure any end-use category, the data acquisition system shall total all of the energy used by that category. Not more than 5 percent of the measured load for each of the end-use categories indicated in Table C405.12.2 shall be permitted to be from a load that is not within that category.

Exceptions:

1. HVAC and water heating equipment serving only an individual dwelling unit shall not require end-use metering.
2. End-use metering shall not be required for fire pumps, stairwell pressurization fans or any system that operates only during testing or emergency.
3. End-use metering shall not be required for an individual tenant space having a floor area not greater than 2,500 square feet (232 m^2) where a dedicated source meter complying with Section C405.12.3 is provided.

TABLE C405.12.2 ELECTRICAL ENERGY USE CATEGORIES

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	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 but not limited to data centers, manufacturing equipment and commercial kitchens.
Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.

Electric hot water heating	Electricity used to generate hot water. Exception: Electric water heating with design capacity that is less than 10 percent of building service rating

C405.12.3 Electric Meters. Meters or other measurement devices required by this section shall be configured to automatically communicate energy consumption data to the data acquisition system required by Section C405.12.4. Source meters shall be allowed to be any digital-type meter. Lighting, HVAC or other building systems that can self-monitor their energy consumption shall be permitted instead of meters. Current sensors shall be permitted, provided that they have a tested accuracy of ±2 percent. Required metering systems and equipment shall have the capability to provide at least hourly data that is fully integrated into the data acquisition system and graphical energy report in accordance with Sections C405.12.4 and C405.12.5. Non-intrusive load monitoring (NILM) packages that extract energy consumption data from detailed electric waveform analysis can be substituted for individual meters if the equivalent data can be made available for collection in Section C405.12.4 and reporting in Section C405.12.5.

C405.12.4 Electrical energy data ~~Data~~ acquisition system. A data acquisition system shall have the capability to store the data from the required meters and other sensing devices for a minimum of 36 months. The data acquisition system shall have the capability to store real-time energy consumption data and provide hourly, daily, monthly and yearly logged data for each end-use category required by Section C405.12.2. The data acquisition system shall have the capability of providing building total peak electric demand and the time(s) of day and time(s) of year at which the peak occurs. Peak demand shall be integrated over the same time period as the underlying meter reading rate, which is typically 15 minutes but shall be no longer than one hour.

C405.12.5 Graphical energy report. A permanent and readily accessible reporting mechanism shall be provided in the building that is accessible by building operation and management personnel. The reporting mechanism shall have the capability to graphically provide the electrical energy consumption for each end-use category required by Section C405.12.2 at least every hour, day, month and year for the previous 36 months. The graphical report shall also incorporate natural gas interval data or the ability to enter gas utility bills into the report.

Add new text as follows:

C405.12.6 Non-electrical energy. Consumption of non-electrical energy such as gas, district heating or cooling, unregulated fuel sources, or other non-renewable energy shall be automatically metered or a method developed for usage calculation annually or more frequently from energy bills. Natural gas usage shall be monitored through on site interval metering or from utility interval data.

C405.12.7 Renewable energy. The ability to measure the production of on-site renewable energy shall be provided with the same or greater frequency as metered systems.

C405.12.8 Plan for disclosure. The plan for annual energy use data gathering and disclosure shall include the following:

1. Property information including building type, total gross floor area, year built or year planned for construction completion, and occupancy type.
2. Total annual building site energy use per unit area (square foot) of gross floor area as collected or documented through Section C405.12.5 (electrical) and Section C405.12.6 (non-electrical) sources, separated by energy type (electric, gas, district cooling or heating, unregulated fuel sources etc.). Electrical energy shall be further broken down by load type as identified in Table C405.12.2.
3. Annual site generated renewable energy per unit area (square foot) of gross floor area.
4. Peak electric demand per unit area (square foot) of gross floor area, with an estimate of relative building system contribution to that peak, and the time and date of the peak.

5. For projects using the Section C407 Total Building Performance approach to show compliance, include the following information from the building simulation:

   5.1. Modeling software used.

   5.2 Assumptions made that impact the simulated annual energy use per unit (square foot or square meter) of gross floor area (e.g. occupancy schedules, daylighting assumptions, climate file, plug loads, envelope performance including use of shading systems).

   5.3 Simulated annual energy use per unit (square foot or square meter) of gross floor area.

   5.4 Peak load, the time of date and time of peak and the hourly load profile on the day that experiences peak load.

Reason: Historically, energy efficiency has been a means to address concerns over oil and fuel shortages, using demand reduction to limit our "vulnerability to energy supply disruptions"[1]. Over the past five decades, however, the role of energy efficiency has morphed into something even more critical – playing a key part in slowing down the rate of anthropogenic climate change highlighted by the IPCC's most recent Sixth Assessment Report and mitigating the impacts that climate change is already manifesting with dire consequences. As the International Code Council's Energy Efficiency website itself states, "The International Code Council family of solutions is helping our communities forge a path forward on energy and sustainability to confront the impacts of a changing climate."[2]With buildings making up nearly 40% of the total greenhouse gas emissions globally[3], it is imperative that we start enforcing accountability for actual building energy use rather than continue to rely on predicted energy consumption, which may not accurately reflect the building's true energy consumption. Of course, operational energy is not the only option we should pursue to mitigate the risks of climate change, but we should consider this a reasonable starting point, in line with the trajectory of the IECC.

We need to close the information loop on building energy performance, and we need to do it fast. If we don't start tracking actual energy use now, and correlating that to design intent, how will we know what aspects of building design, operations, and maintenance require our focus and dedication to rectify or improve upon? This proposal is for the 2024 code cycle, which means we only have two additional opportunities beyond this cycle to implement tangible step changes before we hit 2030, the target date for achieving zero energy buildings.

Furthermore, in the context of the current COVID-19 pandemic, we are seeing significant shifts in the way buildings are being used, with more flexibility in office schedules, hotdesking or hoteling, variable occupancy levels, and the need for more (natural) ventilation. These shifts make it even harder for energy models to predict energy use in a meaningful and informative way using current best standards and methods. Ongoing post-occupancy measurement and verification is the only way to reliably track and manage energy use. Without data, we cannot glean information and turn that into knowledge and even wisdom of how our buildings operate.

We are already seeing the following costs/risks associated with Business As Usual (BAU) here in the US and in Canada:- Shifting map of hurricane zones such that more areas are experiencing higher risks[4] (*e.g.,* Hurricane Sandy affecting New England)

- More extreme wildfires that create their own weather systems, making it even harder to contain them[5] (*e.g.,* Bootleg Fire in Oregon)

- Heat domes that exceed scientific predictions, even accounting for climate change[6] (*e.g.,* Pacific NW in early 2021)

Some are calling this the "social" cost of carbon, but it all boils down to a financial cost to humans – often inequitably – in the end.

Fabia Jeddere-Fisher, Senior Lecturer in Energy Engineering of University of the West of England (UWE) Bristol, Department of Architecture & Built Environment who is in charge of "metering, monitoring, and reporting energy use" and "identifying and setting targets for energy/carbon savings across the UWE estate" noted that Display Energy Certificate ratings do in fact impact the way building users interact with the buildings.

Proposal:

The FTI Advocacy Committee proposes the following new clause under **Chapter 4 – "Commercial Energy Efficiency", Section C407 – "Total Building Performance", Sub-Section, C407.2 – "Mandatory requirements"**:

Energy use intensity (EUI) shall be publicly declared for all buildings that are equal to or greater than 50,000 SF after 12 months of continuous occupied building use within the first 36 months of occupancy. These EUI declarations, based on actual measured energy consumption, will need to be displayed publicly on the building and accessible online.

The following information shall be reported and displayed publicly:

- Property information for each building, including:

o Property name

o Property address

o Property type

o Total gross floor area

o Year built / planned for construction completion

o Occupancy

- Predicted energy use as calculated for the *proposed design* using code-approved compliance software tools, per Section C407.5 – "Calculation software tools".

- Total building site energy use as documented on utility bills, broken down by energy type (*e.g.,* electricity, gas, etc.)*

- If energy use is tied to the electrical grid, provide the following information:

o Peak electric demand

o Date/time of peak

o Load-duration curves for all 8,760 hours of the year (TBD: Some might be monthly, hourly for the year, seasonal, etc.)

*Note: Consideration may also be needed to account for the following:

· Other energy sources on site (*e.g.,* oil, wood pellets, heat recovery incinerators, etc.)

· District heating/cooling (*e.g.,* steam or chilled water delivered to site)

· On-site electrical generation (*e.g.,* photovoltaics, fossil fuel, waste combustion, etc.)

· Waste heat generated on site but used offsite at another building

We have suggested 50,000 sq.ft. as the building size limit because of the relatively large impact that large buildings have on the overall energy usage, yet these comprise a relatively small number of actual buildings. The CBECS database indicates there are approximately 6 million commercial buildings with an average size of 16K sq.ft. Buildings of size greater than 50,000 sq.ft. represent a very small portion, ~5%, of the building stock in number, but around 50% of the floor area, and thus 50% of the energy impact. The 2018 Commercial Building Energy Consumption Survey[7] indicates that the top 3% of the largest buildings use 34% of the energy nationwide. Therefore addressing disclosure for the big buildings first is much easier both logistically and administratively, while not giving up much impact or savings.

The intent of this proposal is for benchmarking energy use, providing more transparency for building tenants, providing a needed feedback loop for energy simulation improvement, and getting the infrastructure in place for future measurement and verification opportunities, such as the possibility of including sub-metering for spotting trends and providing insight into potential areas of improvement.

The infrastructure to report actual building energy use is already in place, and some building energy labels "have gained significant market share".[8] In the US, one such established benchmarking platform is the ENERGY STAR® Portfolio Manager, an online reporting tool developed by the US Environmental Protection Agency (EPA). The following are two more platforms that can also be considered:

- ASHRAE Building Energy Quotient

- International Performance Measurement and Verification Protocol (IPMVP)

The additional effort required by building owners to comply with this proposed code development is not so onerous that it cannot be implemented at a national level. The ASHRAE 90.1 Standard has required sub-metering since the 2013 code cycle, which has been adopted by a number of states already. This EUI declaration proposal for IECC does not currently require sub-metering (to keep it simple and low cost), but it could be a consideration for future code cycles leading up to 2030.

In the future, the following incentives could be included in the further code cycles:

- Building owners will receive a rebate or credit for buildings that perform better than their predicted energy use.

- The IECC shall provide an opportunity for buildings that perform worse than their predicted energy use to make improvements over a subsequent 12-month period change their EUI.

Precedents in the US:

A number of states and cities already require commercial building energy disclosure[9] to some extent, including, but not limited to:

- California
- District of Columbia
- New Jersey
- New York
- Oregon
- Washington State
- Austin[10]
- Boston[11]
- Los Angeles[12]
- San Francisco[13]

A map of US cities and states with benchmarking programs and policies is given in this reference[14] and see attached version of this narrative with illustrations. Even more states require at least some or all of their public buildings and facilities to benchmark energy use[15], including, but not limited to the following states:

- Alabama
- Arkansas
- California
- Colorado
- Connecticut
- Florida
- Maryland
- Michigan
- Mississippi
- Nebraska

- New Mexico
- New York
- Ohio
- Pennsylvania
- Texas
- Washington State

Bibliography: [1]https://www.ase.org/sites/ase.org/files/resources/Media%20browser/ee_commission_history_report_2-1-13.pdf
[2]https://www.iccsafe.org/products-and-services/codes-standards/energy/

[3]https://www.eia.gov/tools/faqs/faq.php?id=86&t=1

[4]https://www.c2es.org/content/hurricanes-and-climate-change/

[5]https://www.nytimes.com/2021/07/19/climate/bootleg-wildfire-weather.html

[6]https://www.theguardian.com/environment/2021/jul/02/canadian-inferno-northern-heat-exceeds-worst-case-climate-models

[8]2018 Commercial Building Energy Consumption
Survey: https://www.eia.gov/consumption/commercial/pdf/CBECS%202018%20Preliminary%20Results%20Flipbook.pdf

[7]https://www.osti.gov/servlets/purl/1168594

[8]https://database.aceee.org/state/building-energy-disclosure

[9]https://austinenergy.com/ae/energy-efficiency/ecad-ordinance/for-commercial-buildings/for-commercial-buildings

[10]https://www.boston.gov/departments/environment/building-energy-reporting-and-disclosure-ordinance

[11]https://www.betterbuildingsla.com/

[12]https://sfenvironment.org/existing-buildings-energy-performance-ordinance

[13]https://www.energystar.gov/buildings/program-administrators/state-and-local-governments/see-federal-state-and-local-benchmarking-policies

[14]https://database.aceee.org/state/public-building-requirements

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Reporting data that is already available from utility bills, construction documents, and building simulations already submitted for code compliance and so will not change the cost of construction. If there is any administrative cost to disclosure, it should be minimal in the budget of a 50,000 sq.ft. building.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Requires new buildings greater than 25,000 sf be equipped with equipment to measure, monitor, record and report energy consumption data. A proposed annual consumption by energy type and disclosure report shall be submitted as part of the CDs.

Final Hearing Results

CEPI-203-21 AM

CEPI-207-21

Original Proposal

IECC®: C407.2, Table C407.2.1 (New)

Proponents: Jim Ranfone, AGA, American Gas Association

2021 International Energy Conservation Code

Revise as follows:

C407.2 Mandatory requirements. Compliance based on total building performance requires that a proposed design meet all of the following:

1. The requirements of the sections indicated within Table C407.2.
2. An annual energy cost that is less than or equal to 80 percent of the annual energy cost of the*standard reference design*. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration’s *State Energy Data System Prices and Expenditures*reports. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

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

1. Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.
2. Where energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area is substituted for the energy cost, the energy use shall be calculated using source energy factors from Table C407.2.1. For electricity, U.S. locations shall use values eGRID subregions. Locations outside the U.S. shall use the value for "All other electricity" or locally derived values.

Add new text as follows:

Table C407.2.1 Source Energy Conversion Factors for Electricity

Fossil Fuels Delivered to Buildings	
Natural Gas	1.092
LPG or propane	1.151
Fuel oil (residual)	1.191
Fuel oil (distillate)	1.158
Coal	1.048
Gasoline	1.187
Other fuels not specified in this table	1.048
Electricity	
AKGD-ASCC Alaska Grid	2.47
AKMS-ASCC Miscellaneous	1.35
AZNM-WECC Southwest	2.57
CAMX-WECC California	1.66
ERCT-ERCOT All	2.32
FRCC-FRCC All	2.78
HIMS-HICC Miscellaneous	3.15
HIOA-HICC Oahu	3.87
MROE-MRO East	2.92
MROW-MRO West	2.21
NEWE-NPCC New England	2.66
NWPP-WECC Northwest	1.48
NYCW-NPCC NYC/Westchester	2.89
NYLI-NPCC Long Island	2.84

NYUP-NPCC Upstate NY	1.81
PRMS-Puerto Rico Miscellaneous	3.27
RFCE-RFC East	2.90
RFCM-RFC Michigan	2.93
RFCW-RFC West	2.97
RMPA-WECC Rockies	2.16
SPNO-SPP North	2.21
SPSO-SPP South	2.05
SRMV-SERC Mississippi Valley	2.84
SRMW-SERC Midwest	3.09
SRSO-SERC South	2.89
SRTV-SERC Tennessee Valley	2.82
SRVC-SERC Virginia/Carolina	2.91
All other electricity	2.51
Thermal Energy	
Chilled water	0.60
Steam	1.84
Hot Water	1.73

Reason: The proposed change brings C407.2 into greater consistency with R405.3 and source energy metric usage in Federal energy programs including Energy Star for Commercial Buildings and Home Energy Score. This revised exception provides the only means of assessing energy performance on fuel cycle energy consumption and ultimately carbon footprints since site energy metrics alone cannot account for these upstream energy system losses. In addition, the allowance in the proposed exception language for use of “other multipliers” addresses a persistent criticism of national average multipliers, which may not reflect regional or local mixes of renewable energy in meeting building demands, and encourages authorities having jurisdiction to use locally-relevant multipliers that are available from utilities and other sources. Also, greater usefulness of the exception is critical since the basic requirements of C407.2 focusing on energy cost is not consistent with the intent of the IECC as stated in C101.3, which addresses energy use and conservation, not energy cost.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Cost Impact: The code change proposal will not increase or decrease the cost of construction The proposal would not increase the cost of construction since the proposal is for changes to an exception. If the use of source energy metrics allows more alternatives for achieving energy performance improvements, it may decrease construction costs ultimately.Cost Impact: The code change proposal will not increase or decrease the cost of construction The proposal would not increase the cost of construction since the proposal is for changes to an exception. If the use of source energy metrics allows more alternatives for achieving energy performance improvements, it may decrease construction costs ultimately.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal revises the building performance exception to include a source energy comparison based on ASHRAE Standard 189.1-2020 conversion factors. This revised exception provides the only means of assessing energy performance on fuel cycle energy consumption and ultimately carbon footprints since site energy metrics alone cannot account for these upstream energy system losses.

Final Hearing Results

CEPI-207-21 AM

CEPI-208-21

Original Proposal

IECC®: TABLE C407.2

Proponents: Marcin Pazera, Polyisocyanurate Insulation Manufacturers Association, Polyisocyanurate Insulation Manufacturers Association (mpazera@pima.org); Justin Koscher, Polyisocyanurate Insulation Manufacturers Association, Polyisocyanurate Insulation Manufacturers Association (jkoscher@pima.org)

2021 International Energy Conservation Code

Revise as follows:

TABLE C407.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION [a]	TITLE
Envelope	
<u>C402.2.1.2</u>	<u>Minimum thickness, lowest point</u>
<u>C402.2.1.3</u>	<u>Suspended ceilings</u>
<u>C402.2.1.4</u>	<u>Joints staggered</u>
<u>C402.2.1.5</u>	<u>Skylight curbs</u>
C402.5	Air leakage–thermal envelope
Mechanical	
C403.1.1	Calculation of heating and cooling loads
C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies
C403.4, except C403.4.3, C403.4.4 and C403.4.5	Heating and cooling system controls
C403.5.5	Economizer fault detection and diagnostics
C403.7, except C403.7.4.1	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.11, except C403.11.3	Refrigeration equipment performance
C403.12	Construction of HVAC system elements
C403.13	Mechanical systems located outside of the building thermal envelope
C404	Service water heating
C405, except C405.3	Electrical power and lighting systems
C408	Maintenance information and system commisioning

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

Reason: This section clarifies the code’s intent that general roof insulation installation requirements apply to all of the IECC compliance methods by including the installation criteria when using total building performance in the IECC.

Currently, the proposed design that utilizes the total building performance path under Section C407 must meet only the mandatory air leakage provisions for the thermal envelope in Section C402.5. This proposal intends to add insulation installation requirements for roof assemblies as mandatory requirements. The specific sections proposed for addition include: minimum thickness, lowest point (Section C402.2.1.2), suspended ceilings (Section C402.2.1.3), joints staggered (C402.2.1.4). In addition, the proposal adds mandatory requirements for insulating skylight curbs, which is already part of (Section C402.2.1.5). This proposal does not bring new requirements into the IECC. It merely, references requirements in existing sections of the IECC for mandatory compliance. More importantly, the provisions that are being added have been developed and recognized as important measures that improve roof and overall performance of building envelopes from an energy, moisture, and air leakage standpoint. As an example, the practice of installing insulation above roof deck in minimum of two layers with joints staggered is not only required by the IECC but it is also recognized by roofing industry stakeholders as an approach that improves overall performance of roof systems.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal will not increase the cost of construction. The proposal does not introduce new requirements into the IECC, but clarifies that these important insulation installation requirements also apply to the total building performance compliance method.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The modeling SC unanimously agreed to additional insulation requirements (suspended ceilings, staggered joints and skylight curbs) to Table C407.2.

Final Hearing Results

CEPI-208-21	AS

CEPI-209-21

Original Proposal

IECC®: TABLE C407.2

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2021 International Energy Conservation Code

Revise as follows:

TABLE C407.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION [a]	TITLE
Envelope	
C401.3	Thermal envelope certificate
C402.2.6	Insulation of radiant heating system
C402.5	Air leakage–thermal envelope
Mechanical	
C403.1.1	Calculation of heating and cooling loads
C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies
C403.4, except C403.4.3, C403.4.4 and C403.4.5	Heating and cooling system controls
C403.5.5	Economizer fault detection and diagnostics
C403.7, except C403.7.4.1	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.11, except C403.11.3	Refrigeration equipment performance
C403.12	Construction of HVAC system elements
C403.13	Mechanical systems located outside of the building thermal envelope
C404	Service water heating
C405, except C405.3	Electrical power and lighting systems
C408	Maintenance information and system commisioning

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

Reason: When this table was introduced last cycle to consolidate various mandatory requirements to be considered in the total building performance path, many details from the mechanical provisions were included. However, many similar mandatory details in the envelope provisions were missed. These include matters that apply regardless of the compliance path used. For example, an envelope certificate should apply regardless of the compliance path. This does not change requirements or limit the use of the performance path to adjust criteria. Instead, it ensures minimum practices are at least satisfied even when otherwise altering insulation and performance requirements for the building thermal envelope.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not change requirements but ensures that minimum practices are used consistently for all compliance paths, even though the criteria for those practices may be traded off in the the performance path.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: removal of insulation installation and airspaces from mandatory provisions

Final Hearing Results

CEPI-209-21	AM

CEPI-211-21

Original Proposal

IECC®: TABLE C407.4.1(1)

Proponents: Anurag Goel, enVerid Systems, enVerid Systems (agoel@enverid.com); Kimberly Cheslak, NBI, NBI (kim@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

TABLE C407.4.1(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 C405.3.2(1) or C405.3.2(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: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed
Walls, below-grade	Type: mass wall	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: as specified in Table C402.1.4 with insulation layer on interior side of walls	As proposed
Floors, above-grade	Type: joist/framed floor	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Floors, slab-on-grade	Type: unheated	As proposed
	F-factor: as specified in Table C402.1.4	As proposed
Opaque doors	Type: swinging	As proposed
	Area: Same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Vertical fenestration other than opaque doors	Area 1. The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 40 percent of above-grade wall area. 2. 40 percent of above-grade wall area; where the proposed vertical fenestration area is 40 percent or more of the above-grade wall area.	As proposed
	U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	External shading and PF: none	As proposed
Skylights	Area 1. The proposed skylight area; where the proposed skylight area is less than that permitted by Section C402.1. 2. The area permitted by Section C402.1; where the proposed skylight area exceeds that permitted by Section C402.1.	As proposed
	U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.3.2. Where the occupancy of the building is not known, the lighting power density shall be 1.0 watt per square foot based on the categorization of buildings with unknown space classification as offices.	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Lighting, exterior	The lighting power shall be determined in accordance with Tables C405.5.2(1), C405.5.2(2) and C405.5.2(3). Areas and dimensions of surfaces shall be the same as proposed.	As proposed
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. End-use load components within and associated with the building shall be modeled to include, but not be limited to, the following: exhaust fans, parking garage ventilation fans, exterior building lighting, swimming pool heaters and pumps, elevators, escalators, refrigeration equipment and cooking equipment.
Schedules	Same as proposed **Exception:** Thermostat settings and schedules for HVAC systems that utilize radiant heating, radiant cooling and elevated air speed, provided that equivalent levels of occupant thermal comfort are demonstrated by means of equal Standard Effective Temperature as calculated in Normative Appendix B of ASHRAE Standard 55.	Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays and any seasonal operation. Schedules shall model the time-dependent variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads. The schedules shall be typical of the proposed building type as determined by the designer and approved by the jurisdiction.
~~Mechanical ventilation~~ Outdoor Airflow	~~Same as proposed~~ Where the proposed design specifies mechanical ventilation: 1. For systems 1-4 as specified in Tables C407.4.1(2) and C407.4.1(3), the outdoor airflow rate shall be determined in accordance with Section C403.7 and *International Mechanical Code* Section 403.3.1.1.2.3.4 Equation 4-8, using a system ventilation efficiency (E_V) of 0.75. 2. For systems 5-11 as specified in Tables C407.4.1(2) and C407.4.1(3), the outdoor airflow rate shall be determined in accordance with Section C403.7 and IMC Section 403.3. Where the proposed design specifies natural ventilation, as proposed.	As proposed, in accordance with Section C403.2.2.
Heating systems	Fuel type: same as proposed design	As proposed
	Equipment type[a]: as specified in Tables C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in the tables in Section C403.3.2.	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 C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in Tables C403.3.2(1), C403.3.2(2) and C403.3.2(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 C403.5.	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.	
Energy Recovery	Where the proposed design specifies mechanical ventilation, as specified in Section C403.7.4 based on the standard reference design airflows. Where the proposed design specifies natural ventilation, as proposed.	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Fan Power	As specified in Section C403.8 for the proposed design. Exceptions: 1. Where the fan power of the proposed design is exempted from the requirements of Section C403.8, as proposed. 2. Fan systems addressed by C403.8.1: Fan system BHP power shall be as proposed or to the limits specified in C403.8.1, whichever is smaller. If the limit is reached, the power or each fan shall be reduced proportionally until the limit is met. 3. Fan systems serving areas where the mechanical ventilation is provided in accordance with an engineered ventilation system design of Section 403.2 of the IMC shall not use the particulate filtration or air cleaner pressure drop adjustment available in Table C403.8(12) when calculating the fan system BHP limit for the portion of the airflow being treated to comply with the engineered ventilation system design.	As proposed

For SI: 1 watt per square foot = 10.7 w/m^2.

SWHF = Service Water Heat Recovery Factor, DWHR = Drain Water Heat Recovery.

a. Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.

b. The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.

c. Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.

d. If an economizer is required in accordance with Table C403.5(1) and where no economizer exists or is specified in the proposed design, then a supply-air economizer shall be provided in the standard reference design in accordance with Section C403.5.

e. The SWHF shall be applied as follows:

1. Where potable water from the DWHR unit supplies not less than one shower and not greater than two showers, of which the drain water from the same showers flows through the DWHR unit then SWHF = [1 – (DWHR 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: Section 403.2.2 Ventilation of the 2021 IECC allows for minimum outdoor airflow rates to be determined in accordance with (a) prescriptive ventilation rates under Table 403.3.1.1 of the 2021 IMC or (b) an engineered ventilation systems design as defined by Section 403.2 of the 2021 IMC. The latter approach may lead to a more efficient design by incorporating source control or removal measures, including air cleaning, to offset a portion of the outside air requirement under the prescriptive ventilation rate approach. Despite these two approaches for determining minimum outdoor airflow rates, baseline and proposed case ventilation rates must be the same. As such, the IECC does not enable design teams using an engineered ventilation system design to take energy credit for a more energy efficient engineered ventilation systems design. The proposed change fixes this.

According to Section 403.2 of the 2021 IMC, “Where a registered design professional demonstrates that an engineered ventilation system design will prevent the maximum concentration of containments from exceeding that obtainable by the rate of outdoor air ventilation determined in accordance with Section 403.3, the minimum required rate of outdoor air shall be reduced in accordance with such engineered system design.” In other words, when source-control and/or removal measures are incorporated into an engineered ventilation system design, minimum outside airflow may be lowered to account for the efficiency of the source-control and/or removal measures. Using this approach, the implemented source-control and/or removal measures may offset a portion of the outside air required by conventional ventilation system designs sized using prescriptive ventilation rates found in Table 403.3.1.1 in order to achieve a more energy efficient design.

The proposed change will allow design teams using an engineered ventilation systems design to take energy credit for a more energy efficient engineered ventilation systems design in accordance with Section 403.2 of the 2021 IMC. This is currently not allowed because baseline and proposed case ventilation rates must be the same as per Table C407.4.1(1).

A 2017 report by the U.S. Department of Energy’s Building Technology Office (BTO) called “Energy Savings Potential and RD&D Opportunities for Commercial Building HVAC Systems” identified Ventilation Reduction through Advanced Filtration as a top energy saving technology for commercial building HVAC systems. The report also said, “The largest barrier to market adoption is acceptance by building code jurisdictions (pg. 44).” More recently the U.S. Green Building Council has endorsed performance-based indoor air quality designs and assessments to reduce ventilation energy consumption by developing two pilot credits based on this approach: EQpc124 for LEED BD+C andEQpc119for LEED O+M. The next step to unlock the full potential of ventilation energy efficiency using source control and removal measures is to update the IECC to allow design teams using an engineered ventilation systems design to take energy credit for a more energy efficient engineered ventilation systems design.

Link to Energy Savings Potential and RD&D Opportunities for Commercial Building HVAC Systems" report:

https://www.energy.gov/sites/prod/files/2017/12/f46/bto-DOE-Comm-HVAC-Report-12-21-17.pdf

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

The code change proposal will decrease the cost of construction. Designs the use the IAQ Procedure typically result in reduced minimum outdoor airflows relative to prescriptive ventilation rates. Designing towards this reduced outside airflow can have a systemic effect on the HVAC design and can allow for the following first cost saving measures: 1. Reduce overall load on central heating and cooling equipment; 2. Reduce overall capacity of cooling and heating coils inside HVAC equipment; 3. Downsize or eliminate energy recovery systems; 4. Eliminate demand control ventilation / CO sensors, if applicable; 5. Downsize outside air intakes and respective ductwork; and 6. Downsize or eliminate general-exhaust / relief air fans.Example 6-AA IAQ Procedure, Single-Zone System in ASHRAE 62.1 User's Manual provides an example of how minimum outdoor airflow can be reduced by 1,000 CFM (47%) when applying the IAQ Procedure with air cleaning and comparing it with prescriptive ventilation rates. The reduction in minimum outdoor airflow results in a range of annual energy and energy cost savings depending on project location (climate) and utility rates. See Appendix A, attached, which includes a table with estimated load reduction and energy savings associated with a 1,000 CFM reduction in outside airflow across the different United States metro areas. Also included in Appendix A, is the calculation methodology used to populate the table.

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Public Hearing Results

Committee Action **As Modified**

Committee Reason: This CCP allows proposed ventilation to be modeled as designed and baseline ventilation to reflect IMC ventilation requirements.

Final Hearing Results	
CEPI-211-21	AM

CEPI-212-21

Original Proposal

IECC®: TABLE C407.4.1(1)

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2021 International Energy Conservation Code

Revise as follows:

TABLE C407.4.1(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
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, except as specified in Section C402.3 and Table C402.3 for Climate Zones 0, 1, 2, and 3	As proposed
	Emittance: 0.90, except as specified in Section C402.3 and Table C402.3 for Climate Zones 0, 1, 2, and 3	As proposed

Reason: This proposal aligns the standard reference design roof parameters with conditions required in the prescriptive path for roof solar reflectance and thermal emittance in Section C402.3. The prescriptive provisions are intended to serve as the basis for the standard reference design in the performance path of Section C407.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal addresses an apparent error or omission in aligning the standard reference design with the prescriptive path which is unchanged by this proposal and is the basis of cost-effectiveness.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: this proposal corrects the solar absorptance and emittance factors contained in Table C407.4.1(1).

Final Hearing Results

CEPI-212-21 AM

CEPI-215-21

Original Proposal

IECC®: C408.2

Proponents: Kimberly Cheslak, New Buildings Institute, NBI (kim@newbuildings.org); Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

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* 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. Buildings with less than 10,000 square feet (929 m^2)and ~~Mechanical systems and service water-heating 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 heating, cooling, and service water-heating ~~and space-heating~~ capacity of less than 960,000 Btu/h (280 kW).
2. Systems included in Section C403.5 that serve individual *dwelling units* and *sleeping units*.

Reason: Changes to exception will expand the applicability of commissioning requirements in commercial buildings. This approach is based off the combined heating, cooling and hot water heating capacity from 90.1-2019, and further informed by the prevalence of city and state benchmarking, retro-commissioning and BPS policies that continue to target 10,000 square feet as a cut off for determining compliance. By ensuring that buildings of this size have completed commissioning at construction, owners and facility managers are better equipped to operate the building as intended and meet continuing performance requirements.

Bibliography: ANSI/ASHRAE/IES Addenda m, ai, aj, au, az, bg, dn to ANSI/ASHRAE/IES Standard 90.1-2016 https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/90.1-2016/90_1_2016_m_ai_aj_au_az_bg_dn_20210324.pdf

https://www.buildingrating.org/

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

Commissioning and functional testing are highly valuable activities that produce real savings in new construction. A research report covering 82 new construction projects has found that median payback is around 4.2 years and the benefit-to cost ratio is 1.1 years. (Mills, E. 2011. "Building commissioning: a golden opportunity for reducing energy costs and greenhouse gas emissions in the United States." Energy Efficiency.) This cost is based on full commissioning that includes commissioning of all Owner's Project Requirements, not just those requirements relevant to Standard 90.1. While some settings corrected during commissioning can decay, the cited study shows good persistence for a 5 year follow-up period, with longer-term impact expected; as assemblies, sequences and settings are correct at occupancy and documentation on proper system operation is available for operating staff later at the site. Based on an average persistence of 10 years, the average heating and cooling scalar limit for 90.1 is 8.5 years and the overall commissioning payback in the cited study is much lower at 4.2 years.

While many of the projects in the Mills study included design phase commissioning, this is required in Standard 90.1 only for buildings with at least 10,000 square feet of conditioned area. Buildings with simple HVAC systems up to 25,000 square feet and non-refrigerated warehouses are exempt. A 2011 study (California Statewide Utility Codes and Standards Program. September 2011. "Draft Measure Information Template – Design-Phase Commissioning.") specifically looked at the cost of design phase commissioning. Looking just at the impact of design review included in commissioning, for buildings above 25,000 square feet, the cost ranges from $0.38 to $0.10 per square foot, with the cost reducing with size and an average of $0.22 per square foot. A weighted average of present value cost savings across climate zones is $1.08 to $1.47 for larger buildings resulting in a BCR of 2.8 for the highest cost and lowest savings situation. When the savings are adjusted to match the 90.1 scalar analysis, the payback is in the range of 2.5 to 7.7 years for five common building types. All these paybacks are under the scalar threshold of 8.7. Again, this analysis is just for the added cost of design review included in the commissioning process.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: amend the capacity thresholds and add an area threshold so that more buildings are required to follow the commissioning requirements of C408.

Final Hearing Results

CEPI-215-21	AS

CEPI-217-21

Original Proposal

IECC®: SECTION 202 (New), C502.3, C503.6 (New), C502.3.7 (New)
Proponents: Sean Denniston, New Buildings Institute, New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Add new definition as follows:

EXTERIOR WALL ENVELOPE. A system or assembly of exterior wall components, including exterior wall finish materials, that provides protection of the building structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment.

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.

Revise as follows:

C502.3 Compliance. *Additions* shall comply with Sections C502.3.1 through ~~C502.3.6.2~~C502.3.7.

Add new text as follows:

C503.6 Additional energy efficiency credits. *Alterations* shall comply with measures from Sections C406.2 and C406.3 to achieve not less than 10 percent the number of required efficiency credits from Table C406.1.1 based on building occupancy group and climate zone. Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of this section.

Exceptions:

1. Alterations that include replacement of no more than one of the following:
   - 1.1. HVAC unitary systems or HVAC central heating or cooling equipment serving the work area of the *alteration*.
   - 1.2 Water heating equipment serving the *work area* of the *alteration*.
   - 1.3 50 percent or more of the lighting fixtures in the *work area* of the *alteration*.
   - 1.4 50 percent or more of the area of interior surfaces of the *thermal envelope* in the *work area* of the *alteration*.
   - 1.5 50 percent or more of the *building's exterior wall envelope*, including fenestration.
2. *Alterations* to *buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, High-Hazard Group H.
3. *Alterations* that do not contain conditioned space.
4. Portions of *buildings* devoted to manufacturing or industrial use.
5. *Buildings* in Climate Zone 0A.
6. *Alterations* that are permitted with an *addition* complying with Section C502.3.7.
7. *Alterations* that comply with Section C407.

C502.3.7 Additional energy efficiency credits. *Additions* shall comply with measures from Sections C406.2 and C406.3 to achieve not less than 50 percent the number of required efficiency credits from Table C406.1.1 based on building occupancy group and climate zone. Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of this section. *Alterations* to the existing building that are not part of an*addition*, but permitted with an *addition*, may be used to achieve the required credits.

Exceptions:

1. *Buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, High-Hazard Group H.
2. *Additions* less than 1,000 ft^2 (92 m^2) and less than 50 percent of existing floor area.
3. *Additions* that do not include the addition or replacement of equipment covered by Tables C403.3.2(1) through C403.3.2(16) or Section C404.2.
4. *Additions* that do not contain *conditioned space.*
5. Where the *addition* alone or the existing building and *addition* together comply with Section C407.

Reason: Since 2012, the IECC has leveraged Section C406 to achieve additional efficiency in the prescriptive path. This section has received steady improvements over the subsequent code cycles with an expansion in the number of options and the adoption of a more flexible credit approach to the additional efficiency option. However, there is one significant gap in C406, it does not apply to additions or alterations. C502 and C503 do not reference C406 in the sections with which additions and alterations must comply. The exclusion from C406 is a significant loophole. Additions and large alterations are prime opportunities for achieving greater energy efficiency utilizing C406.

This missed opportunity is particularly significant given the advent of Building Performance Standards (BPS). These policies set performance requirements that subject existing buildings need to meet. States and local jurisdiction around the country including the states of WA and CO and cities like New York, Boston, Washington DC, and St Louis have already adopted Building Performance Standards (BPS). Many more cities are considering this policy tool as they come to realize that meeting their climate goals will require achieving significant energy and/or carbon improvements in existing buildings. This creates a need for the IECC to be much more proactive in tailoring requirements specifically for existing buildings. Building energy retrofits that are implemented as part of alterations, additions and changes in occupancy are far more cost-effective than stand-alone retrofit projects implemented only to meet a BPS. By incorporating reasonable and cost-effective retrofits into typical existing building projects, the IECC will both provide additional energy, carbon and cost savings to building owners and tenants and help ensure that more building retrofits are undertaken at opportune and cost-effective times.

This proposal creates a framework to apply C406 to additions and large alterations. It creates a new Section C506 that provides guidance for how to utilize C406 for existing buildings. C506.1 essentially replaces and mirrors C406.1, providing charging language for how to calculate credit totals and utilize the sections (C406.2-12) that establish the requirements for each credit option. This section C506 is utilized by new sections in C502 and C503 to set credit requirements for additions and alterations, respectively.

The new Section C502.2.7.1 sets requirements for additions. As additions generally have to meet the requirements for new construction, the credit requirement has been set at 10 credits, the same as C406 for new construction. The section specifically allows additions and alterations to comply together under this section, eliminating the possibility that a building with both an addition and alteration would have to achieve credits for each individually. The section includes a number of important exceptions for situations where achieving the full 10 credits would be less feasible due to lower energy building types, more limited credit options and more limited project scope:

1. Occupancies such as storage, utility, factory and high hazard that generally have low energy usage.
2. Small additions
3. Additions that do not include new HVAC or hot water systems that achieve 5 credits
4. Additions that do not include conditioned space that achieve 5 credits
5. Group R and I occupancies in more temperate climate zones that achieve 5 credits
6. Additions that comply with C407.

The new section C503.7 requires that large alterations achieve 5 credits. The section includes important exceptions:

1. The first exception ensures that the requirements only apply to large additions with significant scope. The exemption is worded to address small alterations that only impact one of the main buildings systems: envelope (C402), HVAC (C403), water heating (C404)

and lighting (C405). Alterations that impact two or more of these systems - and must therefore comply with two or more of these sections – will have a larger scope with more opportunities to choose from among the available credit options.
2. An exception that reflects the allowance for alterations and additions to comply together under C502.
3. An exception for buildings that model using C407.

By limiting requirement to large alterations and keeping the credit requirement low, the proposal ensures that projects will likely have sufficient credit options within the existing scope of the project. The project team will be able to pick credit options that apply to building elements that are already within the project scope.

The savings for this proposal would be at least 2.5% for additions and 1.25% for alterations based on the modeling for the C406 credit options done by PNNL for the 2021 edition of the IECC. However, the savings should be higher for alterations in particular since the baselines for alterations include many below-code existing building features. Depending on how inefficient the rest of the building is, the impact of this proposal could be substantially higher without any greater cost than new construction C406 measures.

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

This proposal is crafted so that it will only impact major renovations / large-scope alterations that are already impacting the major systems that serve as the basis for credits under C406. This means that these projects are already undertaking the cost of bringing two or more of these major systems up to current code requirements, and the incremental cost is therefore only the cost from code rather than the cost of a standalone retrofit. Therefore, the costs for this proposal are the same as the costs for C406 requirements for new construction. However, savings for each package will generally be much higher since the rest of the building will nearly always have specifications that fall short of the latest energy code and each package will deliver greater savings. As a result, any package that is cost effective for new construction will be even more cost effective for major alterations.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal requires that additions and alterations to existing buildings achieve C406 efficiency credits.

Final Hearing Results

CEPI-217-21 AM

CEPI-219-21

Original Proposal

IECC®: C503.3.2 (New)

Proponents: Sean Denniston, New Buildings Institute, New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

C503.3.2 Duct Testing. Ducts and plenums designed to operate at static pressures not less than 3 inches water gauge (747 Pa) that serve an *alteration* shall be tested in accordance with this section where the*alteration* includes any of the following:

1. Where 25 percent or more of the total length of the ducts in the system are relocated.
2. Where the total length of all ducts in the system is increased by 25 percent or more.

Ducts and plenums shall be leak tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual and shown to have a rate of air leakage (CL) less than or equal to 12.0 as determined in accordance with Equation 4-8 of Section C403.12.2.3. Documentation shall be available demonstrating that representative sections totaling not less than 25 percent of the duct area have been tested and that all tested sections comply with the requirements of this section.

Reason: This proposal requires that existing ductwork serving new equipment in additions and alterations is tested. In an alteration, all ductwork serving new equipment will need to be tested. In additions, the ductwork serving the addition, both existing and new ductwork, will need to be tested if it increases the total volume of the ductwork serving the addition by more than 20%. The proposal does not include a performance criterion for the testing; the testing is informational.

The requirements for duct construction and sealing in the IECC have developed substantially over recent code cycles. Fiberboard materials, cloth tape, un-sealed duct joints, cavity plenum returns and other materials and approaches that can lead to very leaky ducts were once commonplace but are not now allowed by the IECC. The result is that the ductwork in many existing buildings fall far below modern standards.

States and local jurisdiction around the country including the states of WA and CO and cities like New York, Boston, Washington DC, and St Louis have adopted Building Performance Standards (BPS). These policies set performance requirements that subject existing buildings need to meet. Many more cities are considering this policy tool as they come to realize that meeting their climate goals will require achieving significant energy and/or carbon improvements in existing buildings. This creates a need for the IECC to be much more pro-active in tailoring requirements specifically for existing buildings. Building energy retrofits that are implemented as part of alterations, additions and changes in occupancy are far more cost-effective than stand-alone retrofit projects implemented only to meet a BPS. By incorporating reasonable and cost-effective retrofits into typical existing building projects, the IECC will both provide additional energy, carbon and cost savings to building owners and tenants and help ensure that more building retrofits are undertaken at opportune and cost-effective times.

Duct tightening can be a very cost-effective energy retrofit. The replacement of equipment or substantial expansion of existing ductwork present prime opportunities to undertake this testing and will provide project teams and building owners important information about the relative need and savings opportunity that could come from duct tightening projects. It will also give project teams important information for configuring new equipment and ductwork to ensure the whole system performs effectively.

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

The cost of the proposal will vary based on the size of the duct system.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Duct tightening can be a very cost-effective energy retrofit. The replacement of equipment or substantial expansion of existing ductwork present prime opportunities to undertake this testing and will provide project teams and building owners important information about the relative need and savings opportunity that could come from duct tightening projects. It will also give project teams important information for configuring new equipment and ductwork to ensure the whole system performs effectively.

Final Hearing Results

CEPI-219-21	AM

CEPI-220-21

Original Proposal

IECC®: C502.3.5

Proponents: Kris Stenger, SEHPCAC (sehpcac@iccsafe.org)

2021 International Energy Conservation Code

Revise as follows:

C502.3.5 Pools and inground permanently installed spas. New pools and inground permanently installed spas shall comply with Section ~~C404.9~~ C404.8.

Reason: C404.9 references portable spas. The correct reference should be C404.8 Energy consumption of pools and permanent spas.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Neutral. Correcting reference.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: per proponents reason statement

Final Hearing Results

CEPI-220-21	AS

CEPI-221-21

Original Proposal

IECC®: SECTION 202 (New), SECTION C503, C503.1, C503.2, C503.2.1, C503.2.2, C503.2.3, C503.2.4 (New), C503.2.5 (New), C503.2.6 (New), C503.2.7 (New)

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2021 International Energy Conservation Code

Add new definition as follows:

APPROVED SOURCE. An independent person, firm or corporation, approved by the *code official*, who is competent and experienced in the application of engineering principles to materials, methods or systems analyses.

CONSTRUCTION DOCUMENTS. Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a building *permit*.

SECTION C503
ALTERATIONS

Revise as follows:

C503.1 General. *Alterations* to any *building* or structure shall comply with the requirements of Section C503. *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.

Exception: The following *alterations* need not comply with the requirements for new construction, provided that the energy use of the building is not increased:

1. Storm windows installed over existing *fenestration*.
2. Surface-applied window film installed on existing single-pane *fenestration* assemblies reducing solar heat gain, provided that the code does not require the glazing or *fenestration* to be replaced.
3. ~~Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation~~.
4. ~~Construction where the existing roof, wall or floor cavity is not exposed~~.

3. ~~5.~~ *Roof recover*.
4. *Roof replacement* where roof assembly insulation is integral to or located below the structural roof deck.
5. ~~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.
6. An existing building undergoing alterations that complies with Section C407.

C503.2 Building thermal envelope. Alterations of existing *building thermal envelope* assemblies shall comply with this section. New *building thermal envelope* assemblies that are part of the *alteration* shall comply with Sections ~~C402.1 through C402.5~~C402. An area-weighted average *U*-factor for new and altered portions of the *building thermal envelope* shall be permitted to satisfy the *U*-factor requirements in Table C402.1.4. The existing *R*-value of insulation shall not be reduced or the U-factor of a *building thermal envelope* assembly be increased as part of a *building thermal envelope* alteration except where complying with Section C407.

Exception: Where the existing building exceeds the fenestration area limitations of Section C402.4.1 prior to alteration, the building is exempt from Section C402.4.1 provided that there is no ~~not an~~ increase in fenestration area.

C503.2.1 Roof alterations ~~replacement~~. Insulation complying ~~*Roof replacements* shall comply~~ with Section C402.1 ~~C402.1.3, C402.1.4, C402.1.5 or C407~~ and Section C402.2.1, or an *approved* design that minimizes deviation from the insulation requirements, shall be provided for the following roof alterations: ~~where the existing roof assembly is part of the *building thermal envelope* and contains insulation entirely above the roof deck. In no case shall the *R*-value of the roof insulation be reduced or the *U*-factor of the roof assembly be increased as part of the *roof replacement*.~~

1. An *alteration* to roof-ceiling construction where ther is no insulation above *conditioned space*,
2. *Roof replacement* for roofs with insulation entirely above deck,

   Exception: Where compliance with Section C402.1 cannot be met due to limiting conditions on an existing roof, an*approved* design shall be submitted with the following:

   1. *Construction documents* that include a report by a *registered design professional* or other *approve source* documenting details of the limiting conditions affecting compliance with the insulation requirements.
   2. *Construction documents* that include a roof design by a *registered design professional* or other *approved source* that minimizes deviation from the insulation requirements.

3. Conversion of unconditioned attic space into *conditioned space*.
4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling construction.

C503.2.2 Vertical fenestration. *(Section unchanged)*

C503.2.3 Skylight area. *(Section unchanged)*

Add new text as follows:

C503.2.4 Above-grade wall alterations. *Above-grade wall* alterations shall comply with the following:

1. Where wall cavities are exposed, the cavity shall be filled with cavity insulation complying with Section C303.1.4. New cavities created shall be insulated in accordance with Section C402.1 or an *approved* design that minimizes deviation from the insulation requirements.
2. Where exterior wall coverings and fenestration are added or replaced for the full extent of any exterior wall assembly on one or more elevations of the building, insulation shall be provided where required in accordance with one of the following:

   2.1. An R-value of *continuous insulation* not less than that designated in Table C402.1.3 for the applicable above-grade wall type and existing cavity insulation R-value, if any;

   2.2 An R-value of not less than that required to bring the *above-grade wall* into compliance with Table C402.1.4; or,

   2.3 An *approved design* that minimizes deviation from the insulation requirements of Section C402.1.

3. Where Items 1 and 2 apply, the insulation shall be provided in accordance with Section C402.1.

Where any of the above requirements are applicable, the *above-grade wall* alteration shall comply with Sections 1402.2 and 1404.3 of the *International Building Code*.

C503.2.5 Floor alterations. Where an alteration to a floor or floor overhang exposes cavities or surfaces to which insulation can be applied, and the floor or floor overhang is part of the *building thermal envelope*, the floor or floor overhang shall be brought into compliance with Section C402.1 or an *approved* design that minimizes deviation from the insulation requirements. This requirement applies to floor alterations where the floor cavities or surfaces are exposed and accessible prior to construction.

C503.2.6 Below-grade wall alterations. Where unconditioned below-grade space is changed to *conditioned space*, walls enclosing such conditioned space shall be insulated where required in accordance with Section C402.1. Where the below-grade space is *conditioned space* and where walls enclosing such space are altered, they shall be insulated where required in accordance with Section C402.1.

C503.2.7 Air barrier. Altered *building thermal envelope* assemblies shall be provided with an *air barrier* in accordance with Section C402.5.1. Such *air barrier* need not be continuous with unaltered portions of the *building thermal envelope*. Testing requirements of Section C402.5.1.2 shall not be required.

Reason: Existing building alterations are perhaps one of the primary opportunities to reduce national energy consumption, yet Chapter 5 misses many opportunities to effectively address this need. There are many opportunities to cost-effectively improve energy efficiency of the existing building stock by use of reasonable criteria to trigger (or avoid) requirements for alterations with flexibility in the manner or extent of compliance where needed. This proposal attempts to strike that balance in a practical and cost-effective manner for building envelope assemblies of existing building that are undergoing specific types of alterations. Consequently, this proposal will help to address the 40% of national energy use that is attributed to the existing building stock and will only apply where alterations are proposed that provide opportunity to improve the performance of the existing building stock. A similar coordinated proposal was also submitted for the IECC-R committee.

Key changes made in this proposal are summarized as follows:

1. Exceptions 3 and 4 of Section C503.1 are deleted as they are now addressed and preserved within requirements in new Section C503.2.4 for above-grade walls.

2. New exception 4 is added to Section C503.1 for roof replacements for roof assemblies that do not have insulation entirely above deck (which is addressed separately in Section C503.2.1).

3. A clause to prevent reduction of insulation levels in existing thermal envelope assemblies is moved from Section C503.2.1 to Section C503.2 to apply to all building thermal envelope alterations.

4. Section C503.2.1 is revised to address multiple types of roof alterations, including roof replacements for roofs with insulation entirely above deck.

5. A new Section C503.2.4 is provided for above-grade wall alterations which identifies conditions where it is appropriate and practical to provide insulation (if not already present). Language is also provided to ensure coordination with building code moisture control requirements which require integration with and can influence the method of complying with the insulation requirements.

6. A new Section C503.2.5 is provided for floor alterations and takes an approach similar to that done for above-grade walls (although with fewer conditional requirements).

7. A new Section C503.2.6 is provided for below-grade wall alterations. This captures the cases where a below-grade space is being converted to conditioned space and where below-grade wall alterations allow addition of insulation if the below grade space is already conditioned space.

8. Finally, new Section C503.2.7 is provided to address air barrier installation in building thermal envelope assemblies that are altered within the scope of Section C503.2. However, it is made clear that continuity of the air barrier with unaltered portions of the building thermal envelope is not required. This avoids causing an alteration to extend beyond its intended scope and extent. This is also consistent with the intent behind existing exception #6 to Section C503.1 dealing with air barriers in roof replacements.

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

Where requirements are triggered and where upgrades in energy efficiency were not already planned for an alteration, this proposal will increase cost for a limited set of envelope alteration activities for existing buildings. Some existing requirements such as roof replacements and filling of exposed stud cavities remain unchanged. For those existing buildings with deficient insulation levels (or no insulation) and where planned alterations allow that deficiency to be addressed efficiently, the cost-benefits are expected to closely align with that for new buildings. However, it is not possible to conduct a simple cost-benefit analysis for existing buildings because of the multitude of variables involved and the flexibility provided in this proposal that make it nearly impossible to quantify with any reasonable level of certainty. Thus, we consider these proposed provisions to be cost-effective by judgment as these types of existing building thermal envelope upgrades are currently being used in the existing building/remodeling/renovation market, although not consistently or in an enforceable manner.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Provides improved clarity and application of existing building envelope alteration requirements with flexibility.

Final Hearing Results

CEPI-221-21	AM

CEPI-225-21

Original Proposal

IECC®: SECTION 202 (New), C503.2.1

Proponents: Marcin Pazera, Polyisocyanurate Insulation Manufacturers Association, Polyisocyanurate Insulation Manufacturers Association (mpazera@pima.org); Justin Koscher, Polyisocyanurate Insulation Manufacturers Association, Polyisocyanurate Insulation Manufacturers Association (jkoscher@pima.org)

2021 International Energy Conservation Code

Add new definition as follows:

APPROVED SOURCE. An independent person, firm or corporation, approved by the *building official*, who is competent and experienced in the application of engineering principles to materials, methods or systems analyses.

CONSTRUCTION DOCUMENTS. Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a building *permit*.

Revise as follows:

C503.2.1 Roof replacement, insulation entirely above deck. *Roof replacements* shall comply with Section C402.1.3, C402.1.4, C402.1.5 or C407 where the existing roof assembly is part of the *building thermal envelope* and contains insulation entirely above the roof deck. ~~In no case shall the *R*-value of the roof insulation be reduced or the *U*-factor of the roof assembly be increased as part of the *roof replacement*.~~

Exception: Where compliance with Table C402.1.3, Table C402.1.4 or Table C402.1.5 cannot be met due to limiting conditions on an existing roof, the following shall be permitted to demonstrate compliance with the insulation requirements:

1. *Construction documents* that include a report by a registered design professional or other *approved source* documenting details of the limiting conditions affecting compliance with the insulation requirements.
2. *Construction documents* that include a roof design by a registered design professional or other *approved source* that minimizes deviation from the insulation requirements.

Insulation shall be installed in accordance with the requirements of Sections C402.2.1.2 through C402.2.1.5.

Reason: Low-sloped roofs comprise the largest thermal envelope surface in many non-residential buildings, which offers a significant opportunity to improve the energy efficiency of the roof and the overall building energy performance. Where an existing roof contains insulation entirely above the deck and is in need of replacement, the roof replacement must comply with the IECC's opaque thermal envelope requirements. For buildings constructed prior to the wide-spread adoption of energy codes, energy-code compliant roof replacements can significantly decrease whole building energy use and reduce associated costs and carbon emissions. This requirement for roof replacements has been part of the IECC since the energy code first regulated existing buildings. However, instances can arise on specific projects where the complexities of other rooftop features create limiting conditions that pose significant practical and cost challenges for installing a replacement roof system containing increased levels of above deck roof insulation in order to comply with the IECC's opaque thermal envelope requirements.

This code change proposal allows for these unique roof replacement projects to, on case-by-case basis, use alternative designs that minimize deviations from the code required insulation levels while also presenting a practical roof replacement solution under the limiting conditions that prevent full compliance. In order to qualify for the exception, the limiting conditions must be documented in construction documents, and report prepared by the approved source and provided to the building code official. The roof design must also be prepared by the approved source showing that deviations from the insulation requirements have been minimized in order to maintain the intent of the IECC to increase building energy efficiency during alterations. The proposal also reinforces that insulation must be installed in accordance with current requirements of applicable sections in Chapter 4 of the IECC. The proposal retains very important existing language regarding insulation R-value and roof assembly U-factor requirements in this provision, and the intent of relocating this language is to ensure that provision is applicable whether or not the exception is utilized. Finally, the proposal also adopts two definitions for “approved source” and “construction documents,” Both definitions are in Chapter 2 of the IBC but are not in Chapter 2 of the IECC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change proposal does not increase the cost of construction. In many instances, there may be cost savings to the building owner, since less than the code required levels of insulation may be installed in roof replacement work.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Adds in some checks about who conducts the design and how it is documented. Clarifies the approved source for use of an expert in the subject matter

Final Hearing Results

CEPI-225-21	AM

CEPI-226-21

Original Proposal

IECC®: C503.2.1

Proponents: Darren Meyers, P.E., International Energy Conservation Consultants LLC, International Energy Conservation Consultants LLC (dmeyers@ieccode.com); Mark Graham, National Roofing Contractors Association, National Roofing Contractors Association (mgraham@nrca.net)

2021 International Energy Conservation Code

Revise as follows:

C503.2.1 Roof replacement. *A* *roof* *replacement* ~~*replacements*~~ shall comply with Section C402.1.3, C402.1.4, C402.1.5 or C407 where the existing roof assembly is part of the *building thermal envelope* and contains insulation entirely above the roof deck. In no case shall the *R*-value of the roof insulation be reduced or the *U*-factor of the roof assembly be increased as part of the *roof replacement*.

Reason: The italicized defined term is singular not plural.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: improve the language

Final Hearing Results

CEPI-226-21 AM

CEPI-227-21

Original Proposal

IECC®: C503.3.2 (New)
Proponents: Sean Denniston, New Buildings Institute, New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

C503.3.2 Controls. New heating and cooling equipment that are part of the*alteration* shall be provided with controls that comply with the control requirements in Section C403.4 and Section C403.5 other than the requirements of Section C403.4.3.3 and Section 403.4.4.

Exceptions:

1. Systems with *direct digital control* of individual zones reporting to a central control panel.
2. The replacement of individual components of multiple-zone VAV systems.

Reason: The IECC only requires that new portions of HVAC systems comply with the requirements for new construction. This leaves unaltered portions of the HVAC system unaffected, including controls. Controls are a vital component of effective and efficient operation of heating and cooling systems and older controls that do not meet current code requirements significantly hamper efficiency in buildings. Obsolete controls also increase the operational costs for building owners and tenants. The IECC has relied on HVAC controls as a cost-effective means of delivering energy efficiency in buildings, so this is a significant missed opportunity. Equipment replacement is an ideal time to also upgrade controls. Contractors are onsite, operation of the HVAC system is already disrupted, and the cost of controls would generally be a small line-item cost in the project.

This missed opportunity is particularly significant given the advent of Building Performance Standards (BPS). These policies set performance requirements that subject existing buildings need to meet. States and local jurisdiction around the country including the states of WA and CO and cities like New York, Boston, Washington DC, and St Louis have already adopted Building Performance Standards (BPS). Many more cities are considering this policy tool as they come to realize that meeting their climate goals will require achieving significant energy and/or carbon improvements in existing buildings. This creates a need for the IECC to be much more pro-active in tailoring requirements specifically for existing buildings. Building energy retrofits that are implemented as part of alterations, additions and changes in occupancy are far more cost-effective than stand-alone retrofit projects implemented only to meet a BPS. By incorporating reasonable and cost-effective retrofits into typical existing building projects, the IECC will both provide additional energy, carbon and cost savings to building owners and tenants and help ensure that more building retrofits are undertaken at opportune and cost-effective times.

This proposal requires that thermostatic controls be brought into compliance with current control requirements when equipment is replaced. It includes an exception for systems with complex central control systems where control upgrades would be far more involved. The proposal does not require the installation of new controls, so if the existing controls already meet current code requirements, they would already be in compliance with this new section.

Cost Impact: The code change proposal will increase the cost of construction.
Cost will vary depending on the type of control and how obsolete existing controls are. In most systems subject to this requirement, compliance would require replacing one thermostat with another. Modern, wireless thermostats can be used to control costs when existing control wiring is insufficient to support modern controls.

The modern, single-zone thermostatic controls subject to this requirement can be purchased for less than $30[.1] Thermostat swaps should easily represent only a fraction of an hour of additional labor.

[1] https://www.supplyhouse.com/Lux-P711-010-7-Day-5-2-day-Programming-or-Non-Programmable-Thermostat-Horizontal-Mount-1-Heat-1-Cool

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The current IECC only requires that new portions of HVAC systems comply with the requirements for new construction. This leaves unaltered portions of the HVAC system unaffected, including controls. Controls are a vital component of effective and efficient operation of heating and cooling systems and older controls that do not meet current code requirements significantly hamper efficiency in buildings.

Final Hearing Results

CEPI-227-21	AM

CEPI-228-21

Original Proposal

IECC®: C503.3.2 (New)
Proponents: Sean Denniston, New Buildings Institute, New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

C503.3.2 System sizing. New heating and cooling equipment that is part of an *alteration* shall be sized in accordance with Section C403.3.1 based on the existing *building* features as modified by the *alteration.*

Exceptions:

1. Where is has been demonstrated to the *code official* that compliance with this section would result in heating or cooling equipment that is incompatible with the rest of the heating or cooling system.
2. Where it has been demonstrated to the *code official* that the additional capacity will be needed in the future.

Reason: Historically, HVAC equipment has been routinely oversized. Studies have found very high rates of equipment oversizing; for example, 60% of RTU units in CA were found to be oversized.[1] Oversized equipment results in increased energy use, decreased occupant comfort and increased wear-and-tear on equipment.[2] Oversized equipment is also less effective at dehumidification. Like-for-like equipment replacement are particularly vulnerable to oversizing. The original equipment may have been installed when code requirements for “right-sizing” equipment did not exist or was not enforced. The materials markups that are common practice among contractors disincentivize them to install smaller, right-sized equipment. Changes to building use could have occurred since the original equipment was installed, creating a mismatch between current design loads and the original equipment. The building may have modified, particularly by energy efficiency programs, altering the design loads of the building. Lighting especially stands out here. Fluorescent and LED lighting is ubiquitous, but many HVAC systems were designed to account for incandescent lamps that convert over 75% of the energy they consume into heat.

With all of these considerations, it is reasonable to assume that the existing equipment sizing is more likely to be wrong than right, yet many equipment replacements use existing system sizing to size new equipment. This proposal explicitly requires that new equipment installed as part of an alteration be sized based on current building characteristics and loads, using current sizing standards. The resulting installations will be more efficient and more effective and many will be less costly to install as owners stop paying for more equipment than they need.

Savings will vary based on the amount that existing equipment is oversized. “Right-sizing” has been found to result in about 0.2% energy savings for every 1% reduction in oversizing.[3]
[1] D.R. Felts, P. Bailey, The State of Affairs – Packaged Cooling Equipment in California, 2000.

[2] Ery Djunaedy, Kevin van den Wymelenberg, Brad Acker, Harshana Thimmana, *Oversizing of HVAC system: Signatures and penalties.* “Energy and Buildings,” Volume 43, Issues 2-3, 2011,

[3] H.McLain,D.Goldberg. “Benefits of Replacing Residential Central Air Conditioning Systems.” American Council for an Energy-Efficient Economy, WashingtonDC, USA, 1984.

Bibliography:
D.R. Felts, P. Bailey, The State of Affairs – Packaged Cooling Equipment in California, 2000.

Ery Djunaedy, Kevin van den Wymelenberg, Brad Acker, Harshana Thimmana. *Oversizing of HVAC system: Signatures and penalties.* “Energy and Buildings,” Volume 43, Issues 2-3, 2011,

H.McLain,D.Goldberg, Benefits of Replacing Residential Central Air Conditioning Systems, American Council for an Energy-Efficient Economy, Washington DC, USA, 1984, pp. E226-E227.

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

As “wrong-sized” equipment is generally oversized, this proposal will generally decrease the cost of installation. Smaller, right-sized equipment will generally be less costly to install.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: “Right-sizing” HVAC equipment can lead to more efficient and effective systems and reduce first costs.

Final Hearing Results

CEPI-228-21 AM

CEPI-229-21

Original Proposal

IECC®: C503.3, C503.3.2 (New), C503.4, C503.4.1 (New), C503.5, C503.5.1 (New)

Proponents: Sean Denniston, New Buildings Institute, New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

C503.3 Heating and cooling systems. New heating, cooling and duct systems that are part of the *alteration* shall comply with Sections C403~~ and C408~~.

Add new text as follows:

C503.3.2 Mechanical system acceptance testing. Where an *alteration* requires compliance with Section C403 or any of its subsections, mechanical systems that serve the *alteration* shall comply with Sections C408.2.2, C408.2.3 and C408.2.5.

Exceptions:

1. *Buildings* with less than 10,000 square feet (929 m^2) and a combined heating, cooling, and service water-heating capacity of less than 960,000 Btu/h (280 kW).
2. Systems included in Section C403.5 that serve individual *dwelling units* and *sleeping units*.

Revise as follows:

C503.4 Service hot water systems. New service hot water systems that are part of the *alteration* shall comply with Sections C404~~ and C408~~.

Add new text as follows:

C503.4.1 Service hot water system acceptance testing. Where an *alteration* requires compliance with Section C404 or any of its subsections, service hot water systems that serve the *alteration* shall comply with Sections C408.2.3 and C408.2.5.

Exceptions:

1. *Buildings* with less than 10,000 square feet (929 m^2) and a combined heating, cooling, and service water-heating capacity of less than 960,000 Btu/h (280 kW).
2. Systems included in Section C403.5 that serve individual dwelling units and sleeping units.

Revise as follows:

C503.5 Lighting systems. New lighting systems that are part of the *alteration* shall comply with ~~Sections~~ Section C405 ~~and C408~~.

Exception: *Alterations* that replace less than 10 percent of the luminaires in a space, provided that such *alterations* do not increase the installed interior lighting power.

Add new text as follows:

C503.5.1 Lighting acceptance testing. Where an *alteration* requires compliance with Section C405 or any of its subsections, lighting systems that serve the *alteration* shall comply with Section C408.3.

Reason: The IECC requires that new mechanical, hot water and lighting systems comply with the acceptance testing requirements of C408. However, the IECC commentary for C503 states that unaltered portions of systems do not have to be brought into compliance with the code. This means that the requirements of C408 only apply to the new portions of existing systems. However, the whole purpose of C408 is to ensure that building systems meet and document a minimum level of system configuration. Even when only part of a system is replaced, there is still the need to ensure this minimum level of system configuration for the whole building. Even in like-for-like replacements, new equipment can have different operating characteristics. It is therefore important to ensure that the whole system is operating appropriately after new components are installed, not just the new components.

Additionally, all systems see their performance degrade over time as components wear, operational parameters change and modifications accumulate. The installation of new portions of equipment also presents the most reasonable and cost-effective opportunity to recalibration the system based on current operations. Therefore, this proposal requires that the whole system meet relevant C408 requirements, rather than just the new components. The proposal is tailored to focus on the parts of C408 that are relevant to existing buildings rather than just a blanket reference to C408 and includes specific references to the appropriate commissioning /acceptance testing requirements:

- The balancing (C408.2.2), functional testing (C408.2.3) and documentation (C408.2.5) requirements for HVAC systems.
- The functional testing (C408.2.3) and documentation (C408.2.5) requirements for water heating systems
- The functional testing, documentation and reporting requirements for lighting (C408.3).·

It repeats the system-size thresholds in the charging language in C408. In this way, it has the same scope as the requirements for new construction.The proposal does not include references to the commissioning plan requirement (C408.2.1) for HVAC and SHW equipment (C408.2.4) since these requirements are most appropriate for new construction.

Retro-commissioning and building re-tuning is generally accepted as one of the most cost-effecting energy efficiency measures for existing buildings. Average savings for building re-tuning is 12%, and studies have found savings as high as 52%.[1]' [2]

[1] "Improving Commercial Building Operations through Building Re-tuning: Meta-Analysis." Pacific Northwest National Laboratory, S. Katipamula and N. Fernandez. 2020.

[2] "The Cost-Effectiveness of Commercial Buildings Commissioning." Lawrence Berkeley National Laboratory, Mills, E., H. Friedman, T. Powell, N. Bourassa, D. Claridge, T. Haasl, and M.A. Piette. 2004

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

According to "Improving Commercial Building Operations through Building Re-tuning: Meta-Analysis," the median costs for building re-tuning was $0.16/sf.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This CCP ensures that the unaltered portions of mechanical, hot water and lighting systems in existing buildings, where a portion of the system is altered, are subject to C408 acceptance testing requirements. The CCP was revised to align with CEPI-215 and to remove C503 references to C408 for clarity.

Final Hearing Results

CEPI-229-21 AM

CEPI-232-21

Original Proposal

IECC®: SECTION 202 (New), C505.1, C505.1.1 (New), C505.1.2 (New), C505.2 (New), C505.2.1 (New), C505.2.2 (New), TABLE C505.2.2 (New), C505.2.3 (New), TABLE C505.2.3 (New), C505.2.4 (New), TABLE C505.2.4 (New)

Proponents: Kris Stenger, SEHPCAC (sehpcac@iccsafe.org)

2021 International Energy Conservation Code

Add new definition as follows:

ENERGY USE INTENSITY (EUI). The metric indicating the total amount of energy consumed by a building in one year divided by the gross floor area of the building.

Revise as follows:

C505.1 General. Spaces undergoing a change in occupancy~~that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code. Where the use in a space changes from one use in Table C405.3.2(1) or C405.3.2(2) to another use in Table C405.3.2(1) or C405.3.2(2), the installed lighting wattage shall comply with Section C405.3. Where the space undergoing a change in occupancy or use is in a building with a fenestration area that exceeds the limitations of Section C402.4.1, the space is exempt from Section C402.4.1 provided that there is not an increase in fenestration area.~~ from F, H, S or U occupancy classification shall comply with Section C503. Buildings or portions of buildings undergoing a change of occupancy without alterations shall comply with Section C502.2.

~~**Exceptions**~~ **Exception:** Where the total building performance option in Section C407 is used to comply with this section, the annual energy cost of the proposed design shall not be greater than 110 percent of the annual energy cost otherwise permitted by Section C407.3.

1. ~~Where the component performance alternative in Section C402.1.5 is used to comply with this section, the proposed UA shall not be greater than 110 percent of the target UA.~~
2. ~~Where the total building performance option in Section C407 is used to comply with this section, the annual energy cost of the proposed design shall not be greater than 110 percent of the annual energy cost otherwise permitted by Section C407.3.~~

Add new text as follows:

C505.1.1 Alterations and change of occupancy. . *Alterations* made concurrently with any change of occupancy shall be in accordance with Section C503.

C505.1.2 Portions of buildings. . Where changes in occupancy and use are made to portions of an existing building, only those portions of the building shall comply with Section C505.2.

C505.2 Energy Use Intensitie. Building envelope, space heating, cooling, ventilation, lighting and service water heating shall comply with Sections C505.2.1 through C505.2.4.

Exceptions:

1. Where it is demonstrated by analysis approved by the*code official* that the change will not increase energy use intensity.
2. Where the occupancy or use change is less than 5,000 square feet (464 m^2) in area.

C505.2.1 Building Envelope. . Where a change of occupancy or use is made to a whole building that the results in fenestration area greater than the maximum fenestration area allowed by Section C402.4.1, the building shall comply with Section C402.1.5, with a proposed

UA that shall not be greater than 110 percent of the target UA.

Exception: Where the change of occupancy or use is made to a portion of the building, the new occupancy is exempt from Section C402.4.1 provided that there is not an increase in fenestration area.

C505.2.2 Building Mechanical Systems. Where a change of occupancy or use results in the same or increased energy use intensity rank as specified in Table C505.2.2, the systems serving the building or space undergoing the change shall comply with Section C403.

TABLE C505.2.2 BUILDING MECHANICAL

Energy Use Intensity Rank	International Building Code Occupancy Classification and Use
1. High	A-2, B-Laboratories, I-2
2. Medium	A-1, A-3[a], A-4, A-5, B[b], E, I-1, I-3, I-4, M, R-4
3. Low	A-3 Places of Religious Worship, R-1, R-2, R-3[c], 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.

C505.2.3 Service Water Heating. Where a change of occupancy or use results in the same or increased energy use intensity rank as specified in Table C505.2.3, the service water heating systems serving the building or space undergoing the change shall comply with Section C404.

TABLE C505.2.3 Service Water Heating

Energy Use Intensity Rank	International Building Code Occupancy Classification and Use
1. High	A-2, I-1, I-2, R-1
2. Low	All other occupancies and uses

C505.2.4 Lighting. Where a change of occupancy or use results in the same or increased energy use intensity rank as specified in Table C505.2.4, the lighting systems serving the building or space undergoing the change shall comply with Section C405 except for Sections C405.2.6 and C405.4.

TABLE C505.2.4 LIGHTING

Energy Use Intensity Rank	International Building Code Occupancy Classification and Use
1. High	B-Laboratories, B-Outpatient Healthcare, I-2, M
2. Medium	A-2, A-3, Courtrooms, B[a], I-1, I-3, I-4, R-1, R-2, R-3[b], R-4, S-1, S-2
3. Low	A-1, A-3[c], A-4, E

a. Excluding laboratories and outpatient healthcare.

b. Buildings three stories or less in height above grade plane shall comply with Section R505.

c. Excluding courtrooms.

Reason: The IECC 2018 change of occupancy requirement (C505.1) begins with this statement:

“Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this

code.”

Field research and surveys of building officials demonstrate that this requirement is difficult to enforce (Clinton et al, 2016). One reason for this is

that while it is a clear performance requirement, there is no simple compliance evaluation method other than energy modeling, which is beyond the

capabilities of most change-of-occupancy permit applicants. As depicted in the referenced survey findings and community-based pilot research,

building officials often require energy efficiency equipment upgrades, such as lighting or HVAC, in buildings undergoing a change of occupancy. This

proposal seeks to provide clarity to that approach by providing a simple breakdown of energy use intensity (EUI) by building occupancy type and

system type.

The proposed code change draws on a tradition of rehabilitation “smart codes” use-based lookup tables, is more consistent with the intent of the

IECC, presents no cost increase, and incorporates extensive research and stakeholder input.

This proposal advances the Energy Use Intensity (EUI) as the metric for energy demand and the trigger for code compliance. Historic energy

intensity per square foot is recorded for commercial buildings in the Commercial Buildings Energy Consumption Survey (CBECS). The CBECS data

make it possible to rank building occupancies in the order of the energy intensities. Note that the ranking of occupancies to trigger specific code

requirements has been a feature of the International Existing Building Code (IEBC) since its earliest editions (see IEBC 2009 Section 912, Change of

Occupancy Classification, Tables 912.4, 912.5 and 912.6), and thus is familiar to building code officials.

Energy intensity data in CBECS is further broken down by various end uses (space conditioning, service water heating and lighting) which makes it possible to identify when it is appropriate to trigger code compliance of specific sections of the IECC. For each of these end uses, an increase in

intensity triggers compliance with the correlating code provisions related to new construction in Chapter 4. Only an increase in energy intensities in

all three of the end uses triggers full compliance with the code.

There are two exceptions that apply to all four end uses, indicated in Section C505.2:

1. Where it is demonstrated by analysis approved by the code official that the change will not increase energy use intensity.

2. Where the occupancy or use change is less than 5,000 square feet in area.

A matrix has been developed for each system end use that groups building occupancy classifications into HIGH, MEDIUM and LOW energy use

intensities, measured in annual kBTU/sf. Data for this analysis came from the U.S. Department of Energy's 2012 CBECS. When occupancy

classification or use is being changed from one energy intensity rank to a higher energy use intensity rank (or remains within the same energy use

intensity rank), this proposal requires that specific system end-use to comply with the code.

Occupancy classifications F, H and U are typically not designed primarily for occupant comfort, and are generally classified as low energy use intensity buildings. Thus any change from one of these groups to any other should be required to comply with the provisions under Section C503 Alterations, even if no physical alteration is planned.

Section C505.2.1 Building Envelope is included as a building system, although with different criteria than EUI Intensity. The requirement and exception exist in the 2018 language; they are simply relocated in this proposal.

This code change proposal has been developed with support from the Consortium for Building Energy Innovation (CBEI), a project of the U.S. Department of Energy, and research conducted by Rutgers University Center for Green Building.

Change of Occupancy Scale - Space Heating, Cooling and Ventilation

EUI Rank	CBECS Building Type	EUI Range kBTU/sq.ft.	IBC Occupancy Classification
1. High	Food Service, Laboratories, Health Care (Inpatient)	> 55	A-2, B-Laboratories, I-2
2. Medium	Public Assembly, Public Order and Safety, Office, Service, Health Care (Outpatient), Education, Retail, Residential Care/Assisted Living	27 - 55	A-1, A-3, A-4, A-5, B, E, I-1, I-3, I-4, M, R-4
3. Low	Religious Worship, Apartments, Warehouse and Storage	<27	A-3 Places of Worship, R-1, R-2, R-3, S-1, S-2

Change of Occupancy Scale - Service Water Heating

EUI Rank	CBECS Building Type	EUI Range kBTU/sq.ft.	IBC Occupancy Classification
1. High	Food Service, Health Care (Inpatient), Residential Care/Assisted Living, Lodging	> 15	A-2, I-1, I-2, R-1
2. Low	All the rest	< 15	All the rest

Change of Occupancy Scale- Lighting

EUI Rank	CBECS Building Type	EUI Range kBTU/sq.ft.	IBC Occupancy Classification
1. High	Laboratories, Health Care (Outpatient), Health Care (Inpatient), Retail	> 11	B-Laboratories, B-Healthcare (Outpatient), I-2, M
2. Medium	Food Service, Office, Health Care (Outpatient), Service, Public Order and Safety, Residential Care/Assisted Living, Lodging, Apartments, Warehouse and Storage	6.5 - 11	A-2, A-3-Courtrooms, B, I-1, I-3, I-4, R-1, R-2, R-3, R-4, S-1, S-2
3. Low	Public Assembly, Religious Worship, Education	< 6.5	A-1, A-3, A-4, E

Bibliography: Clinton J. Andrews, David Hattis, David Listokin, Jennifer A. Senick, Gabriel B. Sherman & Jennifer Souder (2016): Energy - Efficient
Reuse of Existing Commercial Buildings, Journal of the American Planning Association. doi.10.1080/01944363.2015.1134275

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will not increase or decrease the cost of construction
The current code requirements trigger full compliance with the code when there is an increase in energy demand. The proposed code change offers
the metric of energy use intensity per square foot per year for measuring energy demand by occupancy. It applies this metric separately to three
energy end uses: space conditioning, lighting, and water heating. Therefore, compliance with the code is triggered only for the end uses for which
energy intensity is increased.
In most cases, the proposed change triggers partial code compliance, and only rarely will it trigger full code compliance.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal ensures that spaces that undergo a change from F, H, S or U occupancies to a more energy intensive occupancy comply with C503, if alterations are included, or C502.2 if not.

Final Hearing Results

CEPI-232-21	AM

CEPI-254-21

Original Proposal

IECC®: TABLE C405.3.2(1), TABLE C405.3.2(2), TABLE C405.5.2(2), TABLE C405.5.2(3)

Proponents: Lisa Rosenow, Evergreen Technology Consulting, Self (lrosenow@evergreen-tech.net); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

TABLE C405.3.2(1) INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (w/ft^2)
Automotive facility	0.75
Convention center	0.64
Courthouse	0.79
Dining: bar lounge/leisure	0.80
Dining: cafeteria/fast food	0.76
Dining: family	0.71
Dormitory[a, b]	0.53
Exercise center	0.72
Fire station[a]	0.56
Gymnasium	0.76
Health care clinic	0.81
Hospital[a]	0.96
Hotel/Motel[a, b]	0.56
Library	0.83
Manufacturing facility	0.82
Motion picture theater	0.44
Multiple-family[c]	0.45
Museum	0.55
Office	0.64
Parking garage	0.18
Penitentiary	0.69
Performing arts theater	0.84
Police station	0.66
Post office	0.65
Religious building	0.67
Retail	0.84
School/university	0.72
Sports arena	0.76
Town hall	0.69
Transportation	0.50
Warehouse	0.45
Workshop	0.91

For SI: 1 watt per square foot = 10.76 ~~w/m²~~ watts per square meter.

a. Where sleeping units are excluded from lighting power calculations by application of Section R404.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.

b. Where dwelling units are excluded from lighting power calculations by application of Section R404.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.

c. Dwelling units are excluded. Neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.

TABLE C405.3.2(2) INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE TYPES[a]	LPD ($watts/ft^2$)
Atrium	

COMMON SPACE TYPES	LPD (watts/ft²)
Less than 40 feet in height	0.48
Greater than 40 feet in height	0.60
Audience seating area	
In an auditorium	0.61
In a gymnasium	0.23
In a motion picture theater	0.27
In a penitentiary	0.67
In a performing arts theater	1.16
In a religious building	0.72
In a sports arena	0.33
Otherwise	0.33
Banking activity area	0.61
Breakroom (See Lounge/breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	0.89
Otherwise	0.71
Computer room, data center	0.94
Conference/meeting/multipurpose room	0.97
Copy/print room	0.31
Corridor	
In a facility for the visually impaired (and not used primarily by the staff[b])	0.71
In a hospital	0.71
Otherwise	0.41
Courtroom	1.20
Dining area	
In bar/lounge or leisure dining	0.86
In cafeteria or fast food dining	0.40
In a facility for the visually impaired (and not used primarily by the staff[b])	1.27
In family dining	0.60
In a penitentiary	0.42
Otherwise	0.43
Electrical/mechanical room	0.43
Emergency vehicle garage	0.52
Food preparation area	1.09
Guestroom[c, d]	0.41
Laboratory	
In or as a classroom	1.11
Otherwise	1.33
Laundry/washing area	0.53
Loading dock, interior	0.88
Lobby	
For an elevator	0.65
In a facility for the visually impaired (and not used primarily by the staff[b])	1.69
In a hotel	0.51
In a motion picture theater	0.23
In a performing arts theater	1.25
Otherwise	0.84
Locker room	0.52
Lounge/breakroom	
In a healthcare facility	0.42
Otherwise	0.59
Office	
Enclosed	0.74
Open plan	0.61
Parking area, interior	0.15
Pharmacy area	1.66
Restroom	
In a facility for the visually impaired (and not used primarily by the staf[b]f	1.26
Otherwise	0.63
Sales area	1.05
Seating area, general	0.23
Stairwell	0.49
Storage room	0.38
Vehicular maintenance area	0.60
Workshop	1.26
BUILDING TYPE SPECIFIC SPACE TYPES[a]	**LPD (watts/ft²)**
Automotive (see Vehicular maintenance area)	
Convention Center–exhibit space	0.61
Dormitory–living quarters[c, d]	0.50
Facility for the visually impaired[b]	
In a chapel (and not used primarily by the staff)	0.70

COMMON SPACE TYPES	LPD (watts/ft²)
In a recreation room (and not used primarily by the staff)	1.77
Fire Station–sleeping quarters[c]	0.23
Gymnasium/fitness center	
In an exercise area	0.90
In a playing area	0.85
Healthcare facility	
In an exam/treatment room	1.40
In an imaging room	0.94
In a medical supply room	0.62
In a nursery	0.92
In a nurse's station	1.17
In an operating room	2.26
In a patient room[c]	0.68
In a physical therapy room	0.91
In a recovery room	1.25
Library	
In a reading area	0.96
In the stacks	1.18
Manufacturing facility	
In a detailed manufacturing area	0.80
In an equipment room	0.76
In an extra-high-bay area (greater than 50 feet floor-to-ceiling height)	1.42
In a high-bay area (25-50 feet floor-to-ceiling height)	1.24
In a low-bay area (less than 25 feet floor-to-ceiling height)	0.86
Museum	
In a general exhibition area	0.31
In a restoration room	1.10
Performing arts theater–dressing room	0.41
Post office–sorting area	0.76
Religious buildings	
In a fellowship hall	0.54
In a worship/pulpit/choir area	0.85
Retail facilities	
In a dressing/fitting room	0.51
In a mall concourse	0.82
Sports arena–playing area	
For a Class I facility[e]	2.94
For a Class II facility[f]	2.01
For a Class III facility[g]	1.30
For a Class IV facility[h]	0.86
Transportation facility	
At a terminal ticket counter	0.51
In a baggage/carousel area	0.39
In an airport concourse	0.25
Warehouse–storage area	
For medium to bulky, palletized items	0.33
For smaller, hand-carried items	0.69

For SI: 1 foot = 304.8 mm, 1 watt per square foot = 10.76~~w/m^2~~watts per square meter.

a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply.

b. A 'Facility for the Visually Impaired' is a facility that is licensed or will be licensed by local or state authorities for senior long-term care, adult daycare, senior support or people with special visual needs.

c. Where sleeping units are excluded from lighting power calculations by application of Section R404.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.

d. Where dwelling units are excluded from lighting power calculations by application of Section R404.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.

e. Class I facilities consist of professional facilities; and semiprofessional, collegiate, or club facilities with seating for 5,000 or more spectators.

f. Class II facilities consist of collegiate and semiprofessional facilities with seating for fewer than 5,000 spectators; club facilities with seating for between 2,000 and 5,000 spectators; and amateur league and high school facilities with seating for more than 2,000 spectators.

g. Class III facilities consist of club, amateur league and high school facilities with seating for 2,000 or fewer spectators.

h. Class IV facilities consist of elementary school and recreational facilities; and amateur league and high school facilities without provision for spectators.

TABLE C405.5.2(2) LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

	LIGHTING ZONES			
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**
Base Site Allowance	350 W	400 W	500 W	900 W
Uncovered Parking Areas				
Parking areas and drives	0.03 W/ft^2	0.04 W/ft^2	0.06 W/ft^2	0.08 W/ft^2
Building Grounds				
Walkways and ramps less than 10 feet wide	0.50 W/linear foot	0.50 W/linear foot	0.60 W/linear foot	0.70 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	0.60 W/ft^2	0.70 W/ft^2	0.70 W/ft^2	0.70 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	0.20 W/ft^2	0.25 W/ft^2	0.40 W/ft^2	0.40 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	0.40 W/ft^2	0.40 W/ft^2	0.60 W/ft^2	0.70 W/ft^2
Outdoor Sales				
Open areas (including vehicle sales lots)	0.20 W/ft^2	0.20 W/ft^2	0.35 W/ft^2	0.50 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

For SI: 1 foot = 304.8 mm, 1 watt per square foot =~~W/0.0929 m^2~~ 10.76 watts per square meter.

W = watts.

TABLE C405.5.2(3) INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

	LIGHTING ZONES			
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**
Building facades	No allowance	0.075 W/ft^2 of gross above-grade wall area	0.113 W/ft^2 of gross above-grade wall area	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			
Uncovered entrances and gatehouse inspection stations at guarded facilities	0.50 W/ft^2 of area			
Uncovered loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.35 W/ft^2 of area			
Drive-up windows and doors	200 W per drive through			
Parking near 24-hour retail entrances.	400 W per main entry			

For SI: For SI: 1 watt per square foot =~~W/0.0929 m^2~~ 10.76 watts per square meter.

W = watts.

Reason: Correct SI conversion errors and present footnote information consistently for all LPA tables.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Editorial corrections only.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: consistency in unit conversions

Final Hearing Results

CEPI-254-21	AS

CEPI-257-21

Original Proposal

IECC®: APPENDIX X (New), SECTION 202 (New), X.1 (New), X.2 (New), X.3 (New), TABLE X.3 (New), X.4 (New), X.4.1 (New), X.4.2 (New), X.4.3 (New)

Proponents: Duane Jonlin, City of Seattle, City of Seattle (duane.jonlin@seattle.gov)

2021 International Energy Conservation Code

Add new text as follows:

APPENDIX X
THE 2030 GLIDE PATH

Add new definition as follows:

OWNER. Any person, agent, operator, entity, firm or corporation having any legal or equitable interest in the property; or recorded in the official records of the state, county or municipality as holding an interest or title to the property; or otherwise having possession or control of the property, including the guardian of the estate of any such person, and the executor or administrator of the estate of such person if ordered to take possession of real property by a court.

Add new text as follows:

X.1 Prescriptive compliance. Where compliance is demonstrated using the prescriptive compliance option in Section C401.2.1, the number of additional efficiency credits required by Section C406.1 shall be 50 percent higher than that required by Table C406.1.1.

X.2 Total Building Performance compliance. Where compliance is demonstrated using the total building performance option of Section C401.2.1, the percentage of annual energy cost (PAEC), applied to the standard reference design referenced in Equation 4-23, shall be multiplied by 0.98.

X.3 On-site renewable electricity systems. In addition to any renewable energy generation equipment provided to comply with Section C406.3, buildings shall install equipment for on-site renewable energy generation with a direct current (DC) nameplate capacity rating of not less than that computed using Equation X-2.

AA=CA + SNA/3 **(Equation X-1)**

where:AA = Adjusted area, in ft^2 (m^2)CA = Conditioned area, in ft^2 (m^2)SNA = Semi-heated and nonconditioned area, in ft^2 (m^2)

REQ = AA x CF **(Equation X-2)**

where:REQ = Required on-site capacity, in DC wattsAA = Adjusted area from Equation X-1, in ft^2 (m^2)CF = Capacity factor from Table X-3, in watts/ft^2 (m^2)

Exceptions:

1. Any required renewable energy generation capacity in excess of 10 W/ft 2 (108 W/m2) of net available roof area is permitted to be provided using an off-site renewable energy system in accordance with Section X.4. For the purposes of this section, net available roof area is the gross roof area minus the roof area occupied by any combination of skylights, mechanical equipment, vegetated areas, required access pathways, vehicle parking, and occupied roof terrace area.

2. The following buildings are permitted to provide off-site renewable energy generation in accordance with Section X.4 in lieu of all or part of the on-site renewable energy generation capacity required by Section X.3.

   2.1 Any *building* where more than 50 percent of roof area would be shaded from direct-beam sunlight by existing natural objects or by structures that are not part of the *building* for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.

   2.2 Any *building* with gross *conditioned floor area* less than 1,000 square feet (93 m^2).

   2.3 Any *building* whose primary roof slope is greater than 2 in 12.

3. Alternate forms of *renewable energy generation capacity* are permitted where the annual energy generation is not less than that produced by the required solar capacity, and where annual energy generation is calculated using an *approved* methodology.

4. All or part of the required *renewable energy generation capacity* is permitted to be replaced by other efficiency measures provided such measures will reduce the annual energy consumption of the *building* by an amount no less than that which would otherwise be produced annually by the required renewable energy capacity, as calculated using the total building performance compliance path in Section C407 and an *approved* calculation methodology for solar production.

TABLE X.3 ON-SITE RENEWABLE ELECTRICITY

Climate Zone	Capacity Factor
1A, 2B, 3B, 3C, 4B, and 5B	2.0 W/ft^2 (22 W/m^2)
0A, 0B, 1B, 2A, 3A, and 6B	2.3 W/ft^2 (25 W/m^2)
4A, 4C, 5A, 5C, 6A, 7, and 8	2.6 W/ft^2 (29 W/m^2)

X.4 Off-site renewable energy. *Buildings* that qualify for one or more of the exceptions to Section X.3 and that do not have on-site renewable energy systems sufficiently sized to fully comply with Section X.3 shall procure off-site renewable energy in accordance with Sections X.4.1 through X.4.3. Such procured energy shall provide not less than the total annual required off-site renewable energy determined in accordance with Equation X-4 and shall be provided in addition to any renewable energy provided to comply with Section C406.3.

DEF = REQ - INSTL **(Equation X-3)**

where:DEF = Renewable capacity deficit, in DC wattsREQ = Required on-site capacity in DC watts, from Equation X-2INSTL = Installed on-site capacity, in DC watts

OFF = 4.4 x DEF **(Equation X-4)**

where:OFF = Off-site renewable energy to be procured, in kWh/year

X.4.1 Off-site procurement. The building owner shall procure and be credited for the total amount of off-site renewable energy required by Equation X-4. Procured off-site renewable energy shall comply with the requirements applicable to not less than one of the following:

1. *Community renewables energy facility.*
2. *Financial renewable energy power purchase agreement.*
3. Physical renewable energy power purchase agreement.
4. *Direct ownership*
5. *Renewable Energy Investment Fund.*

X.4.2 Off-site contract. The renewable energy shall be delivered or credited to the building site under an energy contract with a duration of not less than 10 years. The contract shall be structured to survive a partial or full transfer of ownership of the building property. The total required off-site renewable energy shall be procured in equal installments over the duration of the off-site contract.

X.4.3 Renewable energy certificate (REC) documentation. The property *owner* or *owner's* authorized agent shall demonstrate that where RECs are associated with on-site and off-site renewable energy production required by Sections X.3 and X.4, the following criteria shall be met:

1. The RECs shall be retained and retired by or on behalf of the property*owner* or tenant for a period of not less than 10 years or the duration of the contract in X.4.2, whichever is less;
2. The RECs shall be created within a 12-month period of the use of the REC; and
3. The RECs represent a generating asset constructed no more than 5 years before the issuance of the certificate of occupancy.

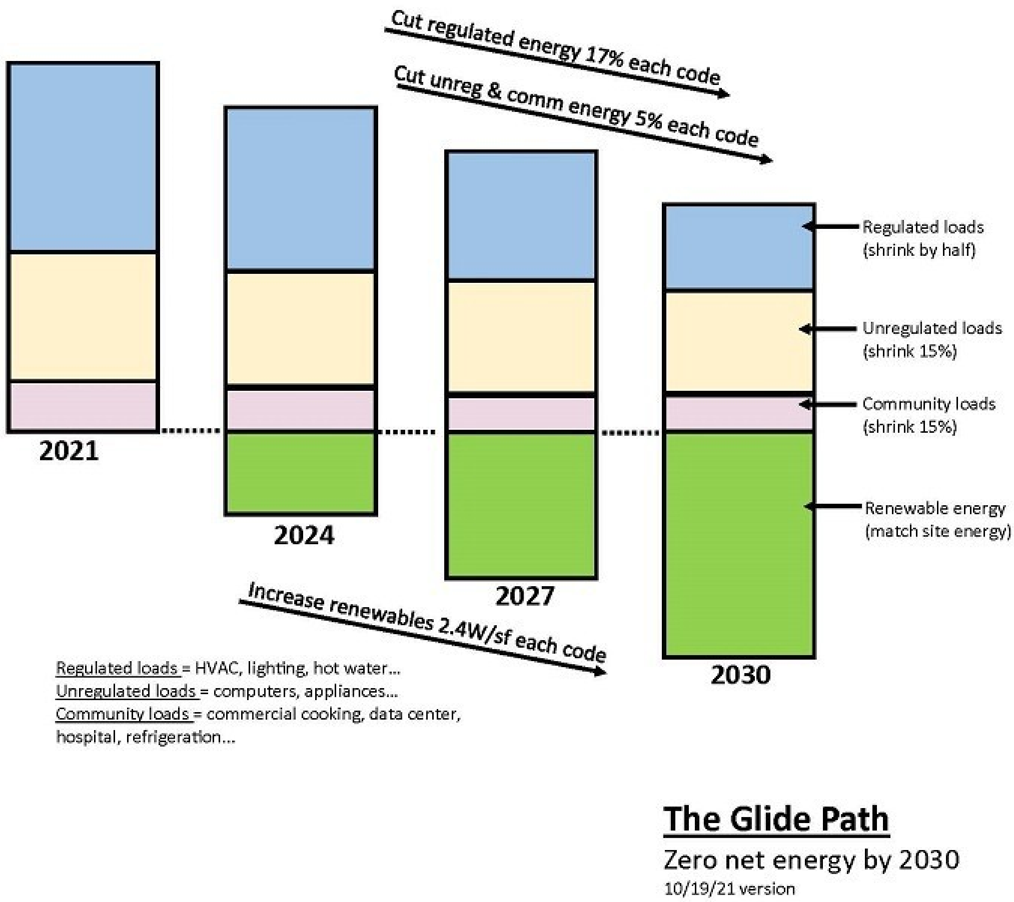
Reason: This appendix is intended to be adopted by jurisdictions that will require new construction to operate at net zero energy by the year 2030. It reduces the net annual energy use of buildings by approximately one-third in comparison with buildings constructed in compliance with the 2021 IECC, assuming that the 2027 and 2030 editions will also reduce energy use by one-third each.

It is estimated that *regulated* energy uses in buildings can be cut by 50% from current levels by 2030, but that unregulated loads and large community process loads will only diminish about 15% in the same time period. If regulated loads comprise 60% of building energy use, and unregulated loads (not counting large process loads) comprise the remaining 40%, halving the regulated loads would result in a 30% reduction in energy use, or 10% for each of the three Glide Path steps. Reducing unregulated and process loads by 15% over this decade would result in an additional 9% overall building energy use reduction by 2030, or 3% reduction per code cycle. Some of this 13% reduction (10% regulated and 3% unregulated/process) will occur in the base code development, and the remainder is required by this appendix.

For the 2030 ZNE target, renewable or site-recovered energy will be required to compensate for the remaining half of regulated energy use, plus the typical unregulated building energy use, and an additional amount to cover a proportionate share of community process energy.

Rather than burdening those buildings that contain large process loads (restaurant, grocery, hospital, data center, laboratory, etc.) with a requirement to provide renewable energy to cover their entire operating energy use, this Appendix requires an additional amount of renewable energy for *all* new building square footage in recognition of the fact that those large process loads serve the entire community with essential services. It is estimated that such community process loads equal approximately 20% of all other building energy loads.

If 39% of a building's net energy use reduction can be covered with efficiency and technology improvements, the remaining 61% of the*net* energy use reduction will be accomplished with acquisition of renewable energy resources, also in three roughly equal steps. Assuming typical PV production to be 1.5 kWh/year/watt, this would result in a requirement for 7 W/sf of conditioned floor area for 2030, or roughly 2.4 W/sf for 2024. For semi-heated or unconditioned space, the requirement will be 1/3 of this amount, or 0.8 W/sf for 2024.



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

The installed cost of rooftop PV arrays will be something like $2.00 per watt during the active period of this code edition, although additional price decreases may continue to occur. The savings will vary greatly, depending on climate zone and utility rates.

The number of additional efficiency credits required for those pursuing the prescriptive compliance paths will vary depending on how much efficiency progress is made in the base code - the more the base code advances, the lower the cost of compliance.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposed appendix establishes a pathway to net-zero energy consumption by 2030.

Final Hearing Results

CEPI-257-21 AM

IRCEAPP-01-24

Original Proposal

IRCECC: N1103.5.5, TABLE N1103.5.5, N1104.7, N1104.7.1, N1104.7.2, N1104.7.3, N1104.7.4, N1104.7.5, N1104.6, N1104.6.1, NL101.1.1.1 (New), NL101.1.1.2 (New), N1104.6.1.3, N1104.6.1.4, N1104.6.2, NL101.1.2.1 (New), NL101.1.2.2 (New), NL101.1.2.3 (New), NL101.1.2.4 (New), NL101.1.2.5 (New), NL101.2.6 (New), NL101.1.2.7 (New), NL101.1.2.8 (New), N1104.5, N1104.5.1, N1104.5.2, N1104.5.3, NK101.1.4 (New), TABLE N1105.2, TABLE N1106.2, APPENDIX AY, AY103, A101.1 (New), A101.2 (New), A102 (New), AY103.1

Proponents: By determination of the ICC Board of Directors on appeals to the IECC heard 3/18/24

IRC Chapter 11 ENERGY R3

~~N1103.5.5~~NJ101.1 Demand responsive water heating. Electric storage water heaters with a rated water storage volume of 40 gallons (150L) to 120 gallons (450L) and a nameplate input rating equal to or less than 12kW shall be provided with demand responsive controls in accordance with Table ~~N1103.5~~NJ101.1.

Exceptions:

1. Water heaters that are capable of delivering water at a temperature of 180°F (82°C) or greater.
2. Water heaters that comply with Section IV, Part HLW or Section X of the ASME Boiler and Pressure Vessel Code.
3. Water heaters that use 3-phase electric power.

Revise as follows:

TABLE ~~N1103.5.5~~NJ101.1 DEMAND RESPONSIVE CONTROLS FOR WATER HEATING

Equipment Type	Controls		
	Manufactured Before 7/1/2025	Manufactured On or After 7/1/2025	
Electric storage water heaters	AHRI Standard 1430-2022 (I-P) or ANSI/CTA-2045-B Level 1 and also capable of initiating water heating to meet the temperature set point in response to a demand response signal.	AHRI Standard 1430-2022 (I-P)	

~~N1104.7~~NE101.2 Electric Vehicle Power Transfer Infrastructure. New residential automobile parking spaces for residential buildings shall be provided with electric vehicle power transfer infrastructure in accordance with Sections ~~N1104.7.1~~NE101.2.1 through ~~N1104.7.5~~ NE101.2.5.

~~N1104.7.1~~NE101.2.1 Quantity. New one- and two-family dwellings and townhouses with a designated attached or detached garage or other onsite private parking provided adjacent to the dwelling unit shall be provided with one EV-capable, EV-ready, or EVSE space per dwelling unit.

~~Exceptions:~~

1. Where the local electric distribution entity has certified in writing that it is not able to provide 100 percent of the necessary distribution capacity within 2 years after the estimated date of the certificate of occupancy. The required EV charging infrastructure shall be reduced based on the available existing electric distribution capacity.
2. Where substantiation has been approved that meeting the requirements of Section~~N1104.7.5~~ NE101.2.5 will alter the local utility infrastructure design requirements on the utility side of the meter so as to increase the utility side cost to the builder or developer by more than $450.00 per dwelling unit.

~~N1104.7.2~~NE101.2.2 EV Capable Spaces. Each EV capable space used to meet the requirements of Section~~N1104.7.1~~NE101.2.1 shall comply with all of the following:

1. A continuous raceway or cable assembly shall be installed between an enclosure or outlet located within 6 feet (1828 mm) of the EV capable space and a suitable panelboard or other onsite electrical distribution equipment.
2. Installed raceway or cable assembly shall be sized and rated to supply a minimum circuit capacity in accordance with Section ~~N1104.7.5~~ NE101.2.5.
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have sufficient dedicated space and spare electrical capacity for a 2-pole circuit breaker or set of fuses.
4. The electrical enclosure or outlet and the electrical distribution equipment directory shall be marked: "For future electric vehicle supply equipment (EVSE)."

Revise as follows:

~~N1104.7.3~~NE101.2.3 EV Ready Spaces. Each branch circuit serving EV ready spaces shall comply with all of the following:

1. Terminate at an outlet or enclosure, located within 6 feet (1828 mm) of each EV ready space it serves and marked "For electric vehicle supply equipment (EVSE)".
2. Be served by an electrical distribution system and circuit capacity in accordance with Section~~N1104.7.5~~ NE101.2.5.
3. Be designated on the panelboard or other electrical distribution equipment directory as "For electric vehicle supply equipment (EVSE)"

~~N1104.7.4~~NE101.2.4 EVSE spaces. An installed EVSE with multiple output connections shall be permitted to serve multiple EVSE spaces. Each EVSE serving either a single EVSE space or multiple EVSE spaces shall comply with the following:

1. Be served by an electrical distribution system in accordance with Section~~N1104.7.5~~ NE101.2.5.
2. Have a nameplate charging capacity of not less than 6.2 kVA (or 30A at 208/240V) per EVSE space served. Where an EVSE serves three or more EVSE spaces and is controlled by an energy management system in accordance with Section ~~N1104.7.5~~ NE101.2.5, the nameplate charging capacity shall be not less than 2.1 kVA per EVSE space served.
3. Be located within 6 feet (1828 mm) of each EVSE space it serves.
4. Be installed in accordance with NFPA 70 and be listed and labeled in accordance with UL 2202 or UL 2594.

~~N1104.7.5~~NE101.2.5 Electrical distribution system capacity. The branch circuits and electrical distribution system serving each EV capable space, EV ready space and EVSE space used to comply with Section ~~N1104.7.1~~NE101.2.1 shall with the following:

1. Sized for a calculated EV charging load of not less than 6.2 kVA per EVSE, EV ready, or EV capable space. Where a circuit is shared or managed it shall be in accordance with NFPA 70.
2. The capacity of the electrical distribution system and each branch circuit serving multiple EVSE spaces, EV ready spaces, or EV capable spaces designed to be controlled by an energy management system in accordance with NFPA 70, shall be sized for a calculated EV charging load of not less than 2.1 kVA per space. Where an energy management system is used to control EV charging loads for the purposes of this section, it shall not be configured to turn off electrical power to EVSE or EV ready spaces used to comply with Section ~~N1104.7.1~~ NE101.2.1.

~~N1104.6~~NL101.1 Renewable energy infrastructure. The building shall comply with the requirements of~~N1104.6.1~~NL101.1.1 or ~~N1104.6.2~~ NL101.1.2.

~~N1104.6.1~~NL101.1.1 One- and two- family dwellings and townhouses . One- and two-family dwellings and townhouses shall comply with Sections ~~N1104.6.1.1~~NL101.1.1.1 through ~~N1104.6.1.4~~NL101.1.1.4.

Exceptions:

1. A dwelling unit with a permanently installed on-site renewable energy system.

2. A dwelling unit with a solar-ready zone area that is less than 500 square feet (46 m^2) of roof area oriented between 110 degrees and 270 degrees of true north.
3. A dwelling unit with less than 500 square feet (46m^2) of roof area oriented between 110 degrees and 270 degrees of true north.
4. Dwelling units where 50 percent of the*solar-ready zone* area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the building for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.
5. A dwelling unit that complies with Appendix~~AX~~ NC.
6. A dwelling unit with a renewable energy power purchase agreement with a duration of not less than 15 years from a utility or a community renewable energy facility and for not less than 80 percent of the estimated *dwelling unit* electric use on an annual basis.
7. A dwelling unit with less than or equal to 1,500 square feet of living space located above grade plane.

~~N1104.6.1.1.1~~NL101.1.1.1 Solar-ready zone area. The total area of the solar-ready zone shall not be less than 250 square feet (23.2 m^2) and shall be composed of areas not less than 5.5 feet (1676 mm) in one direction and not less than 80 square feet (7.4 m^2) exclusive of access or set back areas as required by this code.

Exception: Dwelling units in townhouses three stories or less in height above grade plane and with a total floor area less than or equal to 2,000 square feet (186 m^2) per dwelling shall be permitted to have a solar-ready zone area of not less than 150 square feet (14 m^2).

~~N1104.6.1.1.2~~NL101.1.1.2 Obstructions. Solar-ready zones shall be free from obstructions, including but not limited to vents, chimneys and roof-mounted equipment.

~~N1104.6.1.3~~NL101.1.1.3 Electrical service reserved space. The main electrical service panel shall have a reserved space for a dual pole circuit breaker and shall be labeled "For Future Renewable Electric." The reserved space shall be at the opposite (load) end of the busbar from the primary energy source.

~~N1104.6.1.4~~NL101.1.1.4 Electrical interconnection. An electrical junction box shall be installed within 24 inches (610 mm) of the main electrical service panel and shall be connected to a capped roof penetration sleeve or a location in the attic that is within 3 feet (914 mm) of the solar-ready zone by a not less than 1 inch (25 mm) nonflexible metallic conduit or permanently installed wire as approved . Where the interconnection terminates in the attic, the location shall be not less than 12 inches (35 mm) above ceiling insulation. Both ends of the interconnection shall be labeled "For Future Renewable Electric".

~~N1104.6.2~~NL101.1.2 Group R occupancies. *Residential buildings* other than one- and two-family dwellings and townhouses shall comply with Sections ~~R404.6.2.1~~NL101.1.2.1 through ~~R404.6.2.8~~NL101.1.2.8 ~~of the *International Energy Conservation Code*~~ .

Add new text as follows:

NL101.1.2.1 General.. A solar-ready zone shall be located on the roof of residential buildings that are oriented between 110 degrees and 270 degrees of true north or have low slope roofs. Solar-ready zones shall comply with Sections NL101.1.2.2 through NL101.1.2.8.

Exceptions:

1. A building with a permanently installed on-site renewable energy system.
2. A building with a solar-ready zone area that is shaded for more than 70 percent of daylight hours annually.
3. A building where an approved party certifies that the incident solar radiation available to the building is not suitable for a solar-ready zone.
4. A building where an approved party certifies that the solar-ready zone area required by Section NL101.1.2.3 cannot be met because of rooftop equipment, skylights, vegetative roof areas or other obstructions.

5. A building that complies with Appendix NC.
6. A building with a renewable energy power purchase agreement with a duration of not less than 15 years from a utility or a community renewable energy facility and for not less than 80 percent of the estimated electric use of the residential occupancy portion of the building on an annual basis.

NL101.1.2.2 Construction document requirements for a solar-ready zone. Construction documents shall indicate the solar-ready zone.

NL101.1.2.3 Solar-ready zone area. The total solar-ready zone area shall be not less than 40 percent of the roof area calculated as the horizontally projected gross roof area less the area covered by penthouses, mechanical equipment, rooftop structures, 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 (1524 mm) in width in the narrowest dimension.

NL101.1.2.4 Obstructions. Solar-ready zones shall be free from obstructions, including pipes, vents, ducts, HVAC equipment, skylights and roof-mounted equipment.

NL101.1.2.5 Roof loads and documentation. A collateral dead load of not less than 5 pounds per square foot (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.

NL101.2.6 Interconnection pathway. Construction documents shall indicate pathways for routing of conduit or plumbing from the solar-ready zone to the electrical service panel or service hot water system.

NL101.1.2.7 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 and shall be labeled “For Future Renewable Electric.” The reserved spaces shall be positioned at the end of the panel that is opposite from the panel supply conductor connection.

NL101.1.2.8 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.

Revise as follows:

~~N1104.5~~NK101.1 Electric readiness. Water heaters, household clothes dryers, conventional cooking tops and conventional ovens that use fossil fuel shall comply with Sections ~~N1104.5.1~~NK101.1.1 through ~~N1104.5.4~~NK101.1.4.

~~N1104.5.1~~NK101.1.1 Cooking appliances. A branch circuit outlet with a rating not less than 240-volts, 40-amperes shall be installed, and terminate within three feet of conventional cooking tops, conventional ovens or cooking appliances combining both.

Exception: Cooking appliances not installed in an individual*dwelling unit*.

~~N1104.5.2~~NK101.1.2 Household Clothes Dryers. A branch circuit with a rating not less than 240-volts, 30-amperes shall be installed, and terminate within three feet (304 mm) of each household clothes dryer.

Exception: Clothes dryers not installed in an individual dwelling unit.

~~N1104.5.3~~NK101.1.3 Water heaters. A branch circuit with a rating not less than either 240-volts, 30-amperes or 120V, 20-amperes shall be installed and terminate within three feet (304 mm) of each water heater.

Exception: Water heaters serving multiple dwelling units in a R-2 occupancy.

Revise as follows:

~~N1104.5.4~~NK101.1.4 Electrification-ready circuits. The unused conductors required by Sections ~~N1104.5.1~~NK101.1.1 through ~~N1104.5.3~~

NK101.1.3 shall be labeled with the word "spare." Space shall be reserved in the electrical panel in which the branch circuit originates for the installation of an overcurrent device. Capacity for the circuits required by Sections ~~N1104.5.1~~NK101.1.1 through ~~N1104.5.3~~NK101.1.3 shall be included in the load calculations of the original installation.

TABLE N1105.2 REQUIREMENTS FOR SIMULATED BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
N1101.14	Certificate
Building Thermal Envelope	
N1102.1.1	Vapor retarder
N1102.2.3	Attic knee or pony wall
N1102.2.4	Eave baffle
N1102.2.5.1	Access hatches and doors
N1102.2.9	Basement walls
N1102.2.9.1	Basement wall insulation installation
N1102.2.10.1	Slab-on-grade floor insulation installation
N1102.2.11.1	Crawl space wall insulation installation
N1102.5.1.1	Installation
N1102.5.1.2	Air leakage testing
N1102.5.1.3	Maximum air leakage rate
N1102.5.2	Fireplaces
N1102.5.3	Fenestration air leakage
N1102.5.4	Rooms containing fuel burning appliances
N1102.5.5	Recessed lighting
N1102.5.6	Air Sealed electrical and communication outlet boxes
N1102.6	Maximum fenestration *U*-factor and SHGC
Mechanical	
N1103.1	Controls
N1103.2	Hot Water boiler temperature reset
N1103.3,	Duct systems
N1103.4	Mechanical system piping insulation
N1103.5	Service hot water systems
N1103.6	Mechanical ventilation
N1103.7, except Section N1103.7.1	Equipment sizing and efficiency rating
N1103.8	Systems serving multiple dwelling units
N1103.15	Snow melt and ice system controls
N1103.10	Energy consumption of pools and spas
N1103.11	Portable spas
N1103.12	Residential pools and permanent residential spas
N1103.14	Gas fireplaces
Electrical Power and Lighting Systems	
N1104.1	Lighting equipment
N1104.2	Interior lighting controls
~~N1104.5~~	~~Electric readiness~~
~~N1104.6~~	~~Renewable energy infrastructure~~
~~N1104.7~~	~~Electric vehicle power transfer infrastructure~~

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

TABLE N1106.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
N1101.14	Certificate
Building Thermal Envelope	
N1102.1.1	Vapor retarder
N1102.2.4	Eave baffle
N1102.2.5.1	Access hatches and doors
N1102.2.9	Basement walls
N1102.2.9.1	Basement wall insulation installation
N1102.2.10.1	Slab-on-grade floor insulation installation
N1102.2.11.1	Crawl space wall insulation installation
N1102.5.1.1	Installation
N1102.5.1.2	Air leakage testing
N1102.5.1.3	Maximum air leakage rate
N1102.5.2	Fireplaces

N1102.5.3	Fenestration air leakage
N1102.5.4	Rooms containing fuel burning appliances
N1102.5.5	Recessed lighting
N1102.5.6	Air sealed electrical and communication outlet boxes
N1106.3	*Building thermal envelope*
Mechanical	
N1103.1	Controls
N1103.2	Hot Water boiler temperature reset
N1103.3 except	Duct systems
N1103.4	Mechanical system piping insulation
N1103.5	Service hot water systems
N1103.6	Mechanical ventilation
N1103.7, except Section N1103.7.1	Equipment sizing and efficiency rating
N1103.8	Systems serving multiple dwelling units
N1103.15	Snow melt and ice system controls
N1103.10	Energy consumption of pools and spas
N1103.11	Portable spas
N1103.12	Residential pools and permanent residential spas
N1103.14	Gas fireplaces
Electrical Power and Lighting Systems	
N1104.1	Lighting equipment
N1104.2	Interior lighting controls
N1104.5	Electric readiness
N1104.6	Renewable energy infrastructure
N1104.7	Electric Vehicle power transfer infrastructure

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

Revise as follows:

~~APPENDIX~~RESOURCE A~~Y~~
ALL-ELECTIC RESIDENTIAL BUILDINGS

AY103
ALL-ELECTRIC RESIDENTIAL BUILDINGS

Revise as follows:

~~AY101.1~~A101.1 Intent. The intent of this resource is to amend the International Energy Conservation Code to reduce greenhouse gas emissions and improve the safety and health of buildings by not permitting combustion equipment in buildings.

Add new text as follows:

AY101.2A101.2 Scope. This resource applies to new residential buildings.

Revise as follows:

~~AY102~~A102 GENERAL DEFINITIONS. ALL-ELECTRIC BUILDING. A building that contains no combustion equipment, or plumbing for combustion equipment, installed within the building or building site.APPLIANCE. A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements.
COMBUSTION EQUIPMENT. Any equipment or appliance used for space heating, service water heating, cooking, clothes drying or lighting that uses fuel gas or liquid fuel.EQUIPMENT. Piping, ducts, vents, control devices and other components of systems other than appliances that are permanently installed and integrated to provide control of environmental conditions for buildings. This definition shall also include other systems specifically regulated in this code.

~~AY103.1~~A103.1 Application. Residential buildings shall be *all-electric buildings* and comply with ~~either~~ Sections ~~R401.2.1, R401.2.2, R401.2.3 or R401.2.4~~ N1101.13.1, N1101.13.2, N1101.13.3 or N1101.13.4.

Reason: This is the result of the IECC/IRC Chapter 11 appeals based on the determination of the ICC Board of Directors

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.N/A

Cost Impact (Detailed): The change proposal is editorial in nature or a clarification and has no cost impact on the cost of construction

Justification:

N/A

Public Hearing Results (CAH1)

Committee Action (CAH1) **As Submitted**

Final Hearing Results

IRCEAPP-01-24	AS

IRCED1-7-22

Original Proposal

IRCECC: N1102.5.1.2

Proponents: Theresa Weston, The Holt Weston Consultancy, ABAA (Air Barrier Association of America) (holtweston88@gmail.com)

2024 ENERGY Chapter11

Revise as follows:

N1102.5.1.2 Testing and maximum air leakage rate. The *building* or each *dwelling unit* in the building shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 4.0 air changes per hour or 0.22 cfm/ft^2 (1.1 L/s x m^2) of building or dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, ASTM E1827 or ASTM E3158 and reported at a pressure differential of 0.2 inch water gauge (50 Pa). Where required by the *code official*, testing shall be conducted by an*approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the*building thermal envelope* have been sealed.

Exceptions:

1. When testing individual dwelling units, an air leakage rate not exceeding 0.27 cubic feet per minute per square foot [1.35 L/s x m^2] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch water gauge (50 Pa), shall be permitted in all climate zones for:

   1.1 Attached single and multiple family building dwelling units.

   1.2 Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.

2. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table N1102.5.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other conditioned spaces in accordance with Sections N1102.2.13 and N1102.4.5, as applicable.

3. ~~Where tested in accordance with N1102.5.1.2, testing of each dwelling unit is not required~~.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Mechanical *ventilation* shall be provided in accordance with Section M1505 of this code or Section 403.3.2 of the*International Mechanical Code*, as applicable, or with other*approved* means of *ventilation*.

Reason: This proposal removes the 3rd exception which is confusing and has a circular logic. This exception is applies when following the the section to which it is an exception. It is removed to improve the clarity of the section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal removes confusing and circular language and will not effect the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal removes left over language from another proposal that does not makes sense.

Final Hearing Results

IRCED1-7-22	AS

IRCED1-8-22

Original Proposal

IECC: ASTM Chapter 06; IRCECC: TABLE N1108.2.1.3

Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

ASTM

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

C1549-~~20~~16(2022)	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
E903-20~~2012~~	Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres~~ (Withdrawn 2005)~~
E1918-21~~06(2016)~~	Standard Test Method for Measuring Solar Reflectance of Horizontal or Low-sloped Surfaces in the Field
E1980-11(2019)	Standard Practice for Calculating Solar Reflectance of Horizontal and Low-sloped Opaque Surfaces

2024 ENERGY Chapter11

Revise as follows:

TABLE N1108.2.1.3 MINIMUM ROOF REFLECTANCE[a]

ROOF SLOPE	THREE-YEAR AGED SOLAR REFLECTANCE INDEX[b]
Low-slope	75[b,c]
Steep-slope	16

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for solar reflectance shall be assigned a 3-year aged solar reflectance in accordance with Section N1108.2.1.3.1.

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × ft^2 × °F (12 W/m^2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance. ~~Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100~~.

Reason: This comment is primarily intended to update radiative property referenced standards C1549, E903, E1918, and E1980 to active editions and correct titles for the IECC residential provisions and the IRC. However, while preparing this comment, it became apparent that an error may have occurred while creating the 1st Public Comment Drafts for the IECC residential and IRC Chapter 11, because the third footnote of Table N1108.2.1.3 does not match Table R408.2.1.3. Therefore, the third footnote of Table N1108.2.1.3 is modified to match Table R408.2.1.3, which brings in ASTM E1980 as a required reference standard for the IRC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Update of referenced standards editions and correction of a discrepancy between the IECC and IRC Chapter 11 should have no impact on cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal updates and corrects references and footnotes.

Final Hearing Results

IRCED1-8-22	AS

IRCED1-10-22

Original Proposal

IRCECC: N1103.2

Proponents: Robert O'Brien, NORA, NORA (robrien@noraweb.org)

2024 ENERGY Chapter11

Revise as follows:

N1103.2 Hot water boiler outdoor temperature reset. The manufacturer shall equip each gas, liquid fuel ~~oil~~, and electric boiler (other than a boiler equipped with a tankless domestic water heating coil) with automatic means of adjusting the water temperature supplied by the boiler to ensure incremental change of the inferred heat load will cause an incremental change in the temperature of the water supplied by the boiler. This can be accomplished with outdoor reset, indoor reset or water temperature sensing.

Reason: This change more accurately reflects the liquid fuels in common use for heating and domestic hot water production. Most heating oil already contains 5% renewable liquid fuel (B5) and to comply with state mandates as well as industry goals, liquid fuel equipment manufacturers have rated their products for use with B20 (20% renewable) and are working rapidly to obtain listings for operation with B100. This will provide a pathway to rapid decarbonization

The Inflation Reduction Act of 2022 (IRA) provides a tax credit for Energy Star rated liquid fuel appliances that are rated for B20 in 2023-2026 transitioning to a minimum of 90% AFUE and B50 compatible in 2027-2032

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change will have no impact on the cost of construction

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: per proponents reason statement

Final Hearing Results

IRCED1-10-22	AS

IRCEPI-1-21

Original Proposal

IRC: N1102.2.6, TABLE N1102.2.6, Chapter 44 (New)

Proponents: Jonathan Humble, American Iron and Steel Institute (Jhumble@steel.org)

THIS PROPOSAL WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Residential Code

Revise as follows:

N1102.2.6 Steel-frame ceilings, walls, and floors. Steel-frame ceilings, walls, and floors shall comply with the~~insulation requirements of Table N1102.2.6 or the~~ *U*-factor requirements of Table N1102.1.2. The calculation of the *U*-factor for steel-framed ceilings and walls in an envelope assembly shall ~~use a series-parallel path calculation method~~ be determined in accordance with AISI S250 as modified herein.

1. Where the steel-framed wall contains no cavity insulation, and uses continuous insulation to satisfy the*U*-factor maximum, the *steel-framed wall* member spacing is permitted to be installed at any on-center spacing.
2. Where the steel-framed wall contains framing spaced at 24 inches (610 mm) on center with a 23% framing factor or framing spaced at 16 inches (400 mm) on-center with a 25% framing factor, the lower framing member spacing input values shall be used when calculating using AISI S250.
3. Where the steel-framed wall contains less than 23% framing factors the AISI S250 shall be used without any modifications.
4. Where the steel-framed wall contains other than standard C-shape framing members the AISI S250 calculation option for other than standard C-shape framing is permitted to be used.

~~TABLE N1102.2.6 STEEL-FRAME CEILING, WALL AND FLOOR INSULATION R-VALUES~~

WOOD FRAME *R*-VALUE REQUIREMENT	COLD-FORMED STEEL-FRAME EQUIVALENT*R*-VALUE[a]
Steel Truss Ceilings[b]	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings[b]	
R-30	R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing
R-38	R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10
Steel-frame Wall, 16 inches on center	
R-13	R-13 + 4.2 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1
R-13 + 5	R-0 + 15 or R-13 + 9 or R-15 + 8.5 or R-19 + 8 or R-21 + 7
R-13 + 10	R-0 + 20 or R-13 + 15 or R-15 + 14 or R-19 + 13 or R-21 + 13
R-20	R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-21 + 7.5
R-20 + 5	R-13 + 12.7 or R-15 + 12.3 or R-19 + 11.6 or R-21 + 11.3 or R-25 + 10.9
R-21	R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7
Steel-frame Wall, 24 inches on center	
R-13	R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4
R-13 + 5	R-0 + 15 or R-13 + 7.5 or R-15 + 7 or R-19 + 6 or R-21 + 6
R-13 + 10	R-0 + 20 or R-13 + 13 or R-15 + 12 or R-19 + 11 or R-21 + 11
R-20	R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9
R-20 + 5	R-13 + 11.5 or R-15 + 10.9 or R-19 + 10.1 or R-21 + 9.7 or R-25 + 9.1
R-21	R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9
Steel Joist Floor	
R-13	R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10
R-19	R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10

For SI: 1 inch = 25.4 mm.

a. ~~The first value is cavity insulation *R*-value; the second value is continuous insulation *R*-value. Therefore, for example, "R-30 + 3" means R-30 cavity insulation plus R-3 continuous insulation.~~

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

Add new text as follows:

Chapter 44 Referenced Standards. AISI American Iron and Steel Institute25 Massachusetts Avenue, NW, Suite 800Washington, DC 20001AISI S250-21North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing

Reason: The purpose of this proposal is to address the issue of having to submit to the code official a request to use the alternative means and methods provisions for cold-formed steel framing designs that are not shown in the IECC. For example, Section C402.1.4.2 addresses only wall framing spacing for 16 and 24 inch on center spacing and is limited to cavity plus continuous insulation options only, whereas, in the market there are many more framing spacing and insulation options used.

This proposal recommends that the Section be modified to recognize the ANSI/AISI/COFS S250 standard. This standard covers cold-formed steel wall framing spacings from 6 inches to 24 inches on center, covers member sizes from 3.5 inches to 12 inches wide, and covers member thicknesses from 0.033 inches thick to 0.064 inches thick. This standard will provide greater latitude for the user of the IECC by mitigating the necessity of having to submit for approval under alternate means and methods provisions. Further, this standard also includes provisions for evaluation of wall assemblies where all the insulation is located outside the wall cavity, which is an option the IECC does not cover.

This standard also contains provisions for calculating ceiling assemblies constructed of cold-formed steel framing with either conventional c-shape framing members, or truss construction with insulation in the attic and with additional continuous insulation below the truss framing. Previous to this proposal we found users applying the 2003 IECC provisions, which contained the calculation procedures, as part of the alternative means and methods submission process to demonstrate compliance. This proposal is intended to mitigate that additional step.

The ANSI/AISI/COFS S250 was approved and published in September 2021.

As part of AISI's effort to make this document user friendly, an excel spread sheet containing all the necessary equations and back-ground data was generated so that users would merely input the basic assembly materials data (e.g. R-values of insulations, sheathings, etc.) and allow the spread sheet to calculate within seconds the result. This excel spread sheet is available at no cost to any potential user (e.g. code official, design professional, building owner, etc.)

The proponent wishes to schedule time to present to the IECC Residential Committee this proposal, discuss, and to take questions from the Committee.

Bibliography: AISI, "Development of a U-factor Calculation Procedure for Cold-Formed Steel C-Shaped Clear Wall Assemblies," American Iron and Steel Institute, Washington, DC, Research Report RP20-2, April 2020.

AISI, "North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing," American Iron and Steel Institute, Washington, DC, AISI S250-21.

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

This proposed change we expect will decease the cost of construction by eliminating the need to prepare an application to the alternative means and methods process. This is because of the standards wider range of envelope assembly options that the user is permitted to calculate in order to demonstrate compliance

Public Hearing Results

Committee Action **As Modified**

Committee Reason: provides clear and accurate way of determining wall and ceiling assemblies for closed form steel.

Final Hearing Results

IRCEPI-1-21 AM

IRCEPI-3-21

Original Proposal

IRC: SECTION 202 (New)

Proponents: David Bixby, ACCA, ACCA (david.bixby@acca.org)

THIS PROPOSAL WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Residential Code

Add new definition as follows:

DUCT AIRFLOW BALANCING.

The measurement and adjustment of the delivered airflow to the intended locations.

Reason: A definition for "Duct Airflow Balancing" is proposed to support terminology used in ACCA's proposed exception to**N1103.3.6 (R403.3.6) Duct leakage., 3. Test for ducts within thermal envelope.** Airflow balance procedures document the volume of air returned through the duct system and supplied to the dwelling. This information can be used to ascertain the duct system leakage, thereby accomplishing the same intended purpose. Additionally, airflow balancing directly impacts the delivery of the correct volume of air to a given space. This is drastically better than leak testing ducts as it can only measure the duct's leakage rate. Based on substantiation for the requirement to test ducts within the thermal envelope, airflow balancing will reduce energy costs by increasing the HVAC system's efficiency. A reference to ANSI/ACCA Standard 5 QI is added as it contains an airflow balancing procedure.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed definition does not increase or decrease the cost of construction as it merely supports a term used in another proposal.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Based on reason statement

Final Hearing Results

IRCEPI-3-21	AM

IRCEPI-4-21

Original Proposal

IRC: N1103.3.6, N1108.2.4
Proponents: David Bixby, ACCA, ACCA (david.bixby@acca.org)

THIS PROPOSAL WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Residential Code

Revise as follows:

N1103.3.6 (R403.3.6) Duct leakage. The total leakage of the ducts, where measured in accordance with Section N1103.3.5, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 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 3.0 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 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.
3. Test for ducts within thermal envelope: Where all ducts and air handlers are located entirely within the *building thermal envelope*, total leakage shall be less than or equal to 8.0 cubic feet per minute (226.6 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area*.

   <u>**Exception:** Duct systems designed so the individual room airflow shall be within the greater of ± 20%, or 25 CFM of the design/application requirements for the supply and return ducts. This shall be demonstrated by using a *duct airflow balancing* procedure as specified by ANSI/ACCA 5 QI or by other approved methods.</u>

N1108.2.4 (R408.2.4) More efficient duct thermal distribution system option. The thermal distribution system shall meet one of the following efficiencies:

1. 100 percent of ducts and air handlers located entirely within the *building thermal envelope*.
2. 100 percent of ductless thermal distribution system or hydronic thermal distribution system located completely inside the *building thermal envelope*.
3. 100 percent of duct thermal distribution system located in *conditioned space* as defined by Section N1103.3.2.
4. <u>Duct systems designed so the individual room airflow shall be within ±20% of the design/application requirements for the supply and return ducts. This shall be demonstrated by using a duct airflow balancing procedure as specified by ANSI/ACCA 5 QI or by other approved methods.</u>

Reason: An exception is proposed for leak testing ducts located within the thermal envelope. Airflow balance procedures document the volume of air returned through the duct system and supplied to the dwelling. This information can be used to ascertain the duct system leakage, thereby accomplishing the same intended purpose. Additionally, airflow balancing directly impacts the delivery of the correct volume of air to a given space. This is drastically better than leak testing ducts as it can only measure the duct's leakage rate. Based on substantiation for the requirement to test ducts within the thermal envelope, airflow balancing will reduce energy costs by increasing the HVAC system's efficiency. A reference to ANSI/ACCA Standard 5 QI is added as it contains an airflow balancing procedure. In addition, a definition is proposed for "duct airflow balancing."

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal will not affect cost of construction as the current code requirement involves the cost to leak test ducts. The cost to perform a duct airflow balance test would amount to about the same cost for leak testing ducts, it would just utilize different types of equipment.

Staff Note: ANSI/ACCA 5 QI -2010 HVAC Quality Installation Specification is included as part of the code change proposal. The code change proposal will be updated by staff with the changes in the reference standard chapter of the IECC-R and IRC when the applicable cdpACCESS update is provided.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Based on reason statement

Final Hearing Results

IRCEPI-4-21	AM

IRCEPI-6-21

Original Proposal

IRC: N1103.3, N1103.3.1 (R403.3.1) (New)

Proponents: David Bixby, ACCA, ACCA (david.bixby@acca.org)

THIS PROPOSAL WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Residential Code

Revise as follows:

N1103.3 (R403.3) Ducts. Duct Supply and Duct Return shall be designed and sized in accordance with M1601.1 of the International Residential Code or Section 603.2 of the International Mechanical Code, as applicable. Ducts and air handlers shall be installed in accordance with Sections N1103.3.1 through N1103.3.7.

Add new text as follows:

N1103.3.1 (R403.3.1) Design and sizing. *Duct systems* shall be designed and sized in accordance with ANSI/ACCA Manual D.

Reason: Section N1103.7 (R403.7) in Chapter 11 specifies that heating and cooling equipment must be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J. However, Chapter 11 does not reference ACCA Manual D procedures for sizing residential duct systems. Manual D uses ACCA Manual J heating and cooling loads to determine space air delivery requirements, and matches duct system resistance (pressure drop) to blower performance (as defined by manufacture's blower performance tables). This assures that appropriate airflow is delivered to all rooms and spaces; and that system airflow is compatible with the operating range of primary equipment. It is widely understood that duct leakage and return path restrictions affect the efficiency of the duct system, the performance of the building envelope, the efficiency and effectiveness of the HVAC equipment, the capacity of the exhaust equipment, and the power of the vents for fuel burning components. In most cases these effects are interactive. For this reason, Manual D belongs in Chapter 11. The proposal references M1601.1 which is reproduced below.

[M1601.1 Duct design. *Duct systems* serving heating, cooling and *ventilation equipment* shall be installed in accordance with the provisions of this section and ACCA *Manual D*, the *appliance* manufacturer's installation instructions or other *approved* methods.**]**

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The reference to Manual D is already a mandatory requirement in the mechanical section of the IRC. Therefore, the addition of this reference to Chapter 11 will not affect the cost of construction.

Public Hearing Results

Committee Action	**As Modified**

Committee Reason: Based on reason statement

Final Hearing Results

IRCEPI-6-21	AM

IRCEPI-7-21

Original Proposal

IRC: N1103.3.2

Proponents: Craig Conner, Building Quality, self (craig.conner@mac.com); Joseph Lstiburek, Building Science Corporation (joe@buildingscience.com)

THIS PROPOSAL WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Residential Code

Revise as follows:

N1103.3.2 Ducts located in conditioned space. For ductwork to be considered inside a *conditioned space*, it shall comply with one of the following:

1. The duct system is located completely within the *continuous air barrier* and within the *building thermal envelope.*
2. Ductwork in ventilated attic spaces or unvented attic with vapor diffusion port is buried within ceiling insulation in accordance with Section N1103.3.3 and all of the following conditions exist:
   2.1. The air handler is located completely within the *continuous air barrier* and within the *building thermal envelope*.

   2.2. The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the *building thermal envelope* in accordance with Section N1103.3.6, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area* served by the duct system.

   2.3. The ceiling insulation *R*-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the duct.
3. Ductwork in floor cavities located over unconditioned space shall have the following:
   3.1. A *continuous air barrier* installed between unconditioned space and the duct.

   3.2. Insulation installed in accordance with Section N1102.2.7.

   3.3. A minimum R-19 insulation installed in the cavity width separating the duct from unconditioned space.
4. Ductwork located within *exterior walls* of the *building thermal envelope* shall have the following:
   4.1. A *continuous air barrier* installed between unconditioned space and the duct.

   4.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing.

   4.3. The remainder of the cavity insulation fully insulated to the drywall side.

Reason: Research done by the Department of Energy through the Building America Program shows that sealed attics with vapor diffusion ports significantly reduce the risk of condensation on ductwork. The existing IRC language allows sealed attics with vapor diffusion ports. This language makes it clear that the buried duct language for vented attics also applies to sealed attics with vapor diffusion ports.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This adds an option but not necessarily a cost.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: To align with REPI-79-21 the recommendation would be to approve as modified by changing the term “sealed” to “unvented”.

Final Hearing Results	
IRCEPI-7-21	AM

RE2D-2-23

Original Proposal

IECC RE: R110.4

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R110.4 Administration. The *code official* shall take action ~~without delay~~ in accordance with the decision of the board.

Reason: This change will correlate the provisions of the IECC-R with the IECC-C, which cays this: *"C110.4 Administration The code official shall take action in accordance with the decisions of the board."*

There is no reason for 'without delay.' The code official will act as necessary to comply with the intent of the appeals board; any other conclusion is misinformed about how a building department works.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is an administrative provision with no direct financial implications.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Removes unnecessary language.

Final Hearing Results

RE2D-2-23	AS

RE2D-3-23

Original Proposal

IECC RE: SECTION 202

Proponents: Emily Lorenz, self, International Institute of Building Enclosure Consultants (emilyblorenz@gmail.com)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

EMITTANCE. The ratio of the radiant heat flux emitted by a specimen measured on a scale from 0 to 1, where a value of 1 indicates perfect release of thermal radiation~~emission~~.

Reason: When changing the definition of "emittance" during the last round of public comments, potential confusion was introduced. The word "emission" is frequently used to describe pollutants. However, in this case, we are referring to the property of a material that is related to the release of thermal radiation (or heat). The edit included in this code change proposal corrects the definition for technical accuracy related to the property of "emittance."

Bibliography: U.S. Environmental Protection Agency. 2008. "Reducing urban heat islands: Compendium of strategies." Draft. https://www.epa.gov/heat-islands/heat-island-compendium. (see Section 2.2, Properties of Urban Materials)

VanGeem, M. G., and A. E. Fiorato. 1983. "Thermal Properties of Masonry Materials for Passive Solar Design – A State-of-the-Art Review." U.S. Department of Energy Report No. DOE/CE/30739. Also PCA R&D Serial No. 0888, Portland Cement Association. http://www.vangeemconsulting.com/SN_888_Thermal_Properties_of_Masonry_Materials_VanGeem_Fiorato.pdf

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This CCP only clarifies a definition; it does not change any requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Language removes confusion where “emission” can be mistaken for pollutants, rather than thermal radiation.

Final Hearing Results

RE2D-3-23 AS

RE2D-6-23

Original Proposal

IECC RE: SECTION 202

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

ALTERATION.
<u>Any construction, retrofit or renovation to an existing structure other than *repair* or *addition* . Also, a change in a building, electrical, gas, mechanical or plumbing system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.</u>
~~construction or renovation to an *existing structure* other than a *repair* or *addition*.~~

REPAIR. The reconstruction~~, replacement~~ or renewal of any part of an existing *building* for the purpose of its maintenance or to correct damage.

Reason: This proposal is errata (the underlining and strike-out restores the existing code language). Changes to the “alteration” and “repair” definitions as shown in the legislative draft and cdpACCESS were actually removed from the original RED1-264 proposal in its final amended version that the committee approved (as also recommended by the subcommittee from its deliberation on these definitions and their application in Chapter 5). This was the subject of considerable discussion at subcommittee level and changes to these definitions were not made because it creates conflicts in how these terms are coordinated with provisions in Chapter 5. For example, certain alteration requirements in Chapter 5 specifically include or address replacements. If replacements are broadly defined as a “repair” then the definitions will conflict with the provisions and cause confusion in compliance and enforcement. These definitions were purposefully designed for the IECC Chapter 5 to be different than those used in the IEBC which does not include energy efficiency provisions for existing buildings with nuances that require specifically tailored definitions for IECC Chapter 5 application. So, there are both procedural and technical reasons for restoring these definitions to their original form.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is errata so there is no cost impact. Making this correction will tend to decrease cost of enforcement and compliance simply by ensuring the definitions are restored and are not in conflict with provisions in Chapter 5 of the IECC.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This corrects the published RE-PCD2 as this committee originally approved this change with RED1-264-22 AM.

Final Hearing Results

RE2D-6-23	AS

RE2D-8-23

Original Proposal

IECC RE: SECTION 202

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

SUBSTANTIAL IMPROVEMENT. Any *repair*, reconstruction, rehabilitation, *alteration*, *addition* or other improvement of a *building* or structure, the cost of which equals or is more than 50 percent of the market value of the structure before the improvement. Where the structure has sustained substantial damage, as defined in the *International Building Code*, any repairs are considered *substantial improvement* regardless of the actual *repair* work performed. *Substantial improvement* does not include the following:

1. Improvement of a *building* ordered by the *code official* ~~required~~ to correct health, sanitary or safety code violations ~~ordered by the *code official*~~.
2. *Alteration* of a historic *building* where the *alteration* will not affect the designation as a historic *building*.

Reason: The definition of substantial improvement is substantially improved in terms of clarity.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal adds clarity to the Code because the current language linguistically states that the Code Official is ordering violations – which is not the case; so, the Proposal corrects language in the Code and clarifies the intent of the Code.

Final Hearing Results

RE2D-8-23	AS

RE2D-10-23

Original Proposal

IECC RE: R402.1

Proponents: Alisa McMahon, None, self (mcmahon.gbac@cox.net)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R402.1 General. The *building thermal envelope* shall comply with the requirements of one of the following:

1. Sections R402.1.1 through R402.1.4 and R402.1.6, or
2. Sections R402.1.1, ~~and~~ R402.1.5 , and R402.1.6

Exceptions:

1. The following low-energy *buildings*, or portions thereof, separated from the remainder of the building by*building thermal envelope* assemblies complying with this section shall be exempt from the*building thermal envelope* provisions of Section R402.
   1.1. Those with a peak design rate of energy usage less than 3.4 Btu/h × f^2t (10.7 W/m^2) or 1.0 watt/ft^2 of floor area for space-conditioning purposes.
   1.2. Those that do not contain *conditioned space*.
2. Log homes designed in accordance with ICC 400.

Reason: In the last round, R402.5.4 was relocated to R402.1.6, but the change was not reflected in R402.1.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Adds missing references.

Final Hearing Results

RE2D-10-23 AS

RE2D-20-23

Original Proposal

IECC RE: R404.7.1, R404.7.2, R404.7.5, R404.7.6
Proponents: Alisa McMahon, None, self (mcmahon.gbac@cox.net)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R404.7.1 Quantity. New one- and two-family dwellings and townhouses with a designated attached or detached garage or other onsite private parking provided adjacent to the *dwelling unit* shall be provided with one *EV-capable*, *EV-ready*, or *EVSE* space per *dwelling unit*. R-2 occupancies or allocated parking for R-2 occupancies in mixed-use buildings shall be provided with an *EV capable space*, *EV ready space*, or *EVSE space* for 40 percent of ~~each~~ *dwelling units* or *automobile parking spaces*, whichever is less.

Exceptions:

1. Where the local electric distribution entity ~~has certified~~ <u>certifies</u> in writing that it is not able to provide 100 percent of the necessary distribution capacity within 2 years after the estimated ~~date of the~~ certificate of occupancy <u>date</u>. The required EV charging infrastructure shall be reduced based on the available existing electric distribution capacity.
2. Where substantiation ~~has been~~ <u>is</u> *approved* that meeting the requirements of Section R404.7.5 will alter the local utility infrastructure design requirements on the utility side of the meter so as to increase the utility side cost to the builder or developer by more than $450.00 per *dwelling unit*.

R404.7.2 EV Capable Spaces. Each *EV capable space* used to meet the requirements of Section R404.7.1 shall comply with all of the following:

1. A continuous raceway or cable assembly shall be installed between ~~an enclosure or outlet located within 6 feet (1828mm) of the *EV capable space* and~~ a suitable panelboard or other onsite electrical distribution equipment <u>and an enclosure or outlet located within 6 feet (1828mm) of the *EV capable space*</u>.
2. Installed raceway or cable assembly shall be sized and rated to supply a minimum circuit capacity in accordance with Section R404.7.5.
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have sufficient dedicated space and spare electrical capacity for a 2-pole circuit breaker or set of fuses.
4. The electrical enclosure or outlet and the electrical distribution equipment directory shall be marked: "For future electric vehicle supply equipment (EVSE)."

R404.7.5 Electrical distribution system capacity. The branch circuits and electrical distribution system serving *each EV capable space, EV ready space* and *EVSE space* used to comply with Section R404.7.1 <u>shall</u> comply with one of the following:

1. Sized for a calculated EV charging load of not less than 6.2 kVA per *EVSE, EV ready,* or *EV capable space*. Where a circuit is shared or managed<u>,</u> it shall be in accordance with NFPA 70.
2. The capacity of the electrical distribution system and each branch circuit serving multiple *EVSE spaces, EV ready spaces*, or *EV capable spaces* designed to be controlled by an energy management system in accordance with NFPA 70 shall be sized for a calculated EV charging load of not less than 2.1 kVA per space. Where an energy management system is used to control EV charging loads for the purposes of this section, it shall not be configured to turn off electrical power to *EVSE* or *EV ready spaces* used to comply with Section R404.7.1.

Delete without substitution:

~~**R404.7.6 EVSE installation.** For one- and two-family dwellings and townhouses, EVSE shall be installed in accordance with NFPA 70 and shall be listed and labeled in accordance with UL 2202 or UL 2594. For R-2 occupancies, EVSE shall be installed in accordance with NFPA 70 and Section R404.7.5.1 and shall be listed and labeled in accordance with UL 2202 and UL 2594.~~

Reason: Any certification from a local electric distribution entity should be current, not from the past.

In R404.7.6:

- Should the reference to Section R404.7.5.1 be R404.7.5?
- Does R404.7.5 apply to one- and two-family dwellings and townhouses as well?

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Removes duplicate language. Modification to remove section R404.7.6 as reference is covered in R404.7.4.

Final Hearing Results

RE2D-20-23 AM

RE2D-21-23

Original Proposal

IECC RE: R404.7.6

Proponents: Daniel Carroll, New York State, Department of State (daniel.carroll@dos.ny.gov); Hendrik Shank, NYS Dept. of State, NYS Dept. of State (hendrikus.shank@dos.ny.gov)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R404.7.6 EVSE installation. ~~For one- and two-family dwellings and townhouses~~,EVSE shall be installed in accordance with NFPA 70 and shall be listed and labeled in accordance with UL 2202 or UL 2594. ~~For R-2 occupancies, EVSE shall be installed in accordance with NFPA 70 and Section R404.7.5.1 and shall be listed and labeled in accordance with UL 2202 and UL 2594.~~

Reason: The reference to Section R404.7.5.1 for R-2 occupancies is wrong. That section does not exist. I believe it was meant to be R404.7.6.1 which required a minimum charging rate and is proposed to be deleted. If Section R404.7.6.1 is deleted, then there is no need for the extra language in Section R404.7.6. There will be no difference in the requirements for one- and two-family dwellings and townhouses and the requirements for R-2 buildings.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial Change

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Removes incorrect reference. This section is to be removed based on action in RE2D-20-23.

Final Hearing Results

RE2D-21-23	AS

RE2D-24-23

Original Proposal

IECC RE: R405.2
Proponents: Steven Rosenstock, Edison Electric Institute, Edison Electric Institute (srosenstock@eei.org)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R405.2 Simulated building performance compliance. Compliance based on simulated building performance requires that a*building* comply with the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total *building thermal envelope* thermal conductance TC shall be less than or equal to the*building thermal envelope* thermal conductance TC using the prescriptive U-factors and F-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and 1.15 in Climate Zones 3 through 8 in accordance with Equation 4-2 and Section R402.1.5. The area-weighted maximum *fenestration* SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

$$\text{For Climate Zones 0-2:}\underline{TC}\cancel{UA}_{\text{Proposed design}} \leq 1.08 \times \underline{TC}\cancel{UA}_{\text{Prescriptive reference design}}$$
$$\text{For Climate Zones 3-8:}\underline{TC}\cancel{UA}_{\text{Proposed design}} \leq 1.15 \times \underline{TC}\cancel{UA}_{\text{Prescriptive reference design}}$$

3. For each *dwelling unit* with one or more fuel burning appliances for space heating, or water heating, or both, the annual*energy cost* of the *dwelling unit* shall be less than or equal to 80 percent of the annual*energy cost* of the *standard reference design*. For all other *dwelling units*, the annual *energy cost* of the *proposed design* shall be less than or equal to 85 percent of the annual *energy cost* of the *standard reference design*. For each dwelling unit with greater than 5,000 square feet (465 m^2) of *living space* located above *grade plane*, the annual *energy cost* of the *dwelling unit* shall be reduced by an additional 5 percent of annual *energy cost* of the standard reference design. Energy prices shall be taken from an*approved* source , such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in *energy cost* calculations.

   Exceptions:

   1. The energy use based on source energy expressed in Btu or Btu per square foot of*conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 2.51. The source energy ~~multiplier for fuels other than electricity~~ multipliers shall be 1.09 for natural gas, 1.15 for propane, 1.19 for fuel oil, and 1.30 for imported liquified natural gas.
   2. The energy use based on site energy expressed in Btu or Btu per square foot of*conditioned floor area* shall be permitted to be substituted for the energy cost.

Reason: Based on the information provided in ASHRAE Standards 105, 189.1, and 240P, different fossil fuels have significantly different source energy factors.

This proposed change updates the language to be consistent with the estimates in other published standards.

Bibliography: ASHRAE Standard 105-2021

ASHRAE Standard 189.1-2020 and addenda

ASHRAE 240P Advisory Public Review April 2023

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This only updates the estimated source energy factors and does not affect the cost of construction.

Public Hearing Results

Committee Action	**As Modified**

Committee Reason: clarifying appropriate default factors for fuel types other than electricity.

Final Hearing Results

RE2D-24-23	AM

RE2D-25-23

Original Proposal

IECC RE: R405.3
Proponents: Alisa McMahon, None, self (mcmahon.gbac@cox.net)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R405.3 Compliance documentation. The following compliance reports, which document that the performance of the *proposed design* and the performance of the as-built *dwelling unit* comply ~~complies~~ with the requirements of Section R405, shall be submitted to the*code official*.

1. A compliance report, in accordance with Section R405.5.4.1, shall be submitted with the application for the*building* permit.
2. ~~Upon completion of the *building*, a confirmed~~ A compliance report, in accordance with Section R405.5.4.2 ~~, based on the confirmed condition of the *building*~~ shall be submitted ~~to the *code official*~~ before a certificate of occupancy is issued.

Reason: This section was created in the last round. The first sentence speaks only to the proposed design; it does not include the other half of the compliance documentation.

The proposed change makes clear that compliance reports apply toboth the proposed design and the as-built dwelling unit (or as-built building, if preferred).

The language is consistent with the language approved in RED1-249 for R405.3.2. (In the reconciliation between RED1-249 and RECD1-8, R405.3.2 was deleted.)

The changes made to (2) are not technical. But perhaps they can be considered with the other. They make (1) and (2) parallel and remove excess words. For example, "submitted to the code official" is in the first sentence.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: support editorial updates

Final Hearing Results

RE2D-25-23	AM

RE2D-26-23

Original Proposal

IECC RE: R405.4.2

Proponents: Vladimir Kochkin, NAHB, NAHB (vkochkin@nahb.org)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R405.4.2 Residence specifications. The *standard reference design, proposed design, and as-built dwelling unit* shall be configured and analyzed as specified by Table R405.4.2(1). Table R405.4.2(1) shall include, by reference, all notes contained in Table R402.1.2. Proposed *U*-factors and slab-on-grade *F*-factors shall be taken from Appendix RF, ANSI/ASHRAE/IES Standard 90.1 Appendix A, or determined using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials.

Reason: This modification adds IECC Appendix RF to the list of compliance options.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Clarification of intent.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: support editorial modifications

Final Hearing Results

RE2D-26-23	AM

RE2D-28-23

Original Proposal

IECC RE: R405.5.2
Proponents: Shane Hoeper, SEHPCAC, SEHPCAC

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R405.5.2 Testing required by software vendors. Prior to approval, software tools shall be tested by the software vendor in accordance with ANSI/ASHRAE Standard 140 Class II, Tier 1 test procedures. During testing, hidden inputs that are not normally ~~accessible~~ available to the user shall be permitted to avoid introducing source code changes strictly used for testing. Software vendors shall publish, on a publicly available website, the following ANSI/ASHRAE Standard 140 test results, input files, and modeler reports for each tested version of a software tool:

1. Test results demonstrating the software tool was tested in accordance with ANSI/ASHRAE Standard 140.
2. The modeler report in ANSI/ASHRAE Standard 140, Annex A2, Attachment A2.7.

Reason: Because the term ‘accessible’ is most commonly understood as requiring access for persons with disabilities we are making the changes to delete the word accessible from the remaining codes and replace it with other words, defined terms or phrases that are not attributed to requiring access for the physically disabled. Many of the codes use the defined term ‘access (to)’ or ‘ready access (to)’ for access by maintenance and service personnel or fire departments. This proposal provides clarity and consistency in the remaining codes where those coordination modifications missed or came in as part of new code changes.

This a correlation piece for proposals over the last couple of cycles. This effort was started by the CACs in 2015/16 code change cycle, and continued in 2018/19. This proposal is to provide coordination with the action taken with -P84-15, M2-15, RB2-16, F12-16, CE137-16 Part 1, CE29-19 Part 1 and 2 . G1-21 Part 1 was disapproved; however Part 2 through 7 were approved

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Editorial. Will not change the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal meets the intent to provide clarity and consistency in the use of the term.

Final Hearing Results

RE2D-28-23	AS

RE2D-31-23

Original Proposal

IECC RE: TABLE R407.1; IRCECC: TABLE N1107.1

Proponents: Glen Clapper, National Roofing Contractors Association, National Roofing Contractors Association (gclapper@nrca.net)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE R407.1 MINIMUM LOW SLOPE ROOF REFLECTANCE AND EMITTANCE OPTIONS[a]

Three-year-aged solar reflectance[b] of 0.55 and 3-year aged thermal emittance[c] of 0.75
Three-year-aged solar reflectance index[d] of 64

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for either solar reflectance or thermal *emittance* shall be assigned both a 3-year-aged solar reflectance in accordance with Section C402.4.1 and a 3-year-aged thermal *emittance* of 0.90.

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Aged thermal *emittance* tested in accordance with ASTM C1371 or ASTM E408 or CRRC-S100.

d. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × f^{2}t × °F (12 W/m^2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal*emittance*.

IRC Chapter 11 ENERGY R3

Revise as follows:

TABLE N1107.1 MINIMUM LOW SLOPE ROOF REFLECTANCE AND EMITTANCE OPTIONS[a]

Three-year-aged solar reflectance[b] of 0.55 and 3-year aged thermal emittance[c] of 0.75
Three-year-aged solar reflectance index[d] of 64

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for either solar reflectance or thermal emittance shall be assigned both a 3-year-aged solar reflectance in accordance with Section C402.4.1 and a 3-year-aged thermal emittance of 0.90.

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Aged thermal emittance tested in accordance with ASTM C1371 or ASTM E408 or CRRC-S100.

d. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × f^{2}t × °F (12 W/m^2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance.

Reason: This table and it's requirements were formerly referenced and now imported from Section C402.4 and Table C402.4, which specifically stated only applied to low slope roofs.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: consistency with previous actions on RE2D-32-23.

Final Hearing Results

RE2D-31-23	AS

RE2D-32-23

Original Proposal

IECC RE: R407.2; IRCECC: N1107.2

Proponents: Glen Clapper, National Roofing Contractors Association, National Roofing Contractors Association (gclapper@nrca.net)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R407.2 Tropical climate region. Compliance with this section requires the following:

1. Not more than one-half of the *occupied* space is air conditioned.
2. The *occupied* space is not heated.
3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for *service water heating*.
4. Glazing in *conditioned spaces* has a *solar heat gain coefficient* (SHGC) of less than or equal to 0.40, or has an overhang with a projection factor equal to or greater than 0.30.
5. Permanently installed lighting is in accordance with Section R404.
6. The exterior <u>low slope</u> roof surface complies with one of the options in Table R407.1 or the roof or ceiling has insulation with an *R-value* of R-15 or greater. Where attics are present, attics above the insulation are vented and attics below the insulation are unvented.
7. Roof surfaces have a slope of not less than $^{1}/_{4}$ unit vertical in 12 units horizontal (2-percent slope). The finished roof does not have water accumulation areas.
8. Operable *fenestration* provides a *ventilation* area of not less than 14 percent of the floor area in each room. Alternatively, equivalent *ventilation* is provided by a *ventilation* fan.
9. Bedrooms with *exterior walls* facing two different directions have operable *fenestration* on exterior walls facing two directions.
10. Interior doors to bedrooms are capable of being secured in the open position.
11. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom.

IRC Chapter 11 ENERGY R3

Revise as follows:

N1107.2 Tropical climate region. Compliance with this section requires the following:

1. Not more than one-half of the occupied space is air conditioned.
2. The occupied space is not heated.
3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for service water heating.
4. Glazing in conditioned spaces has a solar heat gain coefficient (SHGC) of less than or equal to 0.40, or has an overhang with a projection factor equal to or greater than 0.30.
5. Permanently installed lighting is in accordance with Section N1104.
6. The exterior <u>low slope</u> roof surface complies with one of the options in Table N1107.1 or the roof or ceiling has insulation with an *R*-value of R-15 or greater. Where attics are present, attics above the insulation are vented and attics below the insulation are unvented.

7. Roof surfaces have a slope of not less than $^1/_4$ unit vertical in 12 units horizontal (2-percent slope). The finished roof does not have water accumulation areas.
8. Operable fenestration provides a ventilation area of not less than 14 percent of the floor area in each room. Alternatively, equivalent ventilation is provided by a ventilation fan.
9. Bedrooms with exterior walls facing two different directions have operable fenestration on exterior walls facing two directions.
10. Interior doors to bedrooms are capable of being secured in the open position.
11. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom.

Reason: This proposal clarifies that the requirements contained in Table C407.1 (N1107.1) apply only to low slope roofs.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: provides clarification on applicability.

Final Hearing Results

RE2D-32-23	AS

RE2D-33-23

Original Proposal

IECC RE: TABLE R407.1

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE R407.1 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS[a]

Portions of table not shown remain unchanged.

Three-year-aged solar reflectance[b] of 0.55 and 3-year aged thermal emittance[c] of 0.75
Three-year-aged solar reflectance index[d] of 64

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for either solar reflectance or thermal *emittance* shall be assigned both a 3-year-aged solar reflectance in accordance with Section R408.2.1.3.1 ~~C402.4.1~~ and a 3-year-aged thermal *emittance* of 0.90.

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Aged thermal *emittance* tested in accordance with ASTM C1371 or ASTM E408 or CRRC-S100.

d. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × ft^2 × °F (12 W/m^2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal*emittance*.

Reason: This comment replaces a reference to the IECC-C with an internal reference to the IECC-R. There is no technical change - R408.2.1.3.1 and Section C402.4.1 have identical formula and content.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No technical change is made.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: To maintain references internally in IECC-R instead of referring to IECC-C.

Final Hearing Results

RE2D-33-23 AS

RE2D-37-23

Original Proposal

IECC RE: TABLE R408.2, R408.2.1, R408.2.1.1, R408.2.1.4, R408.2.2, R408.2.3, R408.2.4, R408.2.5

Proponents: Alisa McMahon, None, self (mcmahon.gbac@cox.net)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Portions of table not shown remain unchanged.

R408.2.3(6)R408.2.3(8) [c]	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.4(1)[c]	More efficient distribution systemDuctless or hydronic thermal distribution	4	6	7	10	10	12	13	15	16
R408.2.4(2)[c]	100% of *duct systems* in conditioned space	4	6	8	12	12	15	17	19	20
R408.2.4(3)[c]	≥80% of ductwork inside *conditioned space*	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.4(4)[c]	Reduced total duct system leakage	1	1	1	1	1	1	2	2	2
R408.2.5(2)[c]	≤2.0 ACH50 with ERV or HRV installed	1	4	5	10	10	13	TBD	TBD	TBD
R408.2.5(3)[c]	≤2.0 ACH50 with a*balanced ventilation system*	2	3	2	4	4	5	TBD	TBD	TBD
R408.2.5(4)[c]	≤1.5 ACH50 with ERV or HRV installed	2	4	6	12	12	15	TBD	TBD	TBD
R408.2.5(5)[c]	≤1.0 ACH50 with ERV or HRV installed	2	5	6	14	14	17	TBD	TBD	TBD

a. Where the measure is selected, each dwelling unit, sleeping unit, and common~~areas~~ area where the measure is applicable must have the measure installed.

b. Where multiple heating or cooling systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

c. Where the measure is selected, each dwelling unit and sleeping unit must comply with the measure.

d. Where the measure is selected, each dwelling unit shall be served by a water heater meeting the applicable requirements. Where multiple service water heating systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

~~SEER2: Seasonal Energy Efficiency Ratio, HSPF2: Heating Season Performance Factor, EER2: Energy Efficiency Ratio, COP: Coefficient of Performance~~

R408.2.1 Enhanced building thermal envelope options. ~~For the enhanced envelope credits, the~~ The *building thermal envelope* shall comply with one or more of the following:

1. Either Section R408.2.1.1 or R408.2.1.2. Credit shall only be permitted from one measure.
2. Section R408.2.1.3.
3. Section R408.2.1.4.

R408.2.1.1 Enhanced building thermal envelope performance. The total *building thermal envelope* thermal conductance TC shall be calculated for the proposed *building* in accordance with Section R402.1.5 and ~~it~~ shall be reduced by not less than the percentage indicated in Table R408.2 in comparison to the reference *building*.

R408.2.1.4 Reduced air leakage. ~~For the reduced air leakage credit, the~~The building shall have a measured air leakage rate no less than 2.0 ACH50 and no greater than 2.5 ACH50 or the dwelling units in the building shall have an average measured air leakage rate no greater than 0.24 cfm50/ft2.

R408.2.2 More efficient HVAC equipment performance ~~option~~options. Heating and cooling *equipment* shall meet one of the following ~~efficiencies~~ measures as applicable for the *climate zone*, where multiple heating or cooling efficiencies are represented by Annual Fuel Utilization Efficiency (AFUE), Coefficient of Performance (COP), Energy Efficiency Ratio (EER and EER2), Heating Season Performance Factor (HSPF2), and Seasonal Energy Efficiency Ratio (SEER2). Where multiple heating and cooling systems are installed serving different zones, credits shall be earned based on the weighted average of square footage of the *zone* served by the system.HVAC options applicable to all climate zones:

1. Ground source Heat Pump -Greater than or equal to 16.1 EER and 3.1 COP ground source heat pump.
2. Cooling (Option 1)-Greater than or equal to 15.2 SEER2 and 12.0 EER2 air conditioner.
3. Cooling (Option 2)-Greater than or equal to 16.0 SEER2 and 12.0 EER2 air conditioner.
4. Gas Furnace (Option 1)-Greater than or equal to 97 % AFUE*fuel gas* furnace.
5. Gas Furnace (Option 2)- Greater than or equal to 95% AFUE*fuel gas* furnace.

HVAC options applicable to climate zones 0, 1, 2, and 3:

6. Gas Furnace (Option 3)-Greater than or equal to 90% AFUE*fuel gas* furnace.
7. Gas Furnace and Cooling (Option 1)- Greater than or equal to 90% AFUE*fuel gas* furnace and 15.2 SEER2 and 10.0 EER2 air conditioner.
8. Gas Furnace and Cooling (Option 2) - Greater than or equal to 95% AFUE*fuel gas* furnace and 16.0 SEER2 and 10.0 EER2 air conditioner.
9. Gas Furnace and Heat Pump (Option 1) - Greater than or equal to 90% AFUE*fuel gas* furnace and 7.8 HSPF2, 15.2 SEER2 and 10.0 EER2 air source heat pump.
10. Heat Pump (Option 1)-Greater than or equal to 7.8 HSPF2, 15.2 SEER2, and 11.7 EER2 air source heat pump.

HVAC options applicable to climate zones 4, 5, 6, 7, and 8:

11. Gas Furnace and Cooling (Option 3)-Greater than or equal to 95% AFUE*fuel gas* furnace and 15.2 SEER2 and 12.0 EER2 air conditioner.
12. Gas Furnace and Cooling (Option 4)-Greater than or equal to 97% AFUE*fuel gas* furnace and 16.0 SEER2 and 12.0 EER2 air conditioner.
13. Gas Furnace and Heat Pump (Option 2)- Greater than or equal to 95% AFUE*fuel gas* furnace and 8.1 HSPF2 and 15.2 SEER2 air source heat pump capable of meeting a capacity ratio ≥ 70% of heating capacity at 5 °F versus rated heating capacity at 47 °F.
14. Heat Pump (Option 2)-Greater than or equal to 8.1 HSPF2 and 15.2 SEER2 air source heat pump capable of meeting a capacity ratio ≥ 70% of heating capacity at 5 °F versus rated heating capacity at 47 °F.

R408.2.3 Reduced energy use in service water-heating options. For measure numbers R408.2.3 (1) through R408.2.3(7), the installed hot water system shall meet one of the Uniform Energy Factors (UEF) or Solar Uniform Energy Factors (SUEF) in Table R408.2.3. For measure number R408.2.3(8), ~~a compact~~ the hot water distribution system shall comply with R408.2.3.1.

R408.2.4 More efficient thermal distribution system ~~option~~options. The thermal distribution system shall comply with one of the following :

1. The ductless thermal distribution system or hydronic thermal distribution system is located completely on the conditioned side of the *building thermal envelope*.

2. The *space conditioning* equipment is located inside conditioned space. In addition, 100 percent of the*ductwork* is located completely inside *conditioned space* as defined by item 1 and item 2 Section R403.3.4.
3. The *space conditioning equipment* is located inside *conditioned space* and no less than 80 percent of*ductwork* is located completely inside conditioned space as defined by item 1 and item 2 of Section R403.3.4. In addition, no more than 20 percent of *ductwork* iscontained within building assemblies separating unconditioned from *conditioned space* as defined by item 3 of Section R403.3.4.
4. Where *ductwork* is located outside *conditioned space*, the total leakage , of the *duct system* measured in accordance with R403.3.7 is one of the following:
   4.1 Where the *space conditioning equipment* is installed at the time of testing, total leakage is not greater than 2.0 cubic feet per minute (0.94 L/s) per 100 square feet (9.29 m^2) of *conditioned floor area*.
   4.2 Where the *space conditioning equipment* is not installed at the time of testing, total leakage is not greater than 1.75 cubic feet per minute (0.83 L/s) per 100 square feet (9.29 m^2) of *conditioned floor area*.

R408.2.5 Improved air sealing and efficient ventilation system~~option~~options. The measured air leakage rate and *ventilation* system shall meet one of the following:

1. Either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed.
2. Less than or equal to 2.0 ACH50, with either an ERV or HRV installed.
3. Less than or equal to 2.0 ACH50, with a *balanced ventilation system* .
4. Less than or equal to 1.5 ACH50, with either an ERV or HRV installed.
5. Less than or equal to 1.0 ACH50, with either an ERV or HRV installed.

In addition, for measures requiring either an ERV or HRV, HRV and ERV Sensible Recovery Efficiency (SRE) shall be no less than 75 percent at 32°F (0°C), at the lowest *listed* net airflow. ERV Latent Recovery/Moisture Transfer (LRMT) shall be no less than 50 percent, at the lowest *listed* net airflow. In *Climate Zone* 8, recirculation shall not be used as a defrost strategy.

Reason: The "technical" aspect of this proposal is the request for review of the inclusion of footnote "c" in certain rows of Table R408.2. Footnotes "a" through "d" were an excellent addition. However, they were approved en masse, with very little to no discussion regarding their application to individual rows. Footnote "c" may not apply to the nine rows listed above.

As to the stricken line, it is unclear why it is under the footnotes beneath Table R408.2. It is not labeled as a footnote and the abbreviations do not appear in the table. The abbreviations are used in R408.2.2 and R408.2.3. The few editorial changes can be processed quickly.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Editorial change improves the section.

Final Hearing Results

RE2D-38-23

Original Proposal

IECC RE: TABLE R408.2, R408.2.1.3, TABLE R408.2.1.3, R408.2.1.3.1

Proponents: Alisa McMahon, None, self (mcmahon.gbac@cox.net)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4 except Marine	Climate Zone 4 Marine	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total TC	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total TC	0	1	1	2	2	3	3	3	3
R408.2.1.1(3)	>7.5% reduction in total TC	0	1	2	2	2	3	3	4	4
R408.2.1.1(4)	>10% reduction in total TC	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.1.1(5)	>15% reduction in total TC	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.1.1(6)	>20% reduction in total TC	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.1.1(7)	>30% reduction in total TC	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.1.2(2)	U-factor and SHGC for vertical fenestration per Table R408.2.1	1	1	1	1	1	1	1	2	
R408.2.1.3	Roof reflectance (roof is part of the *building thermal envelope* and directly above cooled, conditioned space)	TBD	TBD	TBD	TBD	TBD	0	0	0	0
R408.2.1.3(1)	Roof solar reflectance index (roof is above an unconditioned space that contains a duct system)	~~TBD~~1	~~TBD~~0	TBD	TBD	TBD	0	0	0	0
R408.2.1.3(2)	Roof solar reflectance index (roof is above an unconditioned space that contains a duct system)	1	1							
R408.2.1.4	Reduced air leakage	TBD	TBD	TBD	TBD	TBD	TBD	0	0	0
R408.2.2(1)[b]	Ground source heat pump	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(2) [b]	Cooling (Option 1)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(3)[b]	(Cooling Option 2)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(4) [b]	Gas furnace (Option 1)	0	0	0	0	0	TBD	TBD	TBD	0
R408.2.2(5)[b]	Gas furnace (Option 2)	TBD	TBD	TBD	TBD	TBD	0	0	0	TBD
R408.2.2(6)[b]	Gas furnace (Option 3)	TBD	TBD	TBD	TBD	-	-	-	-	-
R408.2.2(7)[b]	Gas furnace and cooling (Option 1)	TBD	TBD	TBD	TBD	-	-	-	-	-
R408.2.2(8)[b]	Gas furnace and cooling (Option 2)	TBD	TBD	TBD	TBD	-	-	-	-	-
R408.2.2(9)[b]	Gas furnace and heat pump (Option 1)	TBD	TBD	TBD	TBD	-	-	-	-	-
R408.2.2(10)[b]	Heat pump (Option 1)	TBD	TBD	TBD	TBD	-	-	-	-	-
R408.2.2(11)[b]	Gas furnace and cooling (Option 3)	-	-	-	-	TBD	TBD	TBD	TBD	TBD

R408.2.2(12) b	Gas furnace and cooling (Option 4)	-	-	-	-	TBD	TBD	TBD	TBD	TBD
R408.2.2(13)[b]	Gas furnace and heat pump (Option 2)	-	-	-	-	TBD	TBD	TBD	TBD	TBD
R408.2.2(14)[b]	Heat pump (Option 2)	TBD -	-	-	-	TBD	TBD	TBD	TBD	TBD
R408.2.3(1)[d]	Gas-fired storage water heaters	7	6	5	3	3	2	2	3	1
R408.2.3(2)[d]	Gas-fired instantaneous water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(3)[d]	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(4)[d]	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(5)[d]	Solar hot water heating system	4	5	6	6	6	6	5	5	4
R408.2.3(6) [c]	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.4(1)[c]	More efficient distribution system	4	6	7	10	10	12	13	15	16
R408.2.4(2)[c]	100% of *duct systems* in conditioned space	4	6	8	12	12	15	17	19	20
R408.2.4(3)[c]	≥80% of ductwork inside *conditioned space*	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.4(4)[c]	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.5(1)	ERV or HRV installed	TBD	TBD	TBD	TBD	TBD	TBD	0	0	0
R408.2.5(2)[c]	≤2.0 ACH50 with ERV or HRV installed	1	4	5	10	10	13	TBD	TBD	TBD
R408.2.5(3)[c]	≤2.0 ACH50 with a*balanced ventilation system*	2	3	2	4	4	5	TBD	TBD	TBD
R408.2.5(4)[c]	≤1.5 ACH50 with ERV or HRV installed	2	4	6	12	12	15	TBD	TBD	TBD
R408.2.5(5)[c]	≤1.0 ACH50 with ERV or HRV installed	2	5	6	14	14	17	TBD	TBD	TBD
R408.2.6[a]	Energy efficient appliances	9	8	8	7	7	5	5	5	4
R408.2.7	On-site renewable energy measures	17	16	17	11	11	9	8	7	4
R408.2.8	Off-site renewable energy measures	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.9[c]	Demand responsive thermostat	1	1	1	1	1	1	1	1	1
R408.2.11	Whole home lighting control	1	1	1	1	1	1	1	1	1
R408.2.12	Higher efficacy lighting	1	1	1	1	1	1	1	1	1

a. Where the measure is selected, each dwelling unit, sleeping unit, and common areas where the measure is applicable must have the measure installed.

b. Where multiple heating or cooling systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

c. Where the measure is selected, each dwelling unit and sleeping unit must comply with the measure.

d. Where the measure is selected, each dwelling unit shall be served by a water heater meeting the applicable requirements. Where multiple service water heating systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

SEER2: Seasonal Energy Efficiency Ratio, HSPF2: Heating Season Performance Factor, EER2: Energy Efficiency Ratio, COP: Coefficient of Performance

R408.2.1.3 Roof solar reflectance index. ~~Roofs in Climate Zones 0-2-4 and 4C shall comply with one or more of the options in Table R408.2.1.3. The following roofs and portions of roofs are excluded from the roof reflectance credit:~~Low slope roofs in Climate Zones 0-2 shall earn credit for Table R408.2 measure numbers R408.2.1.3(1) and R408.2.1.3(2) where the three-year aged solar reflectance index (SRI) is greater than or equal to 75. To earn credit, not less than 95 percent of the roof area shall comply. The combined area of the following portions of roof shall not be greater than 5 percent of the roof area:.

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 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 , or natural objects.
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 sectio~~n.

The three-year aged SRI shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h x f^2t x °F (12 W/m^2 x K). Calculation of aged SRI shall be based on three-year aged solar reflectance values tested in accordance with ASTM C1549, ASTM E903, ASTM E1918, or CRRC S100 and three-year aged thermal emittance values tested in accordance with ASTM C1371, ASTM E408, or CRRC S100

~~**TABLE R408.2.1.3 MINIMUM ROOF REFLECTANCE**~~[a]

ROOF SLOPE	THREE-YEAR AGED SOLAR REFLECTANCE INDEX[b]
Low slope	75
Steep slope	16

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for solar reflectance shall be assigned a 3-year-aged solar reflectance in accordance with Section R408.2.1.3.1.

b. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × f^2t × °F (12 W/m^2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectancetested in accordance with ASTM C1549, ASTM E903, ASTM E1918, or CRRC S100 and thermal emittance tested in accordance with ASTM C1371, ASTM E408, or CRRC S100.

R408.2.1.3.1 Aged solar reflectance. Where ~~an~~a tested 3-year aged solar reflectance value is not available, ~~it~~ an assigned value shall be determined in accordance with Equation 4-4.

$$R_{aged} = [0.2+0.7(R_{initial}-0.2)]$$

(Equation 4-4) **where:**

R_{aged} = The aged solar reflectance

$R_{initial}$ = The initial solar reflectance determined in accordance with ASTM C1549, ASTM E903, ASTM E1918, or~~with~~ CRRC-~~S~~100

Reason: This measure needs further development before it's ready for rollout.

For example, the measure needs to specify what percentage of roof area is required to meet the reflectance criteria, and that percentage must be in line with the points available.

The list of exclusions comes from the IECC-C where they exempt roofs from a **requirement**. That is very different from qualifying for a **credit**. R408.2.1.3(4) provides that a roof could qualify for credit with only 25% of the roof area available to meet the reflectance criteria.

The measure does not reference the two rows in Table R408.2.

Per PNNL analysis and RECD1-13-22, the measure will be applicable only to Climate Zones 0-2.

A modification will be submitted shortly, taking into account the results of PNNL's analysis (RECD1-13-22), in addressing these and other issues.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: more clearly reflects the point total based on more appropriate conditions.

Final Hearing Results

RE2D-38-23	AM

RE2D-40-23

Original Proposal

IECC RE: R408.2.11

Proponents: Michael Jouaneh, Lutron Electronics Co., Inc., Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R408.2.11 Whole home lighting control. The dwelling unit shall have a ~~switch~~ *manual* control by the main entrance that turns off all the permanently installed interior lighting or have a lighting control system that has the capability to turn off all permanently installed interior lighting from remote locations.

Exceptions:

1. Up to 5 percent of the total lighting power may remain uncontrolled.
2. Spaces where lighting is controlled by a count-down timer or *occupant sensor control*.

Reason: This change provides some clarity as the term "switch" has a specific meaning in the NEC. The provision did not intend to require only a toggle switch but any manual control that can provide the functionality. It could be a toggle switch but more often it would be a keypad or button not a toggle switch. So manual control is the more appropriate word.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

editorial change.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Provides proper terminology to align with NEC.

Final Hearing Results

RE2D-40-23	AS

RE2D-42-23

Original Proposal

IECC RE: TABLE R408.2.3

Proponents: Shilpa Surana, 2050 Partners, California Investor Owned Utilities (shilpasurana@2050partners.com)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE R408.2.3 Service water-heating efficiencies

Measure Number	Water Heater	Size and Draw Pattern	Type	Efficiency
R408.2.3(1)(a)	Gas-fired storage water heaters (option 1)	All storage volumes, all draw patterns	-	UEF≥ 0.81
R408.2.3(1)(b)	Gas-fired storage water heaters (option2)	<=55 gallons, Medium	-	UEF≥ 0.81
-	-	<=55 gallons, High	-	UEF≥ 0.86
-	-	>55 gallons, Medium or High	-	UEF≥ 0.86
-	-	Rated input capacity > 75,000 Btu/h	-	UEF≥ 0.86 or Et≥94%
R408.2.3(2)(a)	Gas-fired instantaneous water heater (option 1)	All storage volumes, Medium or High	-	UEF≥ 0.92
R408.2.3(2)(b)	Gas-fired instantaneous water heater (option 2)	All storage volumes, Medium or High	-	UEF≥ 0.95
R408.2.3 (3)(a)	Electric water heaters(option 1)	All storage volumes, Low, Medium, or High	Integrated HPWH	UEF ≥ 3.30
R408.2.3(3)(b)	Electric water heaters(option 2)	All storage volumes, Low, Medium, or High	Integrated HPWH	UEF ≥ 3.75
R408.2.3 (4)	Electric water heaters(option 3)	All storage volumes, Low, Medium, or High	Integrated HPWH, 120 Volt/15 Amp Circuit	UEF ≥ 2.20
R408.2.3(5)(a)	Electric water heaters(option 4)	All storage volumes, Low, Medium, or High	Split-system HPWH	UEF ≥ 2.20
R408.2.3(5)(b)	Electric water heaters(option 5)	All storage volumes, Low, Medium, or High	Split-system HPWH	UEF ≥ 3.75
R408.2.3(~~5~~6)	Electric water heaters (option 6)	Rated input capacity >12 kW	-	COP≥3.00
R408.2.3(~~6~~7)(a)	Solar water heaters(option 1)	All storage volumes, all draw patterns	Electric backup	SUEF ≥ 3.00
R408.2.3(~~6~~7)(b)	Solar water heaters(option 2)	All storage volumes, all draw patterns	Gas backup	SUEF ≥ 1.80

UEF = Uniform Energy Factor, E_t = Thermal Efficiency, COP = Coefficient of Performance

Reason: This proposal deletes R408.2.3(1)(b) Option 2 as it is redundant to the measure (R408.2.3(1)(a) Option 1) above. It fixes a few formatting errors and introduces the language 'all storage volumes' before the draw patterns to ensure consistency with the options above.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal makes editorial clarifications only.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: proposal deletes R408.2.3(1)(b) Option 2 as it is redundant to the measure (R408.2.3(1)(a) Option 1) above. It fixes a few formatting errors and introduces the language 'all storage volumes' before the draw patterns to ensure consistency with the options above.

Final Hearing Results

RE2D-42-23 AM

RE2D-43-23

Original Proposal

IECC RE: R408.2.3.1
Proponents: Alisa McMahon, None, self (mcmahon.gbac@cox.net)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R408.2.3.1 Compact hot water distribution system option. The pipe shall store not more than 16 ounces of water between the nearest source of heated water and the termination of the fixture supply pipe when calculated using section R408.2.3.1.1. Where the source of heated water is a circulation loop, the loop shall be primed with a *demand recirculation water system* that complies with R403.5.1.1.1. There shall be a dedicated return line for the loop that begins after the branch to the last fixture on the supply portion of the loop and runs back to the water heater.

Reason: In the last round, measures were added to R403.5.1.1.1 to modestly increase the energy efficiency of *demand recirculation water systems*. A demand recirculation system qualifying for R408 credit should be at least as efficient as one that does not qualify for that credit.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Per the reason statement that a demand recirculation system qualifying for R408 credit should be at least as efficient as one that does not qualify for that credit.

Final Hearing Results

RE2D-43-23	AS

RE2D-44-23

Original Proposal

IECC RE: R408.2.6, TABLE R408.2.6

Proponents: Alisa McMahon, None, self (mcmahon.gbac@cox.net)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R408.2.6 Energy efficient appliances.

~~appliances~~ Each appliance of a type listed in Table R408.2.6 installed in a *residential building* shall comply with the efficiency requirements specified in ~~Table R408.2.6~~ that table. ~~Not less than three~~ Each appliance ~~types from~~specified in Table R408.2.6 shall be installed. A clothes washer shall be installed at each location plumbed for a clothes washer.

Exception :

In *dwelling units* of Group R-2 occupancies, where a dishwasher is not installed in each unit ~~*dwelling unit*~~, not less than two appliance types complying with Table R408.2.6 shall be installed. ~~In *common areas*, each appliance type shall comply with Table R408.2.6.~~

TABLE R408.2.6 MINIMUM EFFICIENCY REQUIREMENTS: APPLIANCES

APPLIANCE TYPES	EFFICIENCY IMPROVEMENT	TEST PROCEDURE
Refrigerator	Maximum Annual Energy Consumption (AEC), No ~~no~~ greater than 620 kWh/yr	10 CFR 430, Subpart B, Appendix A
Dishwasher	Maximum Annual Energy Consumption (AEC), No ~~no~~ greater than 240 kWh/yr	10 CFR 430, Subpart B, Appendix C1
Clothes washer	Clothes washer located within *dwelling units*: Maximum Annual Energy Consumption (AEC), No ~~no~~ greater than 130 kWh/yr,and Integrated Modified Energy Factor (IMEF) > 1.84 cu.ft/kWh/cycle Clothes washer ~~-~~not located within dwelling units and where *dwelling units* are not provided with ~~laundry facilities~~ rough-in plumbing for washers: Modified Energy Factor (MEF)>2.0 cu.ft/kWh/cycle	10 CFR 430 Subpart B, Appendix J2 and 10 CFR 430, Subpart B, Appendices D1 and D2

Reason: A new version of R408.2.6 was approved in the last round. Like many new code sections, it has some loopholes. This proposal closes those loopholes.

A modification will be submitted shortly, taking into account the results of PNNL's analysis (RECD1-13-22). This reason statement covers the revisions submitted herein.

Compact Appliances Loophole

R408.2.6 criteria are based on standard-size appliances. The annual energy use of compact appliances is much lower. Compact appliances are not chosen to save energy. Rather, they are used when there is limited space and/or no need for standard-size appliances. Allowing compacts to qualify for R408 credit would not incentivize lower energy use; it would provide freebie credit for smaller appliances that will be used in those locations regardless. Therefore, compacts should not qualify for R408 credit.

-

All Appliances Must Comply To Earn Credit

Many larger homes have multiple appliances of one or more types. R408.2.6 does not require that all appliances in each type comply, nor does it exclude compacts. So, for example, a compact refrigerator in a wet bar can qualify a home for R408 credit even when the energy consumption of the standard-size refrigerator in the kitchen exceeds the maximum allowed!

Table R408.2footnote "a" does not protect against this situation. It requires the measure (in this case, a qualifying appliance) to be installed in each location listed. However, it does not require that all appliances in each location comply. So, for example, the footnote does not prevent the installation of just one qualifying washer in a common area laundry room with ten washers.

Clothes Washers Located Outside Dwelling Units

"Where dwelling units are not provided with laundry facilities" in Table R408.2.6 is commonly interpreted as 'where dwelling units are not provided with a common area laundry room.' That is not what the proponents intended. The proposed change conveys the proponents' intent.

Reference: IRC definition of "rough-in."

Prevent Future Installation of Less-Efficient Clothes Washers at Plumbed Locations

-

In some buildings, some (typically the larger) dwelling units are plumbed for washersand common area laundry facilities are provided. In this situation, footnote "a" to Table R408.2 provides that washers must be installed in both the plumbed dwelling units and the common area(s). But that should be stated explicitly in this section. The idea is to avoid future (e.g., post-COO) installation of less efficient appliances in plumbed dwelling units.

Exception 2 Loophole

An early version of RED1-360 included a footnote that made clear thatall washers in a common area must comply. That footnote was deleted. Footnote "a" to Table R408.2 does not ensure this. Thus, Exception 2 could be interpreted that compliance is achieved by a single appliance of each appliance type.

All the loopholes described above are closed by the proposed changes.

Clarifications

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The term "appliance types" is used three times. Its meaning is clarified by changing the left column heading to "appliance types."

"Not less than three appliance types . . ." is a remnant from PCD#1 when the Table contained four appliance types. Since there are now only three, to avoid confusion, that phrase has been replaced by "all."

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: editorial improvements.

Final Hearing Results

RE2D-44-23 AM

RE2D-46-23

Original Proposal

IECC RE: R503.1.1.3

Proponents: Amy Martino, Building Site Synergy, Building Site Synergy (amartino@buildingsitesynergy.com)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R503.1.1.3 Above-grade wall alterations. *Above-grade wall* alterations shall comply with the following as applicable:

1. Where wall cavities are exposed, ~~and~~ the exposed cavities shall be filled with insulation complying with Section R303.1.4. New cavities created shall be insulated in accordance with Section R402.1 or an *approved* design that minimizes deviation from Section R402.1. An interior vapor retarder shall be provided where required in accordance with Section R702.7 of the *International Residential Code* or Section 1404.3 of the *International Building Code,* as applicable.
2. Where *exterior wall* coverings and *fenestration* are added or replaced for the full extent of any exterior~~,~~ facade of one or more elevations of the *building*, continuous insulation shall be provided where required in accordance with Section R402.1 or the wall insulation shall be in accordance with an *approved* design~~,~~ that minimizes deviation from Section R402.1; Where specified, the continuous insulation requirement also shall comply with Section R702.7 of the *International Residential Code*. Replacement exterior wall coverings shall comply with the water resistance requirements of Section R703.1.1 of the *International Residential Code* or Section 1402.2 of the *International Building Code*, as applicable, *and manufacturers' instructions.*
3. Where new interior finishes or *exterior wall* coverings are applied to the full extent of any exterior wall assembly of mass construction, insulation shall be provided in accordance with Section R402.1 or an approved design that minimizes deviation from Section R402.1.

Reason: Every climate zone offers a cavity only alternative. By specifying "continuous" insulation it is confusing and more restrictive than new construction. With existing construction there are many instances that make adding continuous insulation difficult to install without affecting the existing construction not part of the alteration (ex. Existing decks & attachment to the structure, changes in materials such as water tables, porch roofs, flush roof rakes, etc.) which may create a moisture intrusion and flashing problem. If an *approved* design is permitted, specifying "continuous" insulation is not required. "Full extent" is poor code language and should be better quantified. Lastly, in anticipation that local jurisdictions may make amendments, it is likely alternatives which allow cavity only insulation may be adopted.

Bibliography: none

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial for clarification and consistency.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Add "as applicable" after "following" at the beginning of the section, remove "and" from the 1st sentence of item #1, and keep "continuous" in section #2

Final Hearing Results

RE2D-59-23

Original Proposal

IECC RE: TABLE R408.2, TABLE R408.2.3

Proponents:

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4 except Marine	Climate Zone 4 Marine	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total TC	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total TC	0	1	1	2	1	2	2	2	2
R408.2.1.1(3)	>7.5% reduction in total TC	0	1	2	2	2	2	3	3	3
R408.2.1.1(4)	>10% reduction in total TC	1	1	2	3	3	4	4	5	5
R408.2.1.1(5)	>15% reduction in total TC	1	2	2	4	4	5	6	7	8
R408.2.1.1(6)	>20% reduction in total TC	2	4	4	5	6	7	8	9	11
R408.2.1.1(7)	>30% reduction in total TC	3	6	6	8	8	11	12	13	16
R408.2.1.2(~~2~~1)	U-factor and SHGC for vertical fenestration per Table R408.2.1	1	1	1	2	1	1	1	1	
R408.2.1.3(1)	Roof reflectance (roof is part of the *building thermal envelope* and directly above cooled, conditioned space)	1	~~1~~0	0	0	0	0	0	0	0
R408.2.1.3(2)	Roof reflectance (roof is above an unconditioned space that contains a duct system)	1	1	0	0	0	0	0	0	0
R408.2.1.4	Reduced air leakage	1	1	1	2	1	3	NA	NA	NA
R408.2.2(1)[b]	Ground source heat pump	4	8	12	19	14	25	32	35	46
R408.2.2(2) [b]	High Performance Cooling (Option 1)	5	4	3	2	1	1	1	1	1
R408.2.2(3)[b]	High Performance Cooling (Option 2)	6	4	3	2	1	1	1	1	1
R408.2.2(4)[b]	High Performance Gas furnace (Option 1)	~~NA~~0	~~NA~~1	~~NA~~2	~~NA~~5	~~NA~~3	6	7	7	~~NA~~9

R408.2.2(5)[b]	High Performance Gas furnace (Option 2)	0	1	2	4	3	~~NA~~5	~~NA~~6	~~NA~~7	8
R408.2.2(6)[b]	High Performance Gas furnace (Option 3)	0	1	1	~~3~~NA	NA	NA	NA	NA	NA
R408.2.2(7)[b]	High Performance Gas furnace and cooling (Option 1)	5	5	4	~~5~~NA	NA	NA	NA	NA	NA
R408.2.2(8)[b]	High Performance Gas furnace and cooling (Option 2)	6	5	5	~~6~~NA	NA	NA	NA	NA	NA
R408.2.2(9)[b]	High Performance Gas furnace and heat pump (Option 1)	~~13~~15	~~12~~13	~~9~~11	~~7~~NA	NA	NA	NA	NA	NA
R408.2.2(10)[b]	HIgh Performance Heat pump with electric resistance backup (Option 1)	13	12	11	~~12~~NA	NA	NA	NA	NA	NA
R408.2.2(11)[b]	High Performance Gas furnace and cooling (Option 3)	NA	NA	NA	~~NA~~5	4	6	7	7	9
R408.2.2(12)[b]	High Performance Gas furnace and cooling (Option 4)	NA	NA	NA	~~NA~~6	5	7	8	8	10
R408.2.2(13)[b]	High Performance Gas furnace and heat pump (Option 2)	NA	NA	NA	~~NA~~12	8	~~0~~11	~~-1~~11	~~-3~~12	~~-7~~12
R408.2.2(14)[b]	High Performance Heat pump with electric resistance backup (Option 2)	NA	NA	NA	~~NA~~12	8	12	13	14	16
R408.2.3(1)(a)[d]	Gas-fired storage water heaters(option 1)	8	7	7	5	6	4	4	3	2
R408.2.3(1)(b)[d]	Gas-fired storage water heaters ~~Fired Storage Water Heater~~ (option 2)	9	8	8	6	7	5	4	4	3
R408.2.3(2)(a)[d]	Gas-fired instantaneous water heaters (option 1)	10	9	9	6	7	5	5	4	3
R408.2.3(2)(b)[d]	Gas-fired instantaneous water heaters (option 2)	11	10	9	6	7	6	5	4	3
R408.2.3(3)~~(a)~~[d]	Electric water heaters (option 1)	~~12~~10	~~11~~9	~~11~~9	~~8~~7	~~8~~6	~~5~~4	~~4~~3	~~4~~3	~~3~~2
~~R408.2.3(3)(b)~~[d]	~~Electric water heaters (option 2)~~	~~12~~	~~11~~	~~11~~	~~8~~	~~8~~	~~5~~	~~4~~	~~4~~	~~3~~
R408.2.3(4)[d]	Electric water heaters (option ~~3~~2)	~~11~~8	~~11~~8	~~11~~8	~~8~~6	~~8~~5	~~5~~4	~~4~~3	~~4~~3	~~3~~2
R408.2.3(5)(a)[d]	Electric water heaters (option 4~~3~~)	~~8~~7	~~10~~8	~~11~~8	~~8~~6	~~11~~7	~~7~~5	~~5~~4	~~5~~3	
R408.2.3(5)(b)[d]	Electric water heaters (option ~~5~~4)	~~9~~8	~~11~~9	~~12~~10	~~8~~7	~~11~~8	~~7~~5	~~6~~5	~~5~~4	~~4~~3
R408.2.3(~~5~~6)[d]	Electric water heaters (option ~~6~~5)	~~12~~10	~~11~~9	~~11~~9	~~8~~7	~~8~~6	~~5~~4	~~4~~3	~~4~~3	~~3~~2
R408.2.3(~~6~~7)(a)[d]	Solar hot water heating system (option 1)	13	13	13	9	8	5	4	4	3

R408.2.3(~~6~~7)(b)[d]	Solar hot water heating system (option 2)	10	9	9	6	7	6	5	4	3
R408.2.3.1 [c] R408.2.3(8)[c]	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.4(1)[c]	More efficient distribution system	3	4	5	7	8	10	10	10	14
R408.2.4(2)[c]	100% of *duct systems* in conditioned space	2	3	4	6	7	9	9	9	13
R408.2.4(3)[c]	≥80% of ductwork inside *conditioned space*	2	3	3	5	6	7	7	7	9
R408.2.4(4)[c]	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.5(1)[c]	ERV or HRV installed	0	0	0	0	1	3	2	2	2
R408.2.5(2)[c]	≤2.0 ACH50 with ERV or HRV installed	0	0	0	4	4	8	5	5	5
R408.2.5(3)[c]	≤2.0 ACH50 with a *balanced ventilation system*	0	0	0	0	0	0	4	4	4
R408.2.5(4)[c]	≤1.5 ACH50 with ERV or HRV installed	0	0	0	6	5	10	9	9	9
R408.2.5(5)[c]	≤1.0 ACH50 with ERV or HRV installed	0	0	1	7	6	12	12	12	12
R408.2.6[a]	Energy efficient appliances	1	1	1	1	1	1	0	0	0
R408.2.7	On-site renewable energy measures	17	16	17	11	~~9~~11	~~8~~9	~~7~~8	47	
R408.2.8	Off-site renewable energy measures	71	65	62	55	46	41	43	41	3938
R408.2.8b	Off-site renewable energy measure	10	10	10	10	10	10	10	10	10
R408.2.~~9~~8[c]	Demand responsive thermostat	1	1	1	1	1	1	1	1	1
R408.2.1110	Whole home lighting control	~~0~~1	~~0~~1	~~0~~1	0	0	0	0	0	0
R408.2.1211	Higher efficacy lighting	0	0	0	0	0	0	0	0	0

a. Where the measure is selected, each dwelling unit, sleeping unit, and common areas where the measure is applicable must have the measure installed.

b. Where multiple heating or cooling systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

c. Where the measure is selected, each dwelling unit and sleeping unit must comply with the measure.

d. Where the measure is selected, each dwelling unit shall be served by a water heater meeting the applicable requirements. Where multiple service water heating systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

SEER2: Seasonal Energy Efficiency Ratio, HSPF2: Heating Season Performance Factor, EER2: Energy Efficiency Ratio, COP: Coefficient of Performance

TABLE R408.2.3 Service water-heating efficiencies

Measure Number	Water Heater	Size and Draw Pattern	Type	Efficiency
R408.2.3(1)(a)	Gas-fired storage water heaters (option 1)	All storage volumes, all draw patterns	UEF ≥0.81	
R408.2.3(1)(b)	Gas-fired storage water heaters (option 2)	≤ 55 gallons, Medium	UEF ≥0.81	
		≤ 55 gallons, High	UEF ≥0.86	
		>55 gallons, Medium or High	UEF ≥0.86	
Rated input capacity > 75,000 Btu/h	UEF ≥0.86 or E_t ≥94%			
R408.2.3(2)(a)	Gas-fired instantaneous water heaters (option 1)	All storage volumes, Medium or High	UEF ≥ 0.92	
R408.2.3(2)(b)	Gas-fired instantaneous water heaters (option 2)	All storage volumes, Medium or High	UEF ≥0.95	
R408.2.3(3)(a)	Electric water heaters(option 1)	All storage volumes, Low, Medium, or High	Integrated HPWH	UEF ≥ 3.30
R408.2.3(3)(b)	Electric water heaters(option 2)	Low, Medium, or High	Integrated HPWH	UEF ≥ 3.75
R408.2.3 (4)	Electric water heaters(option ~~3~~2)	All storage volumes, Low, Medium, or High	Integrated HPWH, 120 Volt/15 Amp Circuit	UEF ≥ 2.20
R408.2.3(5)(a)	Electric water heaters(option ~~4~~3)	All storage volumes,Low, Medium, or High	Split-system HPWH	UEF ≥ 2.20
R408.2.3(5)(b)	Electric water heaters(option ~~5~~4)	All storage volumes,Low, Medium, or High	Split-system HPWH	UEF ≥ 3.75
R408.2.3(~~5~~6)	Electric water heaters (option ~~6~~5)	Rated input capacity >12 kW	COP≥3.00	
R408.2.3(~~6~~7)(a)	Solar water heaters(option 1)	All storage volumes, all draw patterns	Electric backup	SUEF ≥ 3.00
R408.2.3(~~6~~7)(b)	Solar water heaters(option 2)	All storage volumes, all draw patterns	Gas backup	SUEF ≥ 1.80

UEF = Uniform Energy Factor, E_t = Thermal Efficiency, COP = Coefficient of Performance

Reason: See PNNL methodology posted in 6.29.23 IECC R Agenda

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
See PNNL methodology posted in 6.29.23 IECC R Agenda

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Committee supported the ‘modified’ PNNL proposal which initially included a few corrections to the table of points, but through the MOD was further revised in some measures to reflect updates to the simulations, as well as a few editorial revisions to align with Committee action on AHRI’s RED1-351-22 proposal.

Final Hearing Results

RE2D-59-23 AM

RE2D-66-23

Original Proposal

IECC RE: TABLE R408.2 (New), R408.2.2.1 (New)

Proponents: Vladimir Kochkin, NAHB, NAHB (vkochkin@nahb.org)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4 except Marine	Climate Zone 4 Marine	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total TC	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total TC	0	1	1	2	1	2	2	2	2
R408.2.1.1(3)	>7.5% reduction in total TC	0	1	2	2	2	2	3	3	3
R408.2.1.1(4)	>10% reduction in total TC	1	1	2	3	3	4	4	5	5
R408.2.1.1(5)	>15% reduction in total TC	1	2	2	4	4	5	6	7	8
R408.2.1.1(6)	>20% reduction in total TC	2	4	4	5	6	7	8	9	11
R408.2.1.1(7)	>30% reduction in total TC	3	6	6	8	8	11	12	13	16
R408.2.1.2(2)	U-factor and SHGC for vertical fenestration per Table R408.2.1	1	1	1	2	1	1	1	1	
R408.2.1.3	Roof reflectance (roof is part of the *building thermal envelope* and directly above cooled, conditioned space)	1	1	0	0	0	0	0	0	0
R408.2.1.3	Roof reflectance (roof is above an unconditioned space that contains a duct system)	1	1	0	0	0	0	0	0	0
R408.2.1.4	Reduced air leakage	1	1	1	2	1	3	NA	NA	NA
R408.2.2(1)[b]	Ground source heat pump	4	8	12	19	14	25	32	35	46
R408.2.2(2) [b]	High Performance Cooling (Option 1)	5	4	3	2	1	1	1	1	1
R408.2.2(3)[b]	High Performance Cooling (Option 2)	6	4	3	2	1	1	1	1	1
R408.2.2(4) [b]	High Performance Gas furnace (Option 1)	NA	NA	NA	NA	NA	6	7	7	NA
R408.2.2(5)[b]	High Performance Gas furnace (Option 2)	0	1	2	4	3	NA	NA	NA	8
R408.2.2(6)[b]	High Performance Gas furnace (Option 3)	0	1	1	3	NA	NA	NA	NA	NA
R408.2.2(7)[b]	High Performance Gas furnace and cooling (Option 1)	5	5	4	5	NA	NA	NA	NA	NA
R408.2.2(8)[b]	High Performance Gas furnace and cooling (Option 2)	6	5	5	6	NA	NA	NA	NA	NA
R408.2.2(9)[b]	High Performance Gas furnace and heat pump (Option 1)	~~13~~15	~~12~~13	~~9~~11	~~7~~NA[e]	NA	NA	NA	NA	NA
R408.2.2(10)[b]	HIgh Performance Heat pump with electric resistance backup (Option 1)	13	12	11	12	NA	NA	NA	NA	NA
R408.2.2(11)[b]	High Performance Gas furnace and cooling (Option 3)	NA	NA	NA	NA	4	6	7	7	9
R408.2.2(12) [b]	High Performance Gas furnace and cooling (Option 4)	NA	NA	NA	NA	5	7	8	8	10
R408.2.2(13)[b]	High Performance Gas furnace and heat pump (Option 2)	NA	NA	NA	NA	8	0	-1	-3	-7

R408.2.2(14)[b]	High Performance Heat pump with electric resistance backup (Option 2)	NA	NA	NA	NA	8	12	13	14	16
R408.2.3(1) (a)[d]	Gas-fired storage water heaters(option 1)	8	7	7	5	6	4	4	3	2
R408.2.3(1) (b)[d]	Gas Fired Storage Water Heater(option 2)	9	8	8	6	7	5	4	4	3
R408.2.3(2) (a)[d]	Gas-fired instantaneous water heaters (option 1)	10	9	9	6	7	5	5	4	3
R408.2.3(2) (b)[d]	Gas-fired instantaneous water heaters (option 2)	11	10	9	6	7	6	5	4	3
R408.2.3(3) (a)[d]	Electric water heaters (option 1)	12	11	11	8	8	5	4	4	3
R408.2.3(3) (b)[d]	Electric water heaters (option 2)	12	11	11	8	8	5	4	4	3
R408.2.3(4)[d]	Electric water heaters (option 3)	11	11	11	8	8	5	4	4	3
R408.2.3(5) (a)[d]	Electric water heaters (option 4)	8	10	11	8	11	7	5	5	
R408.2.3(5) (b)[d]	Electric water heaters (option 5)	9	11	12	8	11	7	6	5	4
R408.2.3(5)[d]	Electric water heaters (option 6)	12	11	11	8	8	5	4	4	3
R408.2.3(6) (a)[d]	Solar hot water heating system (option 1)	13	13	13	9	8	5	4	4	3
R408.2.3(6) (b)[d]	Solar hot water heating system (option 2)	10	9	9	6	7	6	5	4	3
R408.2.3.1 [c]	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.4(1)[c]	More efficient distribution system	3	4	5	7	8	10	10	10	14
R408.2.4(2)[c]	100% of *duct systems* in conditioned space	2	3	4	6	7	9	9	9	13
R408.2.4(3)[c]	≥80% of ductwork inside *conditioned space*	2	3	3	5	6	7	7	7	9
R408.2.4(4)[c]	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.5(1)	ERV or HRV installed	0	0	0	0	1	3	2	2	2
R408.2.5(2)[c]	≤2.0 ACH50 with ERV or HRV installed	0	0	0	4	4	8	5	5	5
R408.2.5(3)[c]	≤2.0 ACH50 with a *balanced ventilation system*	0	0	0	0	0	0	4	4	4
R408.2.5(4)[c]	≤1.5 ACH50 with ERV or HRV installed	0	0	0	6	5	10	9	9	9
R408.2.5(5)[c]	≤1.0 ACH50 with ERV or HRV installed	0	0	1	7	6	12	12	12	12
R408.2.6[a]	Energy efficient appliances	1	1	1	1	1	1	0	0	0
R408.2.7	On-site renewable energy measures	17	16	17	11	11	9	8	7	4
R408.2.8	Off-site renewable energy measures	71	65	62	55	46	41	43	41	39
R408.2.8b	Off-site renewable energy measure	1	1	1	1	1	1	1	1	1
R408.2.9[c]	Demand responsive thermostat	1	1	1	1	1	1	1	1	1
R408.2.11	Whole home lighting control	0	0	0	0	0	0	0	0	0

R408.2.12	Higher efficacy lighting	0	0	0	0	0	0	0	0	0

a. Where the measure is selected, each dwelling unit, sleeping unit, and common areas where the measure is applicable must have the measure installed.

b. Where multiple heating or cooling systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

c. Where the measure is selected, each dwelling unit and sleeping unit must comply with the measure.

d. Where the measure is selected, each dwelling unit shall be served by a water heater meeting the applicable requirements. Where multiple service water heating systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

e. 11 credits are available for climate zone 4 where the following measure is used: Gas Furnace and Heat Pump (Option 3): greater than or equal to 95% AFUE fuel gas furnace and 7.8 HSPF2, 15.2 SEER2 and 10.0 EER2 air source heat pump.
SEER2: Seasonal Energy Efficiency Ratio, HSPF2: Heating Season Performance Factor, EER2: Energy Efficiency Ratio, COP: Coefficient of Performance

Add new text as follows:

R408.2.2.1 More efficient HVAC equipment for Climate Zone 4. For Climate Zone 4, the following HVAC options shall also apply:

1. Gas Furnace and Heat Pump (Option 3) - Greater than or equal to 95% AFUE fuel gas furnace and 7.8 HSPF2, 15.2 SEER2 and 10.0 EER2 air source heat pump
2. Heat Pump (Option 1)-Greater than or equal to 7.8 HSPF2, 15.2 SEER2, and 11.7 EER2 air source heat pump.

-

Reason: At the last consensus committee there was substantial support for expanding equipment compliance options in R408. This proposal replaces N/A for several equipment options with credit values from the PNNL analysis. In addition, N/A in some cases appear to indicate that zero credit is allowed if a more efficient practice used than a similar practice with a credit (e.g., 5 credits for a 90 AFUE furnace and 0 credits for a 95 AFUE for climate zone 4). If the committee does not want to give additional credit as will be for a 97 AFUE compared to a 90 AFUE, then the credit should be listed as 5 for 97 AFUE (not zero). Some N/A are left as such intentionally (e.g., a cold climate heat pump in a warm climates).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal adds compliance options.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This change expands high-performance heating and cooling compliance options for CZ 4.

Final Hearing Results

RE2D-66-23 AM

RE2D-67-23

Original Proposal

IECC RE: TABLE R408.2 (New)

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Steven Winter Associates (gayathri@swinter.com)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4 except Marine	Climate Zone 4 Marine	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total TC	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total TC	0	1	1	2	1	2	2	2	2
R408.2.1.1(3)	>7.5% reduction in total TC	0	1	2	2	2	2	3	3	3
R408.2.1.1(4)	>10% reduction in total TC	1	1	2	3	3	4	4	5	5
R408.2.1.1(5)	>15% reduction in total TC	1	2	2	4	4	5	6	7	8
R408.2.1.1(6)	>20% reduction in total TC	2	4	4	5	6	7	8	9	11
R408.2.1.1(7)	>30% reduction in total TC	3	6	6	8	8	11	12	13	16
R408.2.1.2(2)	U-factor and SHGC for vertical fenestration per Table R408.2.1	1	1	1	2	1	1	1	1	
R408.2.1.3	Roof reflectance (roof is part of the *building thermal envelope* and directly above cooled, conditioned space)	1	1	0	0	0	0	0	0	0
R408.2.1.3	Roof reflectance (roof is above an unconditioned space that contains a duct system)	1	1	0	0	0	0	0	0	0
R408.2.1.4	Reduced air leakage	1	1	1	2	1	3	NA	NA	NA
R408.2.2(1)[b]	Ground source heat pump	~~4~~14	~~8~~14	~~12~~14	~~19~~15	~~14~~10	~~25~~15	~~32~~17	~~35~~18	~~46~~21
R408.2.2(2) [b]	High Performance Cooling (Option 1)	5	4	3	2	1	1	1	1	1
R408.2.2(3)[b]	High Performance Cooling (Option 2)	6	4	3	2	1	1	1	1	1
R408.2.2(4) [b]	High Performance Gas furnace (Option 1)	NA	NA	NA	NA	NA	6	7	7	NA
R408.2.2(5)[b]	High Performance Gas furnace (Option 2)	0	1	2	4	3	NA	NA	NA	8
R408.2.2(6)[b]	High Performance Gas furnace (Option 3)	0	1	1	3	NA	NA	NA	NA	NA
R408.2.2(7)[b]	High Performance Gas furnace and cooling (Option 1)	5	5	4	5	NA	NA	NA	NA	NA
R408.2.2(8)[b]	High Performance Gas furnace and cooling (Option 2)	6	5	5	6	NA	NA	NA	NA	NA
R408.2.2(9)[b]	High Performance Gas furnace and heat pump (Option 1)	13	12	9	7	NA	NA	NA	NA	NA
R408.2.2(10)[b]	HIgh Performance Heat pump with electric resistance backup (Option 1)	13	12	11	12	NA	NA	NA	NA	NA
R408.2.2(11)[b]	High Performance Gas furnace and cooling (Option 3)	NA	NA	NA	NA	4	6	7	7	9
R408.2.2(12) [b]	High Performance Gas furnace and cooling (Option 4)	NA	NA	NA	NA	5	7	8	8	10
R408.2.2(13)[b]	High Performance Gas furnace and heat pump (Option 2)	NA	NA	NA	NA	8	0	-1	-3	-7

R408.2.2(14)[b]	High Performance Heat pump with electric resistance backup (Option 2)	NA	NA	NA	NA	8	12	13	14	16
R408.2.3(1) (a)[d]	Gas-fired storage water heaters(option 1)	8	7	7	5	6	4	4	3	2
R408.2.3(1) (b)[d]	Gas Fired Storage Water Heater(option 2)	9	8	8	6	7	5	4	4	3
R408.2.3(2) (a)[d]	Gas-fired instantaneous water heaters (option 1)	10	9	9	6	7	5	5	4	3
R408.2.3(2) (b)[d]	Gas-fired instantaneous water heaters (option 2)	11	10	9	6	7	6	5	4	3
R408.2.3(3) (a)[d]	Electric water heaters (option 1)	12	11	11	8	8	5	4	4	3
R408.2.3(3) (b)[d]	Electric water heaters (option 2)	12	11	11	8	8	5	4	4	3
R408.2.3(4)[d]	Electric water heaters (option 3)	11	11	11	8	8	5	4	4	3
R408.2.3(5) (a)[d]	Electric water heaters (option 4)	8	10	11	8	11	7	5	5	
R408.2.3(5) (b)[d]	Electric water heaters (option 5)	9	11	12	8	11	7	6	5	4
R408.2.3(5)[d]	Electric water heaters (option 6)	12	11	11	8	8	5	4	4	3
R408.2.3(6) (a)[d]	Solar hot water heating system (option 1)	13	13	13	9	8	5	4	4	3
R408.2.3(6) (b)[d]	Solar hot water heating system (option 2)	10	9	9	6	7	6	5	4	3
R408.2.3.1 [c]	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.4(1)[c]	More efficient distribution system	3	4	5	7	8	10	10	10	14
R408.2.4(2)[c]	100% of *duct systems* in conditioned space	2	3	4	6	7	9	9	99	13
R408.2.4(3)[c]	≥80% of ductwork inside *conditioned space*	2	3	3	5	6	7	7	7	9
R408.2.4(4)[c]	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.5(1)	ERV or HRV installed	0	0	0	0	1	3	2	2	2
R408.2.5(2)[c]	≤2.0 ACH50 with ERV or HRV installed	0	0	0	4	4	8	5	5	5
R408.2.5(3)[c]	≤2.0 ACH50 with a *balanced ventilation system*	0	0	0	0	0	0	4	4	4
R408.2.5(4)[c]	≤1.5 ACH50 with ERV or HRV installed	0	0	0	6	5	10	9	9	9
R408.2.5(5)[c]	≤1.0 ACH50 with ERV or HRV installed	0	0	1	7	6	12	12	12	12
R408.2.6[a]	Energy efficient appliances	1	1	1	1	1	1	0	0	0
R408.2.7	On-site renewable energy measures	17	16	17	11	11	9	8	7	4
R408.2.8	Off-site renewable energy measures	71	65	62	55	46	41	43	41	39
R408.2.8b	Off-site renewable energy measure	1	1	1	1	1	1	1	1	1
R408.2.9[c]	Demand responsive thermostat	1	1	1	1	1	1	1	1	1
R408.2.11	Whole home lighting control	0	0	0	0	0	0	0	0	0

R408.2.12	Higher efficacy lighting	0	0	0	0	0	0	0	0	0

a. Where the measure is selected, each dwelling unit, sleeping unit, and common areas where the measure is applicable must have the measure installed.

b. Where multiple heating or cooling systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

c. Where the measure is selected, each dwelling unit and sleeping unit must comply with the measure.

d. Where the measure is selected, each dwelling unit shall be served by a water heater meeting the applicable requirements. Where multiple service water heating systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

SEER2: Seasonal Energy Efficiency Ratio, HSPF2: Heating Season Performance Factor, EER2: Energy Efficiency Ratio, COP: Coefficient of Performance

Reason: The points proposed for the GSHP measure seemed higher than I expected. It was explained that the savings & points were calculated outside the software used to simulate the other HVAC measures. In consultation with PNNL and Dandelion Energy, I reviewed their savings calculations and worked with them to modify inputs in their tool to provide different values, while maintaining the inherent savings potential of GSHP beyond traditional ASHP.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Change will neither increase or decrease the cost of construction

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The Committee agreed that the revised points that resulted from revising the GSHP calculations were an improvement. This is because they now use the same ASHP Baseline HSPF/SEER values as other ASHP measures and also now use the 3.1 COP/16.1 EER that is required per the measure description.

Final Hearing Results

RE2D-67-23 AS

REAPP-01-24

Original Proposal

IECC RE: R403.5.5, TABLE R403.5.5, R404.7, R404.7.1, R404.7.2, R404.7.3, R404.7.4, R404.7.5, R404.6, R404.6.1, RL101.1.1.1 (New), RL101.1.1.2 (New), R404.6.1.3, R404.6.1.4, R404.6.2, R404.6.2.1, R404.6.2.2, R404.6.2.3, R404.6.2.4, R404.6.2.5, R404.6.2.6, R404.6.2.7, R404.6.2.8, R404.5, R404.5.1, R404.5.2, R404.5.3, RK101.1.4 (New), TABLE R405.2, TABLE R406.2, APPENDIX RE, RRA101.1 (New), RRA101.2 (New), RE102, RE102.1, RE103, RE103.1

Proponents: By determination of the ICC Board of Directors on appeals to the IECC heard 3/18/24

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

~~R403.5.5~~RJ101.1 Demand responsive water heating. Electric storage water heaters with a rated water storage volume of 40 gallons (150L) to 120 gallons (450L) and a nameplate input rating equal to or less than 12kW shall be provided with demand responsive controls in accordance with Table ~~R403.5~~RJ101.1.

Exceptions:

1. Water heaters that are capable of delivering water at a temperature of 180°F (82°C) or greater.
2. Water heaters that comply with Section IV, Part HLW or Section X of the ASME Boiler and Pressure Vessel Code.
3. Water heaters that use 3-phase electric power.

TABLE ~~R403.5.5~~RJ101.1 DEMAND RESPONSIVE CONTROLS FOR WATER HEATING

Equipment Type	Controls		
	Manufactured Before 7/1/2025	Manufactured On or After 7/1/2025	
Electric storage water heaters	AHRI Standard 1430-2022 (I-P) or ANSI/CTA-2045-B Level 1 and also capable of initiating water heating to meet the temperature set point in response to a demand response signal.	AHRI Standard 1430-2022 (I-P)	

Revise as follows:

~~R404.7~~RE101.2 Electric Vehicle Power Transfer Infrastructure. New residential automobile parking spaces for residential buildings shall be provided with electric vehicle power transfer infrastructure in accordance with Sections ~~R404.7.1~~RE101.2.1 through ~~R404.7.5~~RE101.2.5.

~~R404.7.1~~RE101.2.1 Quantity. New one- and two-family dwellings and townhouses with a designated attached or detached garage or other onsite private parking provided adjacent to the *dwelling unit* shall be provided with one *EV-capable*, *EV-ready*, or *EVSE* space per *dwelling unit*. R-2 occupancies or allocated parking for R-2 occupancies in mixed-use buildings shall be provided with an *EV capable space*, *EV ready space*, or *EVSE spac*e for 40 percent of each *dwelling units* or *automobile parking spaces*, whichever is less.

Exceptions:

1. Where the local electric distribution entity has certified in writing that it is not able to provide 100 percent of the necessary distribution capacity within 2 years after the estimated date of the certificate of occupancy. The required EV charging infrastructure shall be reduced based on the available existing electric distribution capacity.
2. Where substantiation has been *approved* that meeting the requirements of Section ~~R404.7.5~~ RE101.2.5 will alter the local utility infrastructure design requirements on the utility side of the meter so as to increase the utility side cost to the builder or developer by more than $450.00 per *dwelling unit*.

~~R404.7.2~~RE101.2.2. EV Capable Spaces. Each *EV capable space* used to meet the requirements of Section ~~R404.7.1~~RE101.2.1 shall comply with all of the following:

1. A continuous raceway or cable assembly shall be installed between an enclosure or outlet located within 6 feet (1828mm) of the *EV capable space* and a suitable panelboard or other onsite electrical distribution equipment.
2. Installed raceway or cable assembly shall be sized and rated to supply a minimum circuit capacity in accordance with Section ~~R404.7.5~~ RE101.2.5.
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have sufficient dedicated space and spare electrical capacity for a 2-pole circuit breaker or set of fuses.
4. The electrical enclosure or outlet and the electrical distribution equipment directory shall be marked: "For future electric vehicle supply equipment (EVSE)."

~~R404.7.3~~RE101.2.3 EV Ready Spaces. Each branch circuit serving *EV ready spaces* shall comply with all of the following:

1. Terminate at an outlet or enclosure, located within 6 feet (1828 mm) of each *EV ready space* it serves and marked "For electric vehicle supply equipment (EVSE)".
2. Be served by an electrical distribution system and circuit capacity in accordance with Section ~~R404.7.5~~ RE101.2.5.
3. Be designated on the panelboard or other electrical distribution equipment directory as "For electric vehicle supply equipment (EVSE)"

~~R404.7.4~~RE101.2.4 EVSE spaces. An installed EVSE with multiple output connections shall be permitted to serve multiple EVSE spaces. Each EVSE serving either a single EVSE space or multiple EVSE spaces shall comply with the following:

1. Be served by an electrical distribution system in accordance with Section ~~R404.7.5~~ RE101.2.5.
2. Have a nameplate charging capacity of not less than 6.2 kVA (or 30A at 208/240V) per EVSE space served. Where an EVSE serves three or more EVSE spaces and is controlled by an energy management system in accordance with Section ~~R404.7.5~~ RE101.2.5, the nameplate charging capacity shall be not less than 2.1 kVA per EVSE space served.
3. Be located within 6 feet (1828 mm) of each EVSE space it serves.
4. Be installed in accordance with NFPA 70 and be listed and labeled in accordance with UL 2202 or UL 2594.

~~R404.7.5~~RE101.2.5 Electrical distribution system capacity. The branch circuits and electrical distribution system serving each EV capable space, EV ready space and EVSE space used to comply with Section ~~R404.7.1~~RE101.2.1 comply with one of the following:

1. VSized for a calculated EV charging load of not less than 6.2 kVA per EVSE, EV ready, or EV capable space. Where a circuit is shared or managed it shall be in accordance with NFPA 70.
2. The capacity of the electrical distribution system and each branch circuit serving multiple *EVSE spaces, EV ready spaces*, or *EV capable spaces* designed to be controlled by an energy management system in accordance with NFPA 70, shall be sized for a calculated EV charging load of not less than 2.1 kVA per space. Where an energy management system is used to control EV charging loads for the purposes of this section, it shall not be configured to turn off electrical power to *EVSE* or *EV ready spaces* used to comply with Section ~~R404.7.1~~ RE101.2.1.

~~R404.6~~RL101.1 Renewable energy infrastructure. The *building* shall comply with the requirements of ~~R404.6.1~~Section RL101.1.1 or ~~R404.6.2~~RL101.1.2.

~~R404.6.1~~RL101.1.1 One- and two- family dwellings and townhouses . One- and two-family dwellings and townhouses shall comply with Sections ~~R404.6.1.1~~RL101.1.1.1 through ~~R404.6.1.4~~RL101.1.1.4.

Exceptions:

1. A *dwelling unit* with a permanently installed *on-site renewable energy* system.

2. A *dwelling unit* with a *solar-ready zone* area that is less than 500 square feet (46 m^2) of roof area oriented between 110 degrees and 270 degrees of true north.
3. A *dwelling unit* with less than 500 square feet (46m^2) of roof area oriented between 110 degrees and 270 degrees of true north.
4. Dwelling units where 50 percent of the*solar-ready zone* area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the *building* for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.
5. A *dwelling unit* that complies with Appendix RC.
6. A *dwelling unit* with a renewable energy power purchase agreement with a duration of not less than 15 years from a utility or a community renewable energy facility and for not less than 80 percent of the estimated *dwelling unit* electric use on an annual basis.
7. A *dwelling unit* with less than or equal to 1,500 square feet (139 m^2) of *living space* located above *grade plane*.

~~R404.6.1.1.1~~RL101.1.1.1 Solar-ready zone area.. The total area of the solar-ready zone shall not be less than 250 square feet (23.2 m^2) and shall be composed of areas not less than 5.5 feet (1676 mm) in one direction and not less than 80 square feet (7.4 m^2) exclusive of access or set back areas as required by the International Residential Code.

Exception: Dwelling units in townhouses three stories or less in height above grade plane and with a total floor area less thanor equal to 2,000 square feet (186 m^2) per dwelling shall be permitted to have a solar-ready zone area of not less than 150 square feet (14 m^2) .

~~R404.6.1.1.1~~RL101.1.1.2 Obstructions. Solar-ready zones shall be free from obstructions, including but not limited to vents, chimneys and roof-mounted equipment.

~~R404.6.1.3~~RL101.1.1.3 Electrical service reserved space. The main electrical service panel shall have a reserved space for a dual pole circuit breaker and shall be labeled “For Future Renewable Electric.” The reserved space shall be at the opposite (load) end of the busbar from the primary energy source.

~~R404.6.1.4~~RL101.1.1.4 Electrical interconnection. An electrical junction box shall be installed within 24 inches (610 mm) of the main electrical service panel and shall be connected to a capped roof penetration sleeve or a location in the attic that is within 3 feet (914 mm) of the *solar-ready zone* by a not less than 1 inch (25 mm) nonflexible metallic conduit or permanently installed wire as*approved* . Where the interconnection terminates in the attic, the location shall be not less than 12 inches (35 mm) above ceiling insulation. Both ends of the interconnection shall be labeled “For Future Renewable Electric”.

~~R404.6.2~~RL101.1.2 Group R occupancies. *Residential buildings* other than one- and two-family dwellings and townhouses shall comply with Sections ~~R404.6.2.1~~RL101.1.2.1 through ~~R404.6.2.8~~RL101.1.2.8.

~~R404.6.2.1~~RL101.1.2.1 General. A solar-ready zone shall be located on the roof of residential buildings that are oriented between 110 degrees and 270 degrees of true north or have low-slope roofs. Solar-ready zones shall comply with Sections ~~R404.6.2.2~~RL101.1.2.2 through ~~R404.6.2.8~~RL101.1.2.8.

Exceptions:

1. A building with a permanently installed on-site renewable energy system.
2. A building with a solar-ready zone area that is shaded for more than 70 percent of daylight hours annually.
3. A building where an approved party certifies that the incident solar radiation available to the building is not suitable for a solar-ready zone.
4. A building where an approved party certifies that the solar-ready zone area required by Section~~R404.6.2.3~~ RL101.1.2.3 cannot be met because of rooftop equipment, skylights, vegetative roof areas or other obstructions.
5. A building that complies with Appendix RC.

6. A building with a renewable energy power purchase agreement with a duration of not less than 15 years from a utility or a community renewable energy facility and for not less than 80 percent of the estimated electric use of the residential occupancy portion of the building on an annual basis.

~~R404.6.2.2~~RL101.1.2.2 Construction document requirements for a solar-ready zone. Construction documents shall indicate the solar-ready zone .

~~R404.6.2.3~~RL101.1.2.3 Solar-ready zone area. The total solar-ready zone area shall be not less than 40 percent of the roof area calculated as the horizontally projected gross roof area less the area covered by penthouses, mechanical equipment, rooftop structures, 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 (1524 mm) in width in the narrowest dimension.

Revise as follows:

~~R404.6.2.4~~RL101.1.2.4 Obstructions. Solar-ready zones shall be free from obstructions, including pipes, vents, ducts, HVAC equipment, skylights and roof-mounted equipment.

~~R404.6.2.5~~RL101.1.2.5 Roof loads and documentation. A collateral dead load of not less than 5 pounds per square foot (5 psf) (24.41 kg/m2) 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.

~~R404.6.2.6~~RL101.1.2.6 Interconnection pathway. Construction documents shall indicate pathways for routing of conduit or plumbing from the solar-ready zone to the electrical service panel or service hot water system.

~~R404.6.2.7~~RL101.1.2.7 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 and shall be labeled “For Future Renewable Electric.” The reserved spaces shall be positioned at the end of the panel that is opposite from the panel supply conductor connection.

~~R404.6.2.8~~RL101.1.2.8 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.

~~R404.5~~RK101.1 Electric readiness. Water heaters, household clothes dryers, conventional cooking tops, conventional ovens, and cooking appliances that use *fuel gas* or *liquid fuel* shall comply with Sections ~~R404.5.1~~RK101.1.1 through ~~R404.5.4~~RK101.1.4.

~~R404.5.1~~RK101.1.1 Cooking appliances. A branch circuit with a rating not less than 240-volts, 40-amperes shall be installed, and terminate within three feet of conventional cooking tops, conventional ovens or cooking appliances combining both.

Exception: Cooking appliances not installed in an individual *dwelling unit*.

~~R404.5.2~~RK101.1.2 Household Clothes Dryers. A branch circuit with a rating not less than 240-volts, 30-amperes shall be installed, and terminate within three feet (304 mm) of each household clothes dryer.

Exception: Clothes dryers not installed in an individual dwelling unit.

~~R404.5.3~~RK101.1.3 Water heaters. A branch circuit with a rating not less than either 240-volts, 30-amperes or 120V, 20-amperes shall be installed and terminate within three feet (304 mm) of each water heater.

Exception: Water heaters serving multiple dwelling units in a R-2 occupancy.

~~R404.5.4~~RK101.1.4 Electrification-ready circuits. The unused conductors required by Sections ~~R404.5.1~~RK101.1.1 through ~~R404.5.3~~ RK101.1.3 shall be labeled with the word “spare.” Space shall be reserved in the electrical panel in which the branch circuit originates for the installation of an overcurrent device. Capacity for the circuits required by Sections ~~R404.5.1~~RK101.1.1 through ~~R404.5.3~~RK101.1.3

shall be included in the load calculations of the original installation.

TABLE R405.2 REQUIREMENTS FOR SIMULATED BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Attic knee or pony wall
R402.2.4	Eave baffle
R402.2.5.1	Access hatches and doors
R402.2.9.1	Basement wall insulation installation
R402.2.10.1	Slab-on-grade floor insulation installation
R402.2.11.1	Crawl space wall insulation installations
R402.5.1.1	Installation
R402.5.1.2	Air leakage testing
R402.5.1.3	Maximum air leakage rate
R402.5.2	Fireplaces
R402.5.3	Fenestration air leakage
R402.5.4	Room containing fuel burning applicances
R402.5.5	Recessed lighting
R402.5.6	Air-sealed electrical and communication outlet boxes
R402.6	Maximum fenestration *U*-factor and SHGC
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3	Duct systems
R403.4	Mechanical system piping insulation
R403.5	Service hot water system
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.15	Snow melt and ice system controls
R403.10	Energy consumption of pools and spas
R403.11	Portable spas

R403.12	Residential pools and permanent residential spas
R403.14	Gas fireplaces
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
~~R404.5~~	~~Electric readiness~~
~~R404.6~~	~~Renewable energy infrastructure~~
~~R404.7~~	~~Electric Vehicle power transfer infrastructure~~

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.4	Eave baffle
R402.2.5.1	Access hatches and doors
R402.2.9.1	Basement wall insulation installation
R402.2.10.1	Slab-on-grade floor insulation installation
R402.2.11.1	Crawl space wall insulation installation
R402.5.1.1	Installation
R402.5.1.2	Air leakage testing
R402.5.1.3	Maximum air leakage rate
R402.5.2	Fireplaces
R402.5.3	Fenestration air leakage
R402.5.4	Rooms containing fuel burning appliances
R402.5.5	Recessed lighting
R402.5.6	Air-sealed electrical and communication outlet boxes(air sealed boxes)
R406.3	*Building thermal envelope*
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3	Duct systems
R403.4	Mechanical system piping insulation

R403.5 R403.5.2	Service hot water systems
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.15	Snow melt and ice system controls
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
R403.14	Gas fireplaces
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.5	Electric readiness
R404.6	Renewable energy infrastructure
R404.7	Electric Vehicle power transfer infrastructure

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

~~APPENDIX~~RESOURCE ~~RE~~RRA
ALL-ELECTRIC RESIDENTIAL BUILDINGS

~~RE101.1~~RRA101.1 Intent. The intent of this resource is to amend the International Energy Conservation Code to reduce greenhouse gas emissions and improve the safety and health of buildings by not permitting combustion equipment in buildings.

~~RE101.2~~RRA101.2 Scope. This resource applies to new residential buildings.

~~RE102~~RRA102
GENERAL DEFINITIONS

~~RE102.1~~ . ALL-ELECTRIC BUILDING. A building that contains no combustion equipment, or plumbing for combustion equipment, installed within the building, or *building site*. **APPLIANCE.** A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements. **COMBUSTION EQUIPMENT.** Any equipment or appliance used for space heating, *service water heating*, cooking, clothes drying and/or lighting that uses fuel gas or *fuel oil*. **EQUIPMENT.** Piping, ducts, vents, control devices and other components of systems other than appliances that are permanently installed and integrated to provide control of environmental conditions for buildings. This definition shall also include other systems specifically regulated in this code. **FUEL OIL.** Kerosene or any hydrocarbon oil having a flash point not less than 100°F (38°C).

~~RE103~~RRA103
ALL-ELECTRIC RESIDENTIAL BUILDINGS

~~RE103.1~~RRA103.1 Application. Residential buildings shall be *all-electric buildings* and comply with either Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4.

Reason: This is the final result of the IECC Residential appeals based on the determination of the ICC Board of Directors

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

Cost Impact (Detailed): The change proposal is editorial in nature or a clarification and has no cost impact on the cost of construction

Justification:

N/A

Public Hearing Results (CAH1)

Committee Action (CAH1)	**As Submitted**

Final Hearing Results

REAPP-01-24	AS

REC2D-1-23

Original Proposal

IECC RE: TABLE R402.1.2, R402.1.3, R402.2.10.2, R402.2.11.2, RF105, RF105.1 (New), TABLE RF105.1 (New), RF106, RF107, RF106.1 (New), TABLE RF106.1 (New)

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

Portions of table not shown remain unchanged.

CLIMATE ZONE	0	1	2	3	4 except Marine	5 and Marine 4	6	7 and 8
VERTICAL FENESTRATION U-FACTOR	0.50	0.50	0.40	0.30	0.30	0.28 [d]	0.28 [d]	0.27 [d]
SKYLIGHT *U*-FACTOR	0.60	0.60	0.60	0.53	0.53	0.50	0.50	0.50
GLAZED VERTICAL FENESTRATION SHGC	0.25	0.25	0.25	0.25	0.40	NR	NR	NR
SKYLIGHT SHGC	0.28	0.28	0.28	0.28	0.40	NR	NR	NR
CEILING *U*-FACTOR	0.035	0.035	0.030	0.030	0.026	0.026	0.026	0.026
INSULATION ENTIRELY ABOVE ROOF DECK	0.039	0.039	0.039	0.039	0.032	0.032	0.032	0.028
WOOD FRAME WALL *U*-FACTOR	0.084	0.084	0.084	0.060	0.045	0.045	0.045	0.045
MASS WALL U-FACTOR[b]	0.197	0.197	0.165	0.098	0.098	0.082	0.060	0.057
FLOOR *U*-FACTOR	0.064	0.064	0.064	0.047	0.047	0.033	0.033	0.028
BASEMENT WALL *U*-FACTOR	0.360	0.360	0.360	0.091[c]	0.059	0.050	0.050	0.050
UNHEATED SLAB F-FACTOR [e]	0.73	0.73	0.73	0.54	0.51	0.51	0.48	0.48
HEATED SLAB F-FACTOR [e]	0.74	0.74	0.74	0.66	0.66	0.66	0.66	0.66
CRAWL SPACE *U*-FACTOR	0.477	0.477	0.477	0.136	0.065	0.055	0.055	0.055

For SI: 1 foot = 304.8 mm.

a. Nonfenestration *U*-factors and *F*-factors shall be obtained from measurement, calculation, ~~or~~ an approved source , or Appendix RF of this code where such appendix is adopted or approved.

b. Mass walls shall be in accordance with Section R402.2.6. Where more than half the insulation is on the interior, the mass wall ***U***-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In Warm Humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.

d. A maximum *U*-factor of 0.30 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation above sea level, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

e. F-factors for slabs correspond to the R-values of Table R402.1.3 and the installation conditions of Section R402.2.10.1.

R402.1.3 R-value alternative. Assemblies with *R*-value of insulation materials equal to or greater than that specified in Table R402.1.3 shall be an alternative to the *U*-factor or *F*-factor in Table R402.1.2. ~~R-values of insulation materials for the assemblies specified in Appendix RF that have a U-factor less than or equal to the U-factor required by Table R402.1.2 shall be permitted~~

R402.2.10.2 Alternative slab-on-grade insulation configurations. For buildings complying with Sections R405 or R406, slab-on-grade insulation shall be installed in accordance with the proposed design or rated design . ~~The proposed or rated design shall use an alternative insulation configuration and associated F-factor complying with Appendix A of ANSI/ASHRAE/IES 90.1 or, where adopted, Section RF105 of Appendix RF of this code. Where used to comply with Table R402.1.2 Section R401.2.1, the proposed F-factor shall be equal to or less than the F-factor required by Table R402.1.2 for a heated or unheated slab, as applicable. Where used to comply with Section R402.1.5 or Section R408.2.1, F-factors for the slab-on-grade reference and proposed design shall be applied in accordance with Section R402.1.5.~~

R402.2.11.2 Alternative crawl space wall insulation configurations. For buildings complying with Sections R405 or R406 crawl space wall insulation shall be installed in accordance with the proposed design or rated design . ~~The proposed or rated design shall use an alternative insulation configuration and associated U-factor or C-factor complying with Appendix A of ANSI/ASHRAE/IES 90.1 or, where adopted, Appendix RF of this code. Where used to comply with Section R401.2.1, the U-factor or C-factor shall be equal to or less than the U-factor required by Table R402.1.2 for crawl space walls. Where used to comply with Section R402.1.5 or Section R408.2.1, effective U-factors for the crawlspace wall reference and proposed designs shall be applied in accordance with Section R402.1.5.~~

RF105
BASEMENT AND CRAWLSPACE WALLS ~~RESERVED~~

Add new text as follows:

RF105.1 Basement and crawlspace walls.. U-factors for basement and crawlspace walls shall comply with insulation R-values and configurations be as specified in accordance with Table RF105.1. Where used to substitute alternative basement and crawlspace wall insulation R-values and configurations for compliance with Table 401.1.2, the applicable wall U-factor of Table RF105.1 shall be used. Where used with Section R402.1.5 to determine overall building thermal envelope conductance (TC), the applicable effective Effective U-factors from Table RF105.1 shall be used for basement and crawlspace wallsfor the proposed and reference foundation wall design must be used to demonstrate compliance with Section R402.1.5. reference and proposed design. Basement slabs and crawlspace slabs or grave floor shall be separately addressed in accordance with Section RF106, including adjustment for the floor depth below exterior finish grade. Effective U-factors shall not be used for other compliance methods referenced in Section R401.2.1 of the code.with Sections R405 and R406.

TABLE RF105.1 BASEMENT AND CRAWLSPACE WALLS

Insulation Configurations[b]	Wall U-factor[c] (Btu/hr-ft²-F)	Wall Effective U-factor[d] by Percentage of Wall Height Projecting Above Grade (Btu/hr-ft²-F)for Use Only with Section R402.1.5			
		50%	35%	20%	5%
BASEMENT WALLS					
Uninsulated & unfinished basement wall	0.360	0.324	0.288	0.252	0.216
Continuous Insulation	-	-	-	-	-
R-5ci	0.122	0.109	0.097	0.085	0.073
R-7.5ci	0.093	0.084	0.075	0.065	0.056
R-10ci	0.076	0.068	0.060	0.053	0.045
R-15ci	0.055	0.049	0.044	0.038	0.033
R-20ci	0.043	0.039	0.034	0.030	0.026
R-25ci	0.035	0.032	0.028	0.025	0.021

Cavity Insulation	-	-	-	-	-
R-11	0.076	0.068	0.060	0.053	0.045
R-13	0.067	0.060	0.054	0.047	0.040
R-15	0.060	0.054	0.048	0.042	0.036
R-19	0.050	0.045	0.040	0.035	0.030
R-21	0.045	0.041	0.036	0.032	0.027
Cavity + Continuous Insulation	-	-	-	-	-
R-13 + R-5ci	0.050	0.045	0.040	0.035	0.030
R-13 + R-7.5ci	0.045	0.040	0.036	0.031	0.027
R-13 + R-10ci	0.040	0.036	0.032	0.028	0.024
R-19 + R-5ci	0.040	0.036	0.032	0.028	0.024
R19 + R-7.5ci	0.036	0.033	0.029	0.025	0.022
R19 + R-10ci	0.033	0.030	0.027	0.023	0.020
CRAWLSPACE WALLS					
Unisulated crawlspace wall	0.477	0.429	0.382	0.334	n/a
Continuous Insulation	-	-	-	-	-
R-5ci	0.141	0.127	0.113	0.099	n/a
R-7.5ci	0.104	0.094	0.083	0.073	n/a
R-10ci	0.083	0.074	0.066	0.058	n/a
R-15ci	0.058	0.053	0.047	0.041	n/a
R-20ci	0.045	0.041	0.036	0.032	n/a
R-25ci	0.037	0.033	0.030	0.026	n/a
Cavity Insulation	-	-	-	-	-
R-11	0.083	0.074	0.066	0.058	n/a
R-13	0.072	0.065	0.058	0.051	n/a
R-15	0.065	0.058	0.052	0.045	n/a
R-19	0.054	0.049	0.043	0.038	n/a
R-21	0.048	0.043	0.038	0.033	n/a
Cavity + Continuous Insulation	-	-	-	-	-
R-13 + R-5ci	0.053	0.048	0.043	0.037	n/a
R-13 + R-7.5ci	0.047	0.042	0.038	0.033	n/a
R-13 + R-10ci	0.042	0.038	0.034	0.029	n/a
R19 + R-5ci	0.043	0.038	0.034	0.030	n/a
R19 + R-7.5ci	0.039	0.035	0.031	0.027	n/a
R19 + R-10ci	0.035	0.032	0.028	0.025	n/a

n/a = not applicable

a. The wall U-factor excludes exterior air-film R-value and, for insulated assemblies, includes the following: 0.68 R for interior air film, 0.45 R for ½” gypsum panel finish (insulated basement walls only), and 2.1 R for 12” block basement wall or 1.4 R for 8” block crawlspace wall, both with empty cells. Where cavity insulation is included between 2x4 or 2x6 framing on the interior side of a foundation wall, wood stud material with thermal resistivity of R-1.25/in is assumed to be spaced at not less than 16-inches on center with an assumed framing factor of not greater than 0.15.

b. All insulation configurations extend from top of foundation wall to floor of basement or crawlspace. Extrapolation to partial height insulation shall not be permitted; U-factors for such insulation configurations shall be determined by accepted engineering practice for modeling of thermal bridging and ground-coupled assemblies.

c. Applicable to Sections R402.1.2, R405 and R406.

d. Effective U-factors are adjusted to account for ground-coupling effects to provide equivalency to U-factors used for above-grade building thermal envelope assemblies. The effective U-factors are provided for use with Section R402.1.5 for evaluation of trade-offs with above-grade assemblies and components of the *building thermal envelope*. The effective U-factor shall apply to the foundation wall area from interior floor or ground surface to top of wall. Interpolation between R-values and percentage of wall height projecting above grade within a given insulation configuration type is permitted.

Revise as follows:

~~RF106~~
~~CRAWLSPACE WALLS~~ ~~RESERVED~~

RF106 ~~RF107~~
SLABS-ON-GRADE

Add new text as follows:

RF106.1 Slabs-on-grade.. F-factors for unheated and heated slabs-on-grade shall be as specified in Table RF106.1. All applicable adjustment factors in the table footnotes shall apply. F-factors for basement floor slabs and crawl space ground surface located below exterior grade shall be adjusted in accordance footnote ‘f’ as applicable.

TABLE RF106.1 F-FACTORS FOR SLABS-ON-GRADE[a,b,c,d,e,f]

Unheated Slabs-on-Grade -- Insulation Configurations	F-factor (Btu/hr-ft-F)
Uninsulated Slab	0.73
Horizontal Insulation Under Slab at Slab Perimeter -- Slab Edge Not Insulated	-
>= R-5 for 2ft	0.70
R-5 for 4ft	0.67
>= R-10 for 4ft	0.64

Vertical Insulation on Exterior Face[9] -- Slab Edge Insulated[11]	-
R-2.5 for 2ft	0.66
R-5 for 2ft	0.58
R-7.5 for 2ft	0.56
R-10 for 2ft	0.54
R-15 for 2ft	0.52
R-5 for 3 ft	0.56
R-7.5 for 3ft	0.54
R-10 for 3ft	0.51
R-15 for 3ft	0.49
R-5 for 4ft	0.54
R-7.5 for 4ft	0.51
R-10 for 4ft	0.48
R-15 for 4ft	0.45
Fully Insulated Slab - Full Slab Area and Slab Edge Continuously Insulated	-
R-5 entire slab area and R-3.5 edge	0.48
R-5 entire slab area and edge	0.46
R-7.5 entire slab area and R-3.5 edge	0.45
R-7.5 entire slab area and edge	0.41
R-10 entire slab area and R-5 edge	0.40
R-10 entire slab area and edge	0.36
R-15 entire slab area and R-5 edge	0.35
R-15 entire slab area and edge	0.30
R10 slab edge and under slab perimeter inward 4ft; R-5 remaining slab area	0.42
R-15 slab edge and under slab perimeter inward 4ft; R-5 remaining slab area	0.40
R-15 slabe edge and under slab perimeter inward 4ft; R-10 remaining slab area	0.34
Heated Slabs-on-Grade -- Insulation Configurations	F-factor (Btu/hr-ft-F)
Uninsulated	1.35

Fully Insulated Slab -- Full Slab Area and Slab Edge Continuously Insulated	-
R-5 entire slab area and R-3.5 edge	0.77
R-5 entire slab area and edge	0.74
R-7.5 entire slab area and R-3.5 edge	0.71
R-7.5 entire slab area and edge	0.64
R-10 entire slab area and R-5 edge	0.62
R-10 entire slab area and edge	0.55
R-15 entire slab area and R-5 edge	0.54
R-15 entire slab area and edge	0.44
R-20 entire slab area and R-7.5 edge	0.44
R-20 entire slab area and edge	0.37
R-5 entire slab area and R-10 slab edge extending downward for min. 3ft	0.66
R-10 slab edge and under slab perimeter inward 4ft; R-5 remaining slab area	0.66
R-15 slab edge and under slab perimeter inward 4ft; R-5 remaining slab area	0.62
R-15 slab edge and under slab perimeter inward 4ft; R-10 remaining slab area	0.51

a. For alternative slab-on-grade insulation configurations, F-factors shall be determined in accordance with accepted engineering practice for modeling three dimensional ground-coupled building assemblies using project-specific building and site conditions to estimate annual energy use attributed to foundation heat transfer and converting the result to an equivalent air-to-air F-factor basis.

b. Interpolation between R-values for a given insulation configuration type is permitted.

c. Tabulated F-factors are based on a typical soil thermal conductivity of 0.75 Btu/hr-ft-F and shall be multiplied by one of the following adjustment factors as applicable to site soil conditions: (1) rock or any soil on sites with poor drainage or high water table – 1.2; (2) sandy soils - 1.1; (3) loam or clay soils on well-drained sites in dry climate regions - 0.85; and (3) for all other soil or site conditions - 1.00. Where soil conditions are unknown, use of 1.00 shall be permitted.

d. Tabulated F-factors are based on a slab area to perimeter length ratio of 9:1 and shall be multiplied by one of the following adjustment factors as applicable to a slab's area to perimeter length ratio: 5:1 - 0.7; 6:1 - 0.8; 7:1 - 0.9; 8:1 - 0.95; 9:1 - 1.0; 10:1 - 1.05; 15:1 - 1.2; 20:1 - 1.35; 30:1 - 1.5; and for ≥ 40:1 - 1.7,

e. Tabulated F-factors are based on a slab perimeter edge projection above exterior finish grade of 6 inches. For portions of slab perimeter projecting 12 inches or more above grade, multiply the tabulated F-factors by one of the following adjustment factors as applicable: 12 inches – 1.05; 18 inches – 1.1; 24 inches – 1.15; and 30 inches – 1.2.

f. For basement floor slabs and crawlspaces slabs or gravel floors, the tabulated F-factors shall be multiplied by one of the following adjustment factors based on the depth of the floor surface below exterior finish grade: 1 ft – 0.95; 3 ft – 0.9; and 6 ft or more – 0.8.

g. Vertical insulation on the exterior shall extend for the indicated depth below finish grade and above grade to the top of slab or stem wall. Where insulation is placed on the interior side of a foundation stem wall, it shall extend from the top of slab to the indicated depth below the exterior finish grade and the applicable tabulated F-factor shall be multiplied by 1.05.

h. The R-value of the vertical insulation located on the interior side of a stem wall shall be permitted to be reduced to R-2.5 at the slab edge, not exceeding 6 inches thick, provided the applicable F-factor is multiplied by 1.15 where R-5 vertical insulation is specified, 1.2 where R-10 vertical insulation is specified, or 1.25 where R-15 vertical insulation is specified.

Reason: The main purpose of this proposal is to coordinate with changes to R402.2.10.2 (slabs-on-grade) and R402.2.11.2 (crawlspace walls) which added a reference to Appendix RF in the legislative draft, but the appendix did not include solutions for these assemblies (only placeholders). This proposal provides the solutions and data in Appendix RF as anticipated as a follow-up to these changes made during the recently completed Draft 1 development. It also adds a consistent reference to Appendix RF for alternative assemblies used in the simulated performance compliance path (Section R405). The tabulated F-factors align with those used for R-value and F-factor requirements in Tables R402.1.2 and R402.1.3 of the code. The values are based on the same research used for the code and also referenced in ASHRAE 90.1 Appendix A (see bibliography).

More importantly, tabulated U-factors (and effective U-factors) for below-grade walls (enclosing conditioned basements or crawlspaces) are also provided based on the same research. The effective U-factors for below grade walls are derived in the same manner as F-factors where ground coupling effects are considered and then used to convert the U-factor (or C-factor as used in the commercial code) to an effective value based on air-to-air (instead of air-to-ground) heat exchange such that they have the same basis as U-factors used for above grade assemblies in terms of impacts on annual energy use. This also ensures that equivalent “apples-to-apples” trade-offs are made between above- and below-grade assemblies when using Section R402.1.5 (see revisions to R402.1.5 to coordinate). It also ensures consistent additional UA credits are achieved in accordance with Section R408 for above- and below-grade assemblies. Without these effective U-factors for basement and crawlspace walls, the trade-off value of adding insulation to a typical basement or crawlspace could be over-estimated by as much as 60%. This degree of non-conservative error or bias should not be tolerable.

Alternatively, one could use REScheck (which relies on actual building energy modeling and includes ground-coupling effects) instead of Section R402.1.5 and the proposed effective U-factors. Therefore, an exception is provided for alternative methods based on whole-building energy modeling principles (which is consistent with the REScheck software approach) as laid out in Appendix C of ASHRAE 90.1. With other changes made in this proposal, results should be similar and significant conflicting results avoided.

NOTE TO STAFF: I have attached a Word file of the submitted proposal should the formatting not come through cdpACCESS correctly. It looked correct when submitted, but I had issues inputting the proposal.

Bibliography: Kennedy, M. (1991). Super Good Cents Heat Loss Reference, Volume IV, Earth Contact: Assumptions, Calculations, and Coefficient Tables. Prepared by Ecotope, Seattle, WA for Bonneville Power Administration (Contract No. DE-AP79-91BP15338).

Baylon, D. and Kennedy, M. (2007). Calculating the Impact of Ground Contact on Residential Heat Loss. Buildings X, ASHRAE.

Cleaveland, J.P. and Akridge, J.M. (198?). Slab-on-Grade Thermal Loss in Hot Climates. Georgia Institute of Technology for ASHRAE.

Bahnfleth, W.P. and Amber, J. (1990). Algorithms for Slab-on-Grade Heat Transfer Calculations. U.S. Army Corps of Engineers, USACERL Technical Report E-90/15, September 1990.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The added supporting information in Appendix RF should provide for greater flexibility in evaluating TC trade-offs per R402.2 and R402.1.5, and also TC credit options for additional efficiency credits in R408. This is presumed to provide potential reduced costs. In some cases, depending on conditions the technical improvements could cut both ways, but this would come with the benefit of having a more accurate design where cost vs. benefits are more realistically assessed when considering how much insulation to put where on a building and where to get the lowest-cost credits or trade-offs for a particular building envelope design.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal adds necessary language and tables that coordinate the proper calculation of F-factors for slabs and ground coupling for crawl space walls and basement walls

Final Hearing Results

REC2D-1-23 AM

REC2D-3-23

Original Proposal

IECC RE: ACCA (New)
Proponents:

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

ACCA 1330 Braddock Place, Suite 350, Alexandria, VA 22314. ANSI/ACCA 1 Manual D–2023: Residential Duct Systems

Reason: Provide chapter 6 reference for ANSI/ACCA Manual D that was brought in under RED1-285-22 for R403.3.1 Duct system design.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Editorial

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Provide chapter 6 reference for ANSI/ACCA Manual D that was brought in under RED1-285-22 for R403.3.1 Duct system design.

Final Hearing Results

REC2D-3-23	AS

REC2D-4-23

Original Proposal

IECC RE: TABLE R405.4.2(1)

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	Solar reflectance = 0.25.	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: as specified in Table R402.1.2 , with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Roofs	Type: composition shingle on wood sheathing.	As proposed
	Gross area: same as proposed.	As proposed
	Solar reflectance = 0.25.	As proposed
	Emittance = 0.90.	As proposed
Attics	Type: vented with an aperture of 1 ft^2 per 300 ft^2 of ceiling area.	As proposed
Foundations	Type: same as proposed.	As proposed
	Foundation wall ~~or slab~~ extension above and below grade: same as proposed ~~1 foot (30 cm)~~ ~~Foundation wall or slab extension below grade: same as proposed~~ Foundation wall or slab perimeter length: same as proposed Soil characteristics: same as proposed.	As proposed
	Foundation wall *U*-factor and slab-on-grade *F*-factor: as specified in Table R402.1.2	
Opaque doors	Area: 40 ft^2.	As proposed
	Orientation: North.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	U-factor: same as fenestration as specified in Table R402.1.2 .	As proposed
Vertical fenestration other than opaque doors	Total area[h] = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. (b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: 0.92 – (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 – (0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air leakage rate	For detached one-family dwellings, the air leakage rate at a pressure of 0.2 inch water gauge (50 Pa) shall be Climate Zones 0 through 2: 4.0 air changes per hour. Climate Zones 3 , 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour. For detached one-family dwellings that are 1,500 ft2 (139.4 m^2) or smaller and attached *dwelling units*, the *air leakage* rate at a pressure of 0.2 inch water gauge (50 Pa) shall be 0.27 cfm/ft^2 of the *dwelling unit enclosure area*.	The measured air leakage rate.[a]
Mechanical ventilation rate	-	
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M where: B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air leakage rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms.	The measured mechanical ventilation rate[b], Q, shall be in addition to the measured air leakage rate .
Mechanical ventilation fan energy	The mechanical ventilation system type shall be the same as in the*proposed design*. Heat recovery or energy recovery shall be modeled for mechanical ventilation where required by Section R403.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section R403.6.1.Where mechanical ventilation is not specified in the *proposed design*: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (8.76 × B × M)/ef where: B and M are determined in accordance with the Mechanical Ventilation Rate row of this table. e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of B × M. *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed
Internal gains	IGain, in units of Btu/day per dwelling unit, shall equal 17,900 + 23.8 ×*CFA* + 4,104 × N_{br} where: *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	Same as *standard reference design*.
Internal mass	Internal mass for furniture and contents: 8 pounds per square foot of floor area.	Same as *standard reference design*, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the *building thermal envelope* or structure.
Structural mass	For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.3, located on the interior side of the walls.	As proposed

<table>
<tr><th>BUILDING COMPONENT</th><th>STANDARD REFERENCE DESIGN</th><th>PROPOSED DESIGN</th></tr>
<tr><td rowspan="2"></td><td colspan="2"></td></tr>
<tr><td>For other walls, ceilings, floors, and interior walls: wood frame construction.</td><td>As proposed</td></tr>
<tr><td rowspan="6">Heating systems[d, e, j, k]</td><td>Fuel Type/Capacity: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Product class: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Efficiencies:</td><td>As proposed</td></tr>
<tr><td>Heat pump: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td>Fuel gas and liquid fuel furnaces: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td>Fuel gas and liquid fuel boilers: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td rowspan="2">Cooling systems[d, f, k]</td><td>Fuel Type: Electric
Capacity: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Efficiencies: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td rowspan="6">Service water heating[d, g, k]</td><td>Use, in units of gal/day = 25.5 + (8.5 × N_{br})
where: N_{br} = number of bedrooms.</td><td>Use, in units of gal/day = 25.5 + (8.5 × N_{br}) × (1 - HWDS)
where:
N_{br} = number of bedrooms.
HWDS = factor for the compactness of the hot water distribution system.
<table>
<tr><th colspan="2">Compactness ratio[i] factor</th><th>HWDS</th></tr>
<tr><td>1 story</td><td>2 or more stories</td><td></td></tr>
<tr><td>> 60%</td><td>> 30%</td><td>0</td></tr>
<tr><td>> 30% to ≤ 60%</td><td>> 15% to ≤ 30%</td><td>0.05</td></tr>
<tr><td>> 15% to ≤ 30%</td><td>> 7.5% to ≤ 15%</td><td>0.10</td></tr>
<tr><td>< 15%</td><td>< 7.5%</td><td>0.15</td></tr>
</table></td></tr>
<tr><td>Fuel Type: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Rated Storage Volume: Same asproposed design</td><td>As proposed</td></tr>
<tr><td>Draw Pattern: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td>Tank Temperature: 120° F (48.9° C)</td><td>Same as standard reference design</td></tr>
<tr><td rowspan="3">Thermal distribution systems</td><td>Duct location:
<table>
<tr><th>Foundation Type</th><th>Slab on grade</th><th>Unconditioned crawl space</th><th>Basement or conditioned crawl space</th></tr>
<tr><td>Duct location (supply and return)</td><td>One-story building: 100% in unconditioned attic

All other: 75% in unconditioned attic and 25% inside conditioned space</td><td>One-story building: 100% in unconditioned crawlspace

All other: 75% in unconditioned crawlspace and 25% inside conditioned space</td><td>75 % inside conditioned space

25 % unconditioned attic</td></tr>
</table></td><td>Duct location: as proposed[l] .</td></tr>
<tr><td>Duct insulation: in accordance with Section R403.3.1.</td><td>Duct insulation: as proposed[m] .</td></tr>
<tr><td colspan="2"></td></tr>
</table>

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	Duct system leakage to outside: For *duct systems* serving > 1,000ft^2 (92.9 m^2) of conditioned floor area, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area. For *duct systems* serving ≤ 1,000ft^2 (92.9 m^2) of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).	Duct System Leakage to Outside: The measured total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate. **Exceptions:** 1. Where *duct system* leakage to outside is tested in accordance ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered. 2. Where total *duct system* leakage is measured without the *space conditioning equipment* installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.
	Distribution System Efficiency (DSE): For hydronic systems and ductless systems a thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies.	Distribution System Efficiency (DSE): For hydronic systems and ductless systems, DSE shall be as specified in Table R405.4.2(2).
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F.	Same as *standard reference design*.
Dehumidistat	Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None. Where the proposed design utilizes a mechanical ventilation system with latent heat recovery: Dehumidistat type: manual, setpoint = 60% relative humidity. Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.	Same as *standard reference design*.

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, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a *proposed design* with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a *proposed design* without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the *standard reference design* and *proposed design*.

f. For a *proposed design* without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the *standard reference design* and the *proposed design*.

g. For a *proposed design* without a proposed water heater, the following assumptions shall be made for both the proposed design and *standard reference design*. For a proposed design with a heat pump water heater, the following assumptions shall be made for the *standard reference design*, except the fuel type shall be electric.

Fuel Type: Same as the predominant heating fuel type

Rated Storage Volume: 40 Gallons

Draw Pattern: Medium

Efficiency: Uniform Energy Factor complying with 10 CFR §430.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

AF $= A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = *Standard reference design* total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and
where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a *proposed design* with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the *standard reference design*.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the*standard reference design* shall be the same as *proposed design*.

l. Only sections of *ductwork* that are installed in accordance with Items 1 or 2 of Section R403.3.4, are assumed to be located completely inside *conditioned space*. All other sections of*ductwork* are not assumed to be located completely inside*conditioned space*.

m. Sections of *ductwork* installed in accordance with Section R403.3.5.1, are assumed to have an effective duct insulation R-value of R-25.

Reason: It was discovered recently that the reference design requirement (added by a prior proposal action) to have the foundation wall or slab extension above grade set at 1 foot (while leaving the extension below grade "same as proposed") can create some odd or wrong configurations of the reference design foundation. For example, consider an 8' basement wall that is proposed to be 3 ft above grade and 5 ft below grade. The current reference design requirements would then result in a basement wall that is 1 foot above grade and only 5 ft below grade (for a total wall height of 6 ft). Attempting to fix this by setting a below grade depth for the reference design would then require different values to be established for basement walls vs. conditioned crawlspace walls in a somewhat arbitrary fashion without a clear basis to establish these geometry conditions for a standard reference design.

Given the above, it was decided the best way to fix this for the 2024 code would be to return to the language used in the 2021 code as shown by the changes made in this proposal. Please note that while the term "slab" is used in describing the nature of foundation elements in the table, the term "slab-on-grade" is purposefully used when referencing the F-factors in Table R402.1.2. This is because F-factors are only applicable to slabs-on-grade, not slabs below grade (such as a conditioned basement slab or condition crawlspace ground area). In fact, the F-factors for slabs-on-grade are specifically based on a 6" slab edge extension above grade. Slabs that are some distance below grade are addressed in various rating and modeling software, but are not specifically addressed within the minimum criteria in Table R402.1.2. Consequently, if greater specificity in a standard reference design is to be addressed for a slab or foundation wall geometry relative to exterior grade, more work will be needed to properly coordinate this with the prescriptive requirements as well as how these foundation elements are modeled in various software.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change will neither increase nor decrease the cost of construction

The proposal corrects an error by restoring the reference design foundation wall description related to extension above or below grade to the approach currently in the 2021 IECC. Therefore, there is no cost increase or decrease. Although, this could have soft cost benefits by avoiding confusion in modeling and code compliance.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Corrects an error in the reference design foundation geometry condition and restores to the 2021 code language.

Final Hearing Results

REC2D-4-23	AS

REC2D-6-23

Original Proposal

IECC RE: R402.2.1 (New)

Proponents: Vladimir Kochkin, NAHB, NAHB (vkochkin@nahb.org)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R402.2.1 Ceilings with attics.. Where Section R402.1.3 requires R-38 insulation in the ceiling or attic, installing R-30 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for R-38 insulation wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Where Section R402.1.3 requires R-49 insulation in the ceiling or attic, installing R-38 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for R-49 insulation wherever the full height o uncompressed R-38 insulation extends over the wall top plate at the eaves. ~~Where Section R402.1.3 requires R-60 insulation in the ceiling or attic, installing R-49 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49 insulation extends over the wall top plate at the eaves.~~ This reduction shall not apply to the insulation and *fenestration* criteria in Section R402.1.2 and the component performance alternative in Section R402.1.5.

Reason: Correlates with the changes made to Table R402.1.3.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Correlation with changes made to Table R402.1.3

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: aligns Section R402.2.1 requirements with Table R402.1.3 requirements.

Final Hearing Results

REC2D-6-23	AS

REC2D-7-23

Original Proposal

IECC RE: R403.6.2, TABLE R403.6.2

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R403.6.2 Whole-dwelling mechanical ventilation system fan efficacy. Fans used to provide whole-dwelling mechanical *ventilation* shall meet the efficacy requirements of Table R403.6.2 at one or more rating points. Fans shall be tested in accordance with the test procedure referenced by Table R403.6.2 and *listed*. The airflow shall be reported in the product listing or on the label. Fan efficacy shall be reported in the product listing or shall be derived from the input power and airflow values reported in the product listing or on the label. Fan efficacy for fully ducted HRV, ERV, ~~balanced~~*balanced ventilation systems*, and in-line fans shall be determined at a static pressure of not less than 0.2 inch w.c. (49.85 Pa). Fan efficacy for ducted range hoods, bathroom and utility room fans shall be determined at a static pressure of not less than 0.1 inch w.c. (24.91 Pa).

TABLE R403.6.2 WHOLE-DWELLING MECHANICAL VENTILATION SYSTEM FAN EFFICACY[a]

SYSTEM TYPE	AIRFLOW RATE (CFM)	MINIMUM EFFICACY (CFM/WATT)	TEST PROCEDURE
HRV or ERV	Any	1.2[a]	CAN/CSA C439
Balanced ventilation system without heat or energy recovery	Any	1.2[a]	ASHRAE 51 (ANSI/AMCA Standard 210)
Range hood	Any	2.8	
In-line supply or exhaust fan	Any	3.8	
Other exhaust fan	< 90	2.8	
	≥ 90 and < 200	3.5	
	≥ 200	4.0	
Air-handling unit that is integrated to tested and *listed* HVAC equipment	Any	1.2	Outdoor airflow as specified. *Air-handling unit* fan power determined in accordance with the applicable US Department of Energy Code of Federal Regulations DOE10 CFR 430, or other approved test method .

For SI: 1 cubic foot per minute = 0.47 L/s.

a. For ~~balanced systems~~ *balanced ventilation systems*, HRVs, and ERVs, determine the efficacy as the outdoor airflow divided by the total fan power.

Reason: PCD2 introduces a new term and definition for “balanced ventilation system”. This term was introduced in the newly expanded R408 Additional Efficiency Requirements section. In other sections, in the 2021 IECC, the term was undefined and just called “balanced” (R403.6.2). In PCD2, there still remains two instances where “balanced” or “balanced system” is used and should be reviewed to determine whether the defined term is more appropriate.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

None

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: appropriate use of defined term.

Final Hearing Results

REC2D-7-23 AS

REC2D-8-23

Original Proposal

IECC RE: SECTION 202 (New), R402.5.1.2, R402.5.1.2.1, R402.5.1.3, R403.3.1, R403.3.9, R403.6.4, TABLE R405.4.2(1)
Proponents: Emma Gonzalez-Laders, New York State Dept of State, New York State Dept of State (emma.gonzalez-laders@dos.ny.gov)

2024 International Energy Code [RE] [RE Project] R3

Add new definition as follows:

SLEEPING UNIT. A single unit that provides rooms or spaces for one or more persons, includes permanent provisions for sleeping and can include provisions for living, eating and either sanitation or kitchen facilities but not both. Such rooms and spaces that are part of a *dwelling unit* are not *sleeping units*.

Revise as follows:

~~DWELLING~~ TESTING UNIT ENCLOSURE AREA. The sum of the area of ceiling, floors, and walls separating a dwelling unit or *sleeping unit's* conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the *dwelling unit* or *sleeping unit* to the underside of the floor above.

R402.5.1.2 Air leakage testing. The *building* or each *dwelling unit* or *sleeping unit* in the building shall be tested for air leakage. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, ASTM E1827 or ASTM E3158 and reported at a pressure differential of 0.2 inch water gauge (50 Pa). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed. During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other *infiltration* control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended *infiltration* control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous *ventilation* systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exceptions:

1. For heated~~,~~ attached private garages and heated~~,~~ detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, *building thermal envelope* tightness and insulation installation shall be considered acceptable where the items in Table R402.5.1.1, applicable to the method of construction, are field verified. Where required by the *code official*, an *approved* third party independent from the installer shall inspect both *air barrier* and insulation installation criteria. Heated~~,~~ attached private garage space and heated~~,~~ detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.13 and R402.4.5, as applicable.
2. Where tested in accordance with Section R402.5.1.2.1, testing of each *dwelling unit* or *sleeping unit* is not required.

R402.5.1.2.1 ~~Dwelling unit~~ Unit sampling. For buildings with eight or more *dwelling units* or *sleeping units*, seven or 20 percent of the *dwelling units* or *sleeping units*, whichever is greater, shall be tested. Tested units shall include a top floor unit, a ground floor unit, a middle floor unit, and the *dwelling unit* or *sleeping unit* with the largest ~~*dwelling unit*~~ *testing unit enclosure area*. Where the air leakage rate of a tested unit is greater than the maximum permitted rate, corrective actions shall be taken and the unit re-tested until it passes. For each tested *dwelling unit* or *sleeping unit* with an air leakage rate greater than the maximum permitted rate, three additional units, including the corrected unit, shall be tested. Where buildings have fewer than eight *dwelling units* or *sleeping units*, each ~~*dwelling unit*~~ unit shall be tested.

R402.5.1.3 Maximum air leakage rate. Where tested in accordance with Section R402.5.1.2, the air leakage rate for *buildings*, ~~or~~ *dwelling units*, or *sleeping units* shall be as follows:

1. Where complying with Section R401.2.1, the *building*, or the *dwelling units* or *sleeping units* in the *building* shall have an air leakage rate not greater than 4.0 air changes per hour in Climate Zones 0, 1 and 2~~,~~ ; 3.0 air changes per hour in Climate Zones 3 through 5 ~~,~~ ; and 2.5 air changes per hour in Climate Zones 6 through 8.
2. Where complying with Section R401.2.2 or R401.2.3, the *building* or the *dwelling units* or *sleeping units* in the *building* shall have an air leakage rate not greater than 4.0 air changes per hour, or 0.22 cfm/ft^2 (1.1 L/s x m^2) of the *building thermal envelope* area or the *dwelling* ~~*unit*~~ *testing* unit *enclosure area*, as applicable.

Exceptions:

1. Where *dwelling units* or *sleeping units* are attached or located in an R-2 occupancy, and are tested without simultaneously testing adjacent *dwelling units* or *sleeping units*, the air leakage rate is permitted to be not greater than 0.27 cfm/f^{2}t (1.35 L/s x m^2) of the ~~*dwelling*~~ *testing* *unit enclosure area*. Where adjacent *dwelling units* are simultaneously tested in accordance with ASTM E779, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 (1.35 L/s x m^2) of the ~~*dwelling unit*~~ *testing unit enclosure area* that separates *conditioned space* from the exterior.
2. Where *buildings* have 1,500 square feet (139.4 m^2) or less of *conditioned floor area*, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 (1.35 L/s x m^2).

R403.3.1 Duct system design. *Duct systems* serving one or two *dwelling units* or *sleeping units* shall be designed and sized in accordance with ANSI/ACCA Manual D. *Duct systems* serving more than two *dwelling units* or *sleeping units* shall be sized in accordance with the ASHRAE Handbook of Fundamentals, ANSI/ACCA Manual D, or other equivalent computation procedure.

R403.3.9 ~~Dwelling unit~~ Unit sampling. For *buildings* with eight or more *dwelling units* or *sleeping units* the *duct* systems in the greater of seven, or 20 percent of the *dwelling units* or *sleeping units* in the *building* shall be tested, including a top floor unit, a ground floor unit, a middle floor unit, and the unit with the largest *conditioned floor area*. Where buildings have fewer than eight dwelling units or *sleeping units*, the *duct* systems in each unit shall be tested. Where the leakage of a *duct* system is greater than the maximum permitted *duct system* leakage , corrective actions shall be made to the *duct system* and the *duct system* shall be system re-tested until it passes. For each tested *dwelling unit* or *sleeping unit* that has a greater total *duct system* leakage than the maximum permitted *duct system* leakage , an additional three *dwelling units* or *sleeping units*, including the corrected unit, shall be tested.

R403.6.4 ~~Dwelling unit~~ Unit sampling. For *buildings* with eight or more *dwelling units* or *sleeping units* the mechanical *ventilation* systems in seven, or 20 percent of the *dwelling units* or *sleeping units*, whichever is greater shall be tested.~~,~~ Tested systems shall include ~~a~~ systems in a top floor unit, systems in a ground floor unit, systems in a middle floor unit, and the systems in the *dwelling unit* or *sleeping unit* with the largest *conditioned floor area*. Where *buildings* have fewer than eight *dwelling units* or *sleeping units*, the mechanical *ventilation* systems in each unit shall be tested. Where the *ventilation* flow rate of a mechanical *ventilation* system is less than the minimum permitted rate, corrective actions shall be taken and the system retested until it passes. For each tested *dwelling unit* or *sleeping unit* system with a *ventilation* flow rate lower than the minimum permitted three additional systems, including the corrected system, shall be tested.

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed
	Gross area: same as proposed.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	U-factor: as specified in Table R402.1.2.	As proposed
	Solar reflectance = 0.25.	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: as specified in Table R402.1.2 , with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Roofs	Type: composition shingle on wood sheathing.	As proposed
	Gross area: same as proposed.	As proposed
	Solar reflectance = 0.25.	As proposed
	Emittance = 0.90.	As proposed
Attics	Type: vented with an aperture of 1 ft^2 per 300 ft^2 of ceiling area.	As proposed
Foundations	Type: same as proposed.	As proposed
	Foundation wall or slab extenstion above grade: 1 foot (30 cm) Foundation wall or slab extension below grade: same as proposed Foundation wall or slab perimeter length: same as proposed Soil characteristics: same as proposed.	As proposed
	Foundation wall *U*-factor and slab-on-grade *F*-factor: as specified in Table R402.1.2	
Opaque doors	Area: 40 ft^2.	As proposed
	Orientation: North.	As proposed
	U-factor: same as fenestration as specified in Table R402.1.2 .	As proposed
Vertical fenestration other than opaque doors	Total area[h] = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. (b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: 0.92 - (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 - (0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air leakage rate	For detached one-family dwellings, the air leakage rate at a pressure of 0.2 inch water gauge (50 Pa) shall beas follows: Climate Zones 0 through 2: 4.0 air changes per hour. Climate Zones 3 , 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour. For detached one-family dwellings that are 1,500 ft2 (139.4 m^2) or smaller and attached *dwelling units* or *sleeping units*, the air leakage rate at a pressure of 0.2 inch water gauge (50 Pa) shall be 0.27 cfm/ft^2 of the ~~*dwelling*~~ *testing unit enclosure area*.	The measured air leakage rate.[a]
Mechanical ventilation rate	-	
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M where: B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air leakage rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms.	The measured mechanical ventilation rate[b], Q, shall be in addition to the measured air leakage rate .
Mechanical ventilation fan energy	The mechanical ventilation system type shall be the same as in the*proposed design*. Heat recovery or energy recovery shall be modeled for mechanical ventilation where required by Section R403.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section R403.6.1.Where mechanical ventilation is not specified in the *proposed design*: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (8.76 × B × M)/ef where: B and M are determined in accordance with the Mechanical Ventilation Rate row of this table. e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of B × M. *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed
Internal gains	IGain, in units of Btu/day per dwelling unit, shall equal 17,900 + 23.8 ×*CFA* + 4,104 × N_{br} where: *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	Same as *standard reference design*.
Internal mass	Internal mass for furniture and contents: 8 pounds per square foot of floor area.	Same as *standard reference design*, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the *building thermal envelope* or structure.
Structural mass	For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.3, located on the interior side of the walls.	As proposed
	For other walls, ceilings, floors, and interior walls: wood frame construction.	As proposed
Heating systems[d, e, j, k]	Fuel Type/Capacity: Same as proposed design	As proposed
	Product class: Same as proposed design	As proposed
	Efficiencies:	As proposed
	Heat pump: Complying with 10 CFR §430.32	As proposed
	Fuel gas and *liquid fuel* furnaces: Complying with 10 CFR §430.32	As proposed
	Fuel gas and *liquid fuel* boilers: Complying with 10 CFR §430.32	As proposed
Cooling systems[d, f, k]	Fuel Type: Electric Capacity: Same as proposed design	As proposed
	Efficiencies: Complying with 10 CFR §430.32	As proposed

<table>
<tr><th>BUILDING COMPONENT</th><th>STANDARD REFERENCE DESIGN</th><th>PROPOSED DESIGN</th></tr>
<tr><td rowspan="6">Service water heating[d, g, k]</td><td>Use, in units of gal/day = 25.5 + (8.5 × N_{br})
where: N_{br} = number of bedrooms.</td><td>Use, in units of gal/day = 25.5 + (8.5 × N_{br}) × (1 - HWDS)
where:
N_{br} = number of bedrooms.
HWDS = factor for the compactness of the hot water distribution system.
<table>
<tr><th colspan="2">Compactness ratio[i] factor</th><th>HWDS</th></tr>
<tr><td>1 story</td><td>2 or more stories</td><td></td></tr>
<tr><td>> 60%</td><td>> 30%</td><td>0</td></tr>
<tr><td>> 30% to ≤ 60%</td><td>> 15% to ≤ 30%</td><td>0.05</td></tr>
<tr><td>> 15% to ≤ 30%</td><td>> 7.5% to ≤ 15%</td><td>0.10</td></tr>
<tr><td>< 15%</td><td>< 7.5%</td><td>0.15</td></tr>
</table></td></tr>
<tr><td>Fuel Type: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Rated Storage Volume: Same asproposed design</td><td>As proposed</td></tr>
<tr><td>Draw Pattern: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td>Tank Temperature: 120° F (48.9° C)</td><td>Same as standard reference design</td></tr>
<tr><td rowspan="4">Thermal distribution systems</td><td>Duct location:
<table>
<tr><td>Foundation Type</td><td>Slab on grade</td><td>Unconditioned crawl space</td><td>Basement or conditioned crawl space</td></tr>
<tr><td>Duct location (supply and return)</td><td>One-story building: 100% in unconditioned attic

All other: 75% in unconditioned attic and 25% inside conditioned space</td><td>One-story building: 100% in unconditioned crawlspace

All other: 75% in unconditioned crawlspace and 25% inside conditioned space</td><td>75 % inside conditioned space

25 % unconditioned attic</td></tr>
</table></td><td>Duct location: as proposed[l] .</td></tr>
<tr><td>Duct insulation: in accordance with Section R403.3.1.</td><td>Duct insulation: as proposed[m] .</td></tr>
<tr><td>Duct system leakage to outside:
For duct systems serving > 1,000ft^2 (92.9 m^2) of conditioned floor area, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.
For duct systems serving ≤ 1,000ft^2 (92.9 m^2) of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).</td><td>Duct System Leakage to Outside: The measured total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate.
Exceptions:
<table>
<tr><td>1.</td><td>Where duct system leakage to outside is tested in accordance ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered.</td></tr>
<tr><td>2.</td><td>Where total duct system leakage is measured without the space conditioning equipment installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.</td></tr>
</table></td></tr>
<tr><td>Distribution System Efficiency (DSE): For hydronic systems and ductless systems a thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies.</td><td>Distribution System Efficiency (DSE): For hydronic systems and ductless systems, DSE shall be as specified in Table R405.4.2(2).</td></tr>
</table>

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F.	Same as *standard reference design*.
Dehumidistat	Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None. Where the proposed design utilizes a mechanical ventilation system with latent heat recovery: Dehumidistat type: manual, setpoint = 60% relative humidity. Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.	Same as *standard reference design*.

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, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a *proposed design* with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a *proposed design* without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the *standard reference design* and *proposed design*.

f. For a *proposed design* without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the *standard reference design* and the *proposed design*.

g. For a *proposed design* without a proposed water heater, the following assumptions shall be made for both the proposed design and *standard reference design*. For a proposed design with a heat pump water heater, the following assumptions shall be made for the *standard reference design*, except the fuel type shall be electric.

   Fuel Type: Same as the predominant heating fuel type

   Rated Storage Volume: 40 Gallons

   Draw Pattern: Medium

   Efficiency: Uniform Energy Factor complying with 10 CFR § 430.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

AF = $A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = *Standard reference design* total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and
where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a *proposed design* with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the *standard reference design*.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the*standard reference design* shall be the same as *proposed design*.

l. Only sections of *ductwork* that are installed in accordance with Items 1 or 2 of Section R403.3.4, are assumed to be located completely inside *conditioned space*. All other sections of*ductwork* are not assumed to be located completely inside*conditioned space*.

m. Sections of *ductwork* installed in accordance with Section R403.3.5.1, are assumed to have an effective duct insulation R-value of R-25.

Reason: A problem was created when the term “sleeping unit” was introduced in the Residential provisions of the Energy Code. By mentioning “sleeping units” in some code sections but not others, an ambiguity was created regarding whether certain provisions that only mention “dwelling units” should also apply to “sleeping units.”

This is intended to be an editorial proposal offered as a clarification consistent with the intent of existing code provisions. It adds a definition for the term “sleeping unit” but it neither adds new sections nor deletes existing sections. For simplicity and to avoid unnecessarily repetitive language, we’ve modified the term “~~dwelling~~ unit enclosure area” to read “testing unit enclosure area” in Chapter 2 and wherever it’s mentioned. We also corrected some punctuation mistakes.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is editorial.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: removes ambiguity created regarding whether certain provisions that only mention “dwelling units” should also apply to “sleeping units.”

Final Hearing Results

REC2D-8-23	AM

REC2D-10-23

Original Proposal

IECC RE: R402.5.1.3, R408.2.1.4, R403.3.7, R503.1.2.3, R403.6.2

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

R402.5.1.3 Maximum air leakage rate. Where tested in accordance with Section R402.5.1.2, the air leakage rate for *buildings* or *dwelling units* shall be as follows:

1. Where complying with Section R401.2.1, the *building* or *dwelling units* in the *building* shall have an air leakage rate not greater than 4.0 air changes per hour in Climate Zones 0, 1 and 2, 3.0 air changes per hour in Climate Zones 3 through 5, and 2.5 air changes per hour in Climate Zones 6 through 8.
2. Where complying with Section R401.2.2 or R401.2.3, the *building* or dwelling units in the *building* shall have an air leakage rate not greater than 4.0 air changes per hour, or 0.22 cfm/ft^2 ~~(1.1 L/s x m^2)~~ [1.1 L/(s x m^2)] of the *building thermal envelope* area or *dwelling unit enclosure area*, as applicable.

Exceptions:

1. Where *dwelling units* are attached or located in an R-2 occupancy, and are tested without simultaneously testing adjacent *dwelling units*, the air leakage rate is permitted to be not greater than 0.27 cfm/f^{2}t ~~(1.35 L/s x m^2)~~ [1.4 L/(s x m^2)] of the *dwelling unit enclosure area*. Where adjacent dwelling units are simultaneously tested in accordance with ASTM E779, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 ~~(1.35 L/s x m^2)~~ [1.4 L/(s x m^2)] of the *dwelling unit enclosure area* that separates *conditioned space* from the exterior.
2. Where *buildings* have 1,500 square feet (139.4 m^2) or less of *conditioned floor area*, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 ~~(1.35 L/s x m^2)~~ [1.4 L/(s x m^2)].

R408.2.1.4 Reduced air leakage. For the reduced air leakage credit, the *building* shall have a measured air leakage rate no less than 2.0 ACH50 and no greater than 2.5 ACH50 or the *dwelling units* in the *building* shall have an average measured *air leakage* rate no greater than 0.24 cfm~~50~~/ft^2 [1.2 L/(s x m^2)].

R403.3.7 Duct system testing. Each *duct system* shall be tested for air leakage in accordance with ANSI/RESNET/ICC 380 or ASTM E1554. Total leakage shall be measured with a pressure differential of 0.1 inch water gauge (25 Pa) across the *duct system* and shall include the measured leakage from the supply and return *ductwork*. A written report of the test results shall be signed by the party conducting the test and provided to the *code official*. *Duct system* leakage testing at either rough-in or post-construction shall be permitted with or without the installation of registers or grilles. Where installed, registers and grilles shall be sealed during the test. Where registers and grilles are not installed, the face of the register boots shall be sealed during the test.

Exceptions:

1. Testing shall not be required for *duct systems* serving *ventilation* systems that are not integrated with *duct systems* serving heating or cooling systems.
2. Testing shall not be required where there is not more than 10 feet (3.03 m) of total *ductwork* external to the *space conditioning equipment* and both the following are met:

   2.1. The *duct system* is located entirely within *conditioned space*.

   2.2 The *ductwork* does not include *plenums* constructed of building cavities or gypsum board.

3. Where the *space conditioning equipment* is not installed, testing shall be permitted. The total measured leakage of the supply and return *ductwork* shall be less than or equal to 3.0~~cubic feet per minute~~ cfm (85 L/min) per 100ft^2 ~~square feet~~ (9.29 m) of *conditioned floor area*.
4. Where tested in accordance with Section R403.3.9, testing of each*duct system* is not required.

R503.1.2.3 Duct system leakage. Where an *alteration* includes any of the following, *duct systems* shall be tested in accordance with Section R403.3.5 and shall have a total leakage less than or equal to 12.0 ~~cubic feet per minute~~cfm (339.9 L/min) per 100ft^2~~square feet~~ (9.29 m^2) of *conditioned floor area*:

1. Where 25 percent or more of the registers that are part of the*duct system* are relocated.
2. Where 25 percent or more of the total length of all*ductwork* in the *duct* system are relocated.
3. Where the total length of all *ductwork* in the *duct system* is increased by 25 percent or more.

Exception: *Duct systems* located entirely inside a *conditioned space* in accordance with Section R403.3.2.

R403.6.2 Whole-dwelling mechanical ventilation system fan efficacy. Fans used to provide whole-dwelling mechanical *ventilation* shall meet the efficacy requirements of Table R403.6.2 at one or more rating points. Fans shall be tested in accordance with the test procedure referenced by Table R403.6.2 and *listed*. The airflow shall be reported in the product listing or on the label. Fan efficacy shall be reported in the product listing or shall be derived from the input power and airflow values reported in the product listing or on the label. Fan efficacy for fully ducted HRV, ERV, balanced, and in-line fans shall be determined at a static pressure of not less than 0.2 inch water gauge ~~w.c.~~ (~~49.85~~ 50 Pa). Fan efficacy for ducted range hoods, bathroom and utility room fans shall be determined at a static pressure of not less than 0.1 inch water gauge~~w.c.~~ (~~24.91~~25 Pa).

Reason: Clean-up Units for Air-Leakage and Duct Leakage metrics

Proponents: Gayathri Vijayakumar, gvijayakumar@swinter.com

Reason Statement: Since we don't have a style guide to strictly follow, we now have some incorrect and also inconsistent use of units that cannot be corrected by staff without a proposal. This proposal corrects some but not all.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Inconsistent Units:

1. The 2024 IECC-R uses both "cfm/ft^2" and "cubic feet per minute per square foot". It also uses "L/s x m^2" and "L/(s × m^2)" which are not technically the same conversion.

Recommendation 1:

Consistently use "cfm/ft^2" and "[L/(s × m^2)]" and check conversions (seem to be different in R303 than R402)

R303.1.5 Air-impermeable insulation

. Insulation having an air permeability not greater than

0.004 ~~cubic feet per minute per square foot~~cfm/ft^2 [0.0~~0~~02 L/(s × m^2)] under pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E2178 shall be determined air-impermeable insulation.

R402.5.1.3 Maximum air leakage rate.

1…

2. Where complying with Section R401.2.2 or R401.2.3, the building or dwelling units in the building shall have an air leakage rate not greater than 4.0 air changes per hour, or 0.22 cfm/ft^2 ~~(1.1 L/s x m^2)~~ [1.1 L/(s × m^2)] of the building thermal envelope area or dwelling unit enclosure area, as applicable.

Exceptions:

1. Where dwelling units are attached or located in an R-2 occupancy, and are tested without simultaneously testing adjacent dwelling units, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 ~~(1.35 L/s x m^2)~~ [1.4 L/(s × m^2)] of the dwelling unit enclosure area. Where adjacent dwelling units are simultaneously tested in accordance with ASTM E779, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 ~~(1.35 L/s x m^2)~~ [1.4 L/(s × m^2)] of the dwelling unit enclosure area that separates conditioned space from the exterior.

2. Where buildings have 1,500 square feet (139.4 m^2) or less of conditioned floor area, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 ~~(1.35 L/s x m^2)~~ [1.4 L/(s × m^2)[GV(1] [GV2]].

R408.2.1.4 Reduced air leakage

. For the reduced air leakage credit, the building shall have a measured air leakage rate no less than 2.0 ACH50 and no greater than 2.5ACH50 or the dwelling units in the building shall have an average measured air leakage rate no greater than 0.24 cfm~~50~~/ft^2 [1.2 L/(s × m^2)].

2. The 2024 IECC-R is inconsistent in duct leakage metrics.

Recommendation 2: Consistently use “cfm (## L/min) per 100 f^{2}t ”

R403.3.7 Duct system testing.

Exceptions:

1.

2.

3. Where the space conditioning equipment is not installed, testing shall be permitted. The total measured leakage of the supply and return ductwork shall be less than or equal to 3.0 cfm ~~cubic feet per minute~~ (85 L/min) per 100ft^2 ~~square feet~~ (9.29 m^2) of conditioned floor area.

TABLE R403.3.8

MAXIMUM TOTAL DUCT SYSTEM LEAKAGE

cfm/100 ft^2 (LPM/9.29 m^2)

R503.1.2.3 Duct system leakage.

Where an alteration includes any of the following, duct systems shall be tested in accordance with Section R403.3.5 and shall have a total leakage less than or equal to 12.0 cfm ~~cubic feet per minute~~ (339.9 L/min) per 100ft^2 ~~square feet~~ (9.29 m^2) of conditioned floor area:

TABLE R405.4.2 (1)

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2)

3.

In air leakage and duct leakage tests, we say “0.2 inch water gauge (50 Pa)” and “0.1 inch water gauge (25 Pa)” respectively. R403.6.2 shows 49.85 and 24.91 Pa respectively.

Recommendation 3: Round to 25 and 50 Pa. Consider whether “w.c.” could be “water gauge[”GV3]

R403.6.2 Whole-dwelling mechanical ventilation system fan efficacy. Fans used to provide whole-dwelling mechanical ventilation shall meet the efficacy requirements of Table R403.6.2 at one or more rating points. Fans shall be tested in accordance with the test procedure referenced by Table R403.6.2and listed. The airflow shall be reported in the product listing or on the label. Fan efficacy shall be reported in the product listing or shall be derived from the input power and airflow values reported in the product listing or on the label. Fan efficacy for fully ducted HRV, ERV, balanced, and in-line fans shall be determined at a static pressure of not less than 0.2 inch water gauge~~w.c.~~ (50~~49.85~~ Pa). Fan efficacy for ducted range hoods, bathroom and utility room fans shall be determined at a static pressure of not less than 0.1 water gauge~~w.c.~~ (25~~24.91~~ Pa).

4. Where using “percent” sometimes it is preceded by a dash (sometimes not). It is spelled out most everywhere except R408.2.2.

Recommendation 4: Don’t use the dash between the number and the “percent”

5.

Climate Zone is a defined term. Sometimes is it is capitalized when referencing a specific climate zone, sometimes it is in italics when not referencing a specific zone.

Recommendation 5: Replace “*Climate Zone*” in R408.2 & RG101.3 with “*climate zone*”. Remove italics from “Climate Zone 8” in R408.2.5 and Appendix RI where they reference specific zones.

Also, when a range of climate zones are referenced, it should always be stated “Climate Zones 4 through 8”, not “Climate Zones 4 to 8” nor “Climate Zones 4 – 8.”

[GV(1]2024 IECC-C is using (1.4 L/s x m2)

[GV2]90.-2022 uses "cfm/ft2"

[GV3]Confirmed with Mike Moore.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
editorial changes

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Editorial consistency in units and terminology

Final Hearing Results

REC2D-10-23	AM

RECD1-1-22

Original Proposal

IRCECC: N1103.6.4(R403.6.4) (New)
Proponents: John Hensley, ICC RE HVACR subcommittee, ICC RE HVACR subcommittee (ieccrehvacr@iccsafe.org)

2024 ENERGY Chapter11

Add new text as follows:

N1103.6.4(R403.6.4) Intermittent exhaust control for bathrooms and toilet rooms. Where an exhaust system serving a bathroom or toilet room is designed for intermittent operation, the exhaust system controls shall include one or more of the following:

1. A timer control with one or more delay setpoints that automatically turns off exhaust fans when the selected setpoint is reached. Not fewer than one delay-off setpoint shall be 30 minutes or less.
2. An occupant sensor control with one or more delay setpoints that automatically turns off exhaust fans in accordance with the selected delay setpoint after all occupants have vacated the space. Not fewer than one delay-off setpoint shall be 30 minutes or less.
3. A humidity control with an adjustable setpoint ranging between 50 percent or more and 80 percent or less relative humidity that automatically turns off exhaust fans when the selected setpoint is reached.
4. A contaminant control that responds to a particle or gaseous concentration and automatically turns off exhaust fans when a design setpoint is reached.

Manual-off functionality shall not be used in lieu of the minimum setpoint functionality required by this section.

Exception: Bathroom and toilet room exhaust systems serving as an integral component of an outdoor air ventilation system or a whole-house mechanical ventilation system.

Reason: This proposal will coordinate the IECC-R with Section C403.8.6.2 of IECC-C PC#1. Following is the PC#1 text of that Section with

strikethrough and underline shown for minor modifications that adapt it to the residential chapter.

C403.8.6.2 Intermittent exhaust control for bathrooms and toilet rooms.

Where an exhaust system serving a bathroom or toilet room is designed for intermittent operation, the exhaust system shall be provided with manual-on capability and one or more of the following controls:

1. A timer control that has a minimum setpoint not greater than 30 minutes.

2. An occupant sensor control that automatically turns off exhaust fans within 30 minutes after all occupants have left the space.

3. A humidity control capable of manual or automatic adjustment from a minimum setpoint not greater than 50 percent to a maximum setpoint not greater than 80 percent relative humidity.

4. A contaminant control that responds to a particle or gaseous concentration.

An off setpoint shall not be used to comply with a minimum setpoint requirement.

Exception: Bathroom and toilet room exhaust systems serving as an integral component of an outdoor air ventilation systemor a whole-house

mechanical ventilation system ~~in Group R-2, R-3, and R-4 occupancies~~ shall not be required to provide controls other than manual on capability.

~~An off setpoint shall not be used to comply with a minimum setpoint requirement~~.

Rationale for modifications for the IECC-R version versus the IECC-C PC1 version:

1. Move the sentence beginning with, "an off setpoint shall not…" ahead of the exception to align with the ICC convention of placing all

requirements prior to the exception.

2. Remove the reference to R-2, R-3, and R-4 occupancies because the requirement should apply to dwelling units in all occupancies within the

scope of the IECC-R.

3. Add "whole-house mechanical ventilation system" because this is the defined term that is used in the IRC. "Outdoor air ventilation system" is

the term used in the IMC.

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

The code change proposal will increase the cost of construction
The timers are approximately $ 20 retail (see links below for costs) with a $ 1 credit for the light switch, the installation is the same as a light switch
during new construction. Payback is generally between 3 months and 3 years.
https://www.lowes.com/pd/TORK-Digital-Countdown-Lighting-Timer/1000341275
https://www.homedepot.com/p/GE-In-Wall-Digital-Countdown-Timer-15318/202788262

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal will coordinate the IECC-R with Section C403.8.6.2 of IECC-C PC#1. Following is the PC#1 text of that Section with strikethrough and underline shown for minor modifications that adapt it to the residential chapter.

Final Hearing Results

RECD1-1-22	AM

RECD1-2-22

Original Proposal

IECC: 6 AAMA, AAMA Chapter 06, CSA Chapter 06, 6 WDMA, WDMA Chapter 06
Proponents:

2024 International Energy Conservation Code [CE Project]

Delete and substitute as follows:

Revise as follows:

AAMA

American Architectural Manufacturers Association
1827 Walden Office Square Suite 550
Schaumburg, IL 60173-4268

AAMA/WDMA/CSA 101/I.S.2/A440~~–17~~22:	North American Fenestration Standard/Specification for ~~Windows, Doors, and Skylights~~windows, doors, and skylights

CSA

CSA Group
8501 East Pleasant Valley Road
Cleveland, OH 44131-5516

AAMA/WDMA/CSA 101/I.S.2/A440~~–17~~22:	North American Fenestration Standard/Specification for ~~Windows, Doors and Unit Skylights~~windows, doors, and skylights

WDMA

Window and Door Manufacturers Association
2025 M Street NW, Suite 800
Washington, DC 20036-3309

AAMA/WDMA/CSA 101/I.S.2/A440~~–17~~22:	North American Fenestration Standard/Specification for ~~Windows, Doors and Skylights~~windows, doors, and skylights

Reason: This proposal provides corrections to the listing of the *North American Fenestration Standard/Specification for windows, doors, and skylights* which is a referenced standard in Chapter 4 the IECC. There have been recent changes to the names and/or locations of the promulgating organizations. In addition, the title was slightly incorrect and the standard has also been updated.

The American Architectural Manufacturers Association (AAMA) has changed its name to the Fenestration & Glazing Industry Alliance (FGIA) and also changed its office address.

The Window & Door Manufacturers Association relocated its office.

Also, the title of *AAMA/WDMA/CSA 101/I.S.2/A440: North American Fenestration Standard/Specification for windows, doors, and skylights* has been inconsistently referenced in the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
No change in cost

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: update reference standards and promulgators information.

Final Hearing Results

RECD1-2-22 AS

RECD1-3-22

Original Proposal

IECC: TABLE R402.5.1.1

Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE R402.5.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

Portions of table not shown remain unchanged.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	A sealed air barrier shall be installed in any dropped ceiling or soffit to separate it from unconditioned space. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be air sealed with gasketing materials that allow for repeated entrance over time.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier. Access hatches and doors shall be installed and insulated in accordance with Section R402.2.4 Eave Baffles shall be installed in accordance with Section R402.2.3
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, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The ~~space~~ rough opening gapbetween framing and the frames of skylights, ~~and the jambs of~~ windows and doors, shall be sealed in accordance with fenestration manufacturer's instructions.	Insulation shall not be required in the rough opening gap except as required by the fenestration manufacturer's instructions. ~~Framing cavities around windows, skylights, and doors shall be completely filled with insulation or insulated per window manufacturer's instructions.~~
Rim joists	Rim joists shall include an air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.11. Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.11. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.9.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.11.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.8.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.5.5.	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

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

b. Insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Reconciles the differences between RED1-232, RED1-227, RED1-234 and RED1-183.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal will not increase the cost of construction. It will remove conflict with installation instructions and will prevent consumers, builders, and manufacturers from incurring costs related to repairs caused by code requirements that contradict the manufacturer's instructions.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The previous language had some unintended consequences and possibly voiding the manufacturer's warranty. Multiple members expressed the need to modify the language of the insulation criteria. Proposed language provides clarity and resolves issues related to unintended consequences and is preferred to the language currently in draft 1

Final Hearing Results

RECD1-3-22	AM

RECD1-4-22

Original Proposal

IECC: R404.6.1 (New), R404.6.2 (New), R404.6.2.1 (New), R404.6.2.2 (New), R404.6.2.3 (New), R404.6.2.4 (New), R404.6.2.5 (New), R404.6.2.6 (New), R404.6.2.7 (New), R404.6.2.8 (New)
Proponents:

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.6.1 One- and two- family dwellings and townhouses. One- and two-family dwellings and townhouses shall comply with Sections R404.6.1.1 through R404.6.1.4.

Exceptions:

1. A dwelling unit with a permanently installed, on-site renewable energy system.
2. A dwelling unit with a solar-ready zone area that is less than 500 square feet (46 m^2) of roof area oriented between 110 degrees and 270 degrees of true north.
3. A dwelling unit with less than 500 square feet (46m2) of roof area oriented between 110 degrees and 270 degrees of true north.
4. Dwelling units where 50 percent of the solar-ready zone area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the building for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.
5. A dwelling unit that complies with Appendix RC.
6. A dwelling unit with a renewable energy power purchase agreement with a duration of not less than 15 years from a utility or a community renewable energy facility and for not less than 80 percent of the estimated *dwelling unit* ~~whole-building~~ electric use on an annual basis.
7. A dwelling unit with less than or equal to 1,500 square feet (139 m^2) of living space ~~floor area~~ located above grade plane.

R404.6.2 Group R occupancies. Residential buildings other than one- and two-family dwellings and townhouses ~~Buildings in Group R-2, R-3 and R-4~~ shall comply with ~~the requirements of~~ Sections R404.6.2.1 through R404.6.2.8 ~~Appendix CB~~.

Add new text as follows:

R404.6.2.1 General.. A *solar-ready zone* shall be located on the roof of residential buildings that are oriented between 110 degrees and 270 degrees of true north or have low-slope roofs. *Solar-ready zones* shall comply with Sections R404.6.2.2 through R404.6.2.8.

Exceptions:

1. A building with a permanently installed on-site renewable energy system.
2. A building with a *solar-ready zone* area that is shaded for more than 70 percent of daylight hours annually.
3. A building where an *approved* party certifies that the incident solar radiation available to the building is not suitable for a *solar-ready zone.*
4. A building where an *approved party* certifies that the *solar-ready zone* area required by Section R404.6.2.3 cannot be met because of rooftop equipment, skylights, vegetative roof areas or other obstructions.
5. A building that complies with Appendix RC.

6. A building with a renewable energy power purchase agreement with a duration of not less than 15 years from a utility or a community renewable energy facility and for not less than 80 percent of the estimated electric use of the residential occupancy portion of the building on an annual basis.

R404.6.2.2 Construction document requirements for a solar-ready zone. Construction documents shall indicate the solar-ready zone.

R404.6.2.3 Solar-ready zone area. The total *solar-ready zone* area shall be not less than 40 percent of the roof area calculated as the horizontally projected gross roof area less the area covered by penthouses, mechanical equipment, rooftop structures, 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 (1524 mm) in width in the narrowest dimension.

R404.6.2.4 Obstructions. *Solar-ready zones* shall be free from obstructions, including pipes, vents, ducts, HVAC equipment, skylights and roof-mounted equipment.

R404.6.2.5 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.

R404.6.2.6 Interconnection pathway. *Construction documents* shall indicate pathways for routing of conduit or plumbing from the *solar-ready zone* to the electrical service panel or service hot water system.

R404.6.2.7 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 and shall be labeled “For Future Renewable Electric.” The reserved spaces shall be positioned at the end of the panel that is opposite from the panel supply conductor connection.

R404.6.2.8 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.

Reason: We cannot point to an Appendix for requirements; the requirements have to be stated in the section itself. This proposal takes the requirements from the referenced Appendix CB and copies it into the R404.6.2 section. There are some edits to consider, given that the R404.6.1 section that applies to other residential buildings does not contain some of these sub-sections, as they are covered in R103 and R401.

Bibliography: Appendix CB from 2024 IECC-C, 1st public comment draft [https://www.iccsafe.org/wp-content/uploads/IECC2024P1CE_2022-09-07-clean-gray-red2.pdf]

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

None. Rather than pointing to an Appendix for a requirement, it brings the requirement text into the actual section.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The committee discussed changes proposed in RED1-140 and RED1-169 before voting on RECD1-4-22 to remove references to the commercial code. The committee felt that this proposal successfully combined the elements of past committee work and brought clarity to the section.

Final Hearing Results

RECD1-4-22 AM

RECD1-6-22

Original Proposal

IECC: R405.2
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

R405.2 Simulated performance compliance. Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total building thermal envelope UA, which is the sum of the U-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.15 in accordance with Equation 4-1. the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.15 in accordance with Equation 4-1. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be:

   (Equation #)

   $$\text{For Climate Zones 0-2: } UA_{\text{Proposed design}} \leq 1.08 \text{ x } UA_{\text{Prescriptive reference design}}$$
   $$\text{For Climate Zones 3-8: } UA_{\text{Proposed design}} \leq 1.15\text{x } UA_{\text{Prescriptive reference design}}$$

3. An annual energy cost that is less than or equal to the annual energy cost of the *standard reference design*. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

   Exceptions:

   1. The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multipliers for electricity shall be 2.51. The source energy multiplier for fuels other than electricity shall be 1.09. ~~multipliers for all energy sources shall be obtained from ASHRAE Standard 105 (Tables K2, K4, or K8) or from another data source approved by the code official.~~
   2. The energy use based on site energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost ~~for an all electric building with on-site renewable energy installe~~d.

Reason: Based on discussion during the 2-28 SC meeting on numerous Panel 1 proposals that sought to remove, add, or delete the reference to Appendix K Tables from ASHRAE Standard 105, the Sub-Committee questioned whether the complexity of adding this Standard was worth it. While the Main Committee supported the inclusion of this Standard in the 1st round of comment, upon closer examination, the Table references offer 6 different site-to-source multipliers for electricity which could lead to unnecessary complexity for the code official and software implementers. Additionally, the need for the site-based Exception was called into question given that it yields the same result as the energy cost calculation.

This proposal is similar to RED1-47, which removes the Exception 2 and restores a more simple approach for source energy savings calculation, when it is selected as an alternative to energy cost savings. It also recognizes that the multipliers have decreased, as evidenced by the values in ASHRAE Std 105. This simplifies the code without negatively affecting energy performance.

For reference, how this Section is stated in PCD1 of 2024 IECC-C:

C407.2 Mandatory requirements. Compliance based on total building performance requires that a proposed design meet all of the following:

1. The requirements of the sections indicated within **Table C407.2(1)**.
2. An annual energy cost that is less than or equal to ~~80~~ the percent of the annual energy cost (PAEC) of the *standard reference design* calculated in Equation 4-32. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's *State Energy Data System Prices and Expenditures* reports. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

Exceptions:

1. Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.
2. Where energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area is substituted for the energy cost, the energy use shall be calculated using source energy factors from Table C407.2(2) For electricity, U.S. locations shall use values eGRID subregions. Locations outside the United States shall use the value for "All other electricity" or locally derived values.

$$PAEC = 100 \times (0.85 + 0.025 - ECr/1000)$$

(Equation 4-32)

PAEC = Percentage of annual energy cost applied to standard reference design
EC_r= Energy efficiency credits required for the building in accordance with Section C406.1 (do not include load management and renewable credits)

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No cost impact

See cost effectiveness calculator https://www.iccsafe.org/wp-content/uploads/Copy-of-Source-Multipliers.xlsx

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The term fossil fuel is misleading, and the net result will not improve energy efficiency.

Final Hearing Results

RECD1-6-22 AM

RECD1-7-22

Original Proposal

IECC: TABLE R406.5

Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE R406.5 MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP	ENERGY RATING INDEX WITH OPP
0-1	51	4035
2	51	4034
3	50	4033
4	53	40
5	54	4043
6	53	4043
7	52	4046
8	52	4046

Reason:

Climate Zone	Developed Using PNNL SF Prototypes	Building Type	R406 Target ERI without OPP *	1 kW PV Target ERI with OPP	2 kW PV Target ERI with OPP	3 kW PV Target ERI with OPP	4 kW PV Target ERI with OPP
CZ 1	R406 ERI Home - 51	Single Family	51	43	35	27	19
CZ 2	R406 ERI Home - 51	Single Family	51	42	34	26	18
CZ 3	R406 ERI Home - 50	Single Family	50	42	33	24	15
CZ 4	R406 ERI Home - 53	Single Family	53	47	40	32	25
CZ 5	R406 ERI Home - 54	Single Family	54	49	43	37	32
CZ 6	R406 ERI Home - 53	Single Family	53	48	43	39	35
CZ 7 & 8	R406 ERI Home - 52	Single Family	52	49	46	43	40

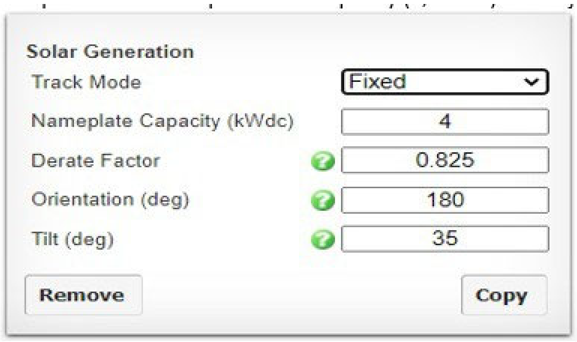
* R406 ERI "not including OPP" targets in IECC 2024 Public Comment Draft #1

The ERI with OPP targets in Public Comment Draft #1 (40 in every climate zone) were placeholders and not based on any form of analysis. The purpose of this proposal is to update the ERI with OPP targets based on simulation analysis via Residential Energy Services Network (RESNET) Accredited Rating Software (Ekotrope). PNNL analyzed the single-family prototypes (2376 sq ft) in the Ekotrope Rating software across all system types, foundation types and 19 representative cities based on a national scale analysis. According to NAHB, 2021 fourth quarter Census Quarterly Starts show a median single-family home is 2,338 square feet. Using prototype models that meet the ERI without OPP targets in Public Comment Draft #1 as the baseline, PNNL modeled onsite PV systems (1 kW, 2 kW and 4 kW) to calculate ERI with OPP potential targets based on system size. The modeled PV systems were oriented due south and tilted equal to the site latitude. The results are summarized in the table above.

The decision to propose 2 kW ERI with OPP scores for Table R406.5 was based in part on the fact that a 2 kW size system fits almost any rooftop. However, based on LBNL and PNNL research, the median size residential PV system in the U.S. in 2021 was 7 kW, with most systems – those within the 20th to 80th percentile – between 4 and 10 kW.

The proposed ERI with OPP targets represent an easy score for a home to meet utilizing onsite PV.

PV specs from Ekotrope - varied capacity (1, 2 or 4) and adjusted tilt to match latitude:



Real Examples for context: CZ5 house with 1500 ft^2 footprint, and around 2,700 ft^2 of CFA. 30 panels, 7.14 kW, produces ~9,400 kWh/yr (Net-zero for electric, still uses gas for heat/DHW)

Another CZ5 home, with 1384 ft^2 CFA…24 panels, ~5 kW.

Bibliography: PV System Sizes - Lawrence Berkeley National Laboratory
https://emp.lbl.gov/sites/default/files/2_tracking_the_sun_2022_report.pdf

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Because the ERI with OPP targets in Public Comment Draft #1 are only placeholders, there is no basis for comparing cost between this proposal and Public Comment Draft #1. Compared to the placeholder targets, the proposed targets are less stringent in four climate zones, more stringent in three climate zones, and the same in one climate zone.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: support the revised ERI maximum values based on analysis provided by PNNL which estimated the ERI with 2 kW of OPP

Final Hearing Results	
RECD1-7-22	AM

RECD1-8-22

Original Proposal

IECC: R405.3, R405.3.1, R405.3.2, R405.3.2.1, R405.3.2.2, R405.4, R405.4.1, R405.4.2; IECC: R405.4.3 (New); IECC: R405.5, R405.5.1, R405.5.2, R405.5.3; IECC: R405.5.2 (New), R405.5.3 (New), R405.5.4 (New), R405.5.4.1 (New), R405.5.4.2 (New)
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

R405.3 Compliance Documentation. ~~Documentation of the software used for the proposed design and the parameters for the baseline *building* shall be in accordance with Sections R405.3.1 through R405.3.2.2.~~ The following compliance reports, which document that the performance of the *proposed design* complies with the requirements of Section R405, shall be submitted to the *code official*.

1. A compliance report, in accordance with Section R405.5.4.1, shall be submitted with the application for the building permit.
2. Upon completion of the building, a confirmed compliance report, in accordance with Section R405.5.4.2, based on the confirmed condition of the building shall be submitted to the code official before a certificate of occupancy is issued.

Delete without substitution:

~~**R405.3.1 Compliance software tools.** Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the *code official*.~~

~~**R405.3.2 Compliance report.** Compliance software tools shall generate a report that documents that the *proposed design* complies with Section R405.3. A compliance report on the *proposed design* shall be submitted with the application for the building permit. Upon completion of the building, a confirmed compliance report based on the confirmed condition of the building shall be submitted to the *c ode official* before a certificate of occupancy is issued.Compliance reports shall include information in accordance with Sections R405.3.2.1 and R405.3.2.2.~~

~~**R405.3.2.1 Compliance report for permit application.** A compliance report submitted with the application for building permit shall include the following:~~

1. ~~Building street address, or other *building site* identification.~~
2. ~~The name of the individual performing the analysis and generating the compliance report.~~
3. ~~The name and version of the compliance software tool.~~
4. ~~Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.~~
5. ~~A certificate indicating that the proposed design complies with Section R405.3. The certificate shall document the building components' energy specifications that are included in the calculation including: component-level insulation *R*-values or *U*-factors; duct system and building envelope air leakage testing assumptions; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.~~
6. ~~Where a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.~~

~~**R405.3.2.2 Compliance report for certificate of occupancy.** A compliance report submitted for obtaining the certificate of occupancy shall include the following:~~

1. ~~Building street address, or other building site identification.~~
2. ~~Declaration of the simulated building performance path on the title page of the energy report and the title page of the building plans.~~
3. ~~A statement, bearing the name of the individual performing the analysis and generating the report, indicating that the as-built building complies with Section R405.3.~~
4. ~~The name and version of the compliance software tool.~~
5. ~~A site-specific energy analysis report that is in compliance with Section R405.3.~~
6. ~~A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the confirmed rated design of the built home complies with Section R405.3. The certificate shall report the energy features that were confirmed to be in the home, including component-level insulation *R*-values or *U*-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation and service water-heating equipment installed.~~
7. ~~When on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.~~

Revise as follows:

R405.4 Calculation procedure. ~~Calculations~~ Performance calculations of the *proposed design* shall be in accordance with Sections R405.4.1, ~~and~~ R405.4.2, R405.4.3. Except as specified by this section, the standard reference design and proposed design shall be configured and analyzed using identical methods and techniques.

R405.4.1 General. ~~Except as specified by this section, the *standard reference design* and *proposed design* shall be configured and analyzed using identical methods and techniques.~~Calculation procedures used to comply with Section R405 shall use an approved software tool, in accordance with R405.5, capable of calculating the annual energy consumption of all building elements that differ between the standard reference design and the proposed design.

R405.4.2 Residence specifications. The *standard reference design* and *proposed design* shall be configured and analyzed as specified by Table R405.4.2(1). Table R405.4.2(1) shall include, by reference, all notes contained in Table R402.1.3.

2024 International Energy Conservation Code [RE Project]

Add new text as follows:

R405.4.3 Input values. When calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from an *approved* source.

2024 International Energy Conservation Code [CE Project]

Revise as follows:

R405.5 Calculation software tools. ~~Calculation software, where used, shall be in accordance with Sections R405.5.1 through R405.5.3~~. Performance analysis tools meeting the applicable provisions of Sections R405.5.1 through R405.5.4 shall be permitted to be approved. Tools are permitted to be *approved* based on meeting a specified threshold for a jurisdiction. The code official shall be permitted to*approve* such tools for a specified application or limited scope.

R405.5.1 Minimum capabilities. ~~Calculation procedures used to comply with this section shall be software tools capable of calculating the annual energy consumption of all building elements that differ between the *standard reference design* and the *proposed design* and~~ *Approved* software tools shall include the following capabilities:

1. Computer generation of the *standard reference design* using only the input for the *proposed design.* The calculation procedure shall not allow the user to directly modify the building component characteristics of the *standard reference design.*

2. Calculation of whole-building (as a single *zone*) sizing for the heating and cooling equipment in the *standard reference design* residence in accordance with Section R403.7.

3. Hourly calculations of building operation for a full calendar year (8760 hours).

~~3.~~ 4. Calculations that account for ~~the effects~~ hourly variations of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.

~~4.~~ 5. Printed *code official* inspection checklist listing each of the *proposed design* component characteristics from Table R405.4.2(1) determined by the analysis to provide compliance, along with their respective performance ratings such as *R*-value, *U*-factor, SHGC, HSPF, AFUE, SEER and EF.

Delete without substitution:

~~**R405.5.2 Specific approval.** Performance analysis tools meeting the applicable provisions of Section R405 shall be permitted to be *approved.* Tools are permitted to be *approved* based on meeting a specified threshold for a jurisdiction. The *code official* shall be permitted to approve such tools for a specified application or limited scope.~~

~~**R405.5.3 Input values.** When calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from an *approved* source.~~

2024 International Energy Conservation Code [RE Project]

Add new text as follows:

R405.5.2 Testing required by software vendors. Prior to approval, software tools shall be tested by the software vendor in accordance with ANSI/ASHRAE Standard 140 Class II, Tier 1 test procedures. During testing, hidden inputs that are not normally accessible to the user shall be permitted to avoid introducing source code changes strictly used for testing. Software vendors shall publish, on a publicly available website, the following ANSI/ASHRAE Standard 140 test results, input files, and modeler reports for each tested version of a software tool:

1. Test results demonstrating the software tool was tested in accordance with ANSI/ASHRAE Standard 140.
2. The modeler report in ANSI/ASHRAE Standard 140, Annex A2, Attachment A2.7.

R405.5.3 Algorithms not tested. Algorithms not tested in accordance with R405.5.2 shall be permitted in accordance with ANSI/RESNET/ICC 301.. Numerical settings not tested, such as timestep duration and tolerances shall be permitted when they represent a higher resolution than the numerical settings used for testing.

R405.5.4 Compliance reports. *Approved* software tools shall generate compliance reports in accordance with R405.5.4.1 and R405.5.4.2.

R405.5.4.1 Compliance report for permit appliction. A compliance report generated for submission with the application for building permit shall include the following:

1. Building street address, or other *building site* identification.
2. The name of the individual performing the analysis and generating the compliance report.
3. The name and version of the compliance software tool.
4. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.

5. A certificate indicating that the *proposed design* complies with Section R405.3. The certificate shall document the building components' energy specifications that are included in the calculation including: component-level insulation R-values or U-factors; duct system and building envelope air leakage testing assumptions; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
6. Where a site-specific report is not generated, the *proposed design* shall be based on the worst-case orientation and configuration of the rated home.

R405.5.4.2 Compliance report for certificate of occupancy. A compliance report generated for submission prior to obtaining the certificate of occupancy shall include the following:

1. Building street address, or other building site identification.
2. Declaration of the simulated building performance path on the title page of the energy report and the title page of the building plans.
3. A statement, bearing the name of the individual performing the analysis and generating the report, indicating that the as-built building complies with the requirements of Section R405.
4. The name and version of the compliance software tool.
5. A site-specific energy analysis report that is in compliance with the requirements of Section R405.
6. A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the confirmed rated design of the built home complies with Section R405. The certificate shall report the energy features that were confirmed to be in the home, including component-level insulation R-values or U-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation and service water-heating equipment installed.
7. When on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.

Reason: This proposal adds language to align the software requirements for R405 with the requirements in R406. The changes are a joint effort in collaboration with members of ASHRAE Standard 140. The new language being proposed is in R405.5.2 and R405.5.3 and a new item #3 in R405.5.1. The rest of the changes are editorial to the existing language in R405.3, R405.4 and R405.454 to cleanup and reorganize the existing requirements.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed changes will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Provides consistent testing requirements for software compliance tools based on ASHRAE Standard 140.

Final Hearing Results

RECD1-8-22 AS

RECD1-10-22

Original Proposal

IECC: R503.1.2, R503.1.2.1

Proponents: Gil Rossmiller (ieccreexistingbldg@iccsafe.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

R503.1.2 Heating and cooling systems. New heating and cooling and duct systems installed as part of an*alteration* shall comply with Section R403. Alterations to heating, cooling and duct systems shall comply with this section.

Exception: Where ducts from an existing heating and cooling system are extended~~ to an *addition*~~.

R503.1.2.1 Ducts. HVAC ducts newly installed as part of an alteration shall comply with Section R403.

Exception: Where ducts from an existing heating and cooling system are extended~~to an *addition*~~.

Reason: Having the term addition tends to be confusing when in the alterations section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This will not increase the cost of construction.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Deletes “To an addition” in both sections. Having “addition” in the alteration section adds confusion. Removing provides clarity to the code.

Final Hearing Results

RECD1-10-22	AS

RECD1-11-22

Original Proposal

IECC: R402.2.8

Proponents: Emma Gonzalez-Laders, New York State Dept of State, New York State Dept of State (ieccreenvelope@iccsafe.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

R402.2.8 Floors. Floor insulation shall ~~comply with one~~ be installed in accordance with allof the following:

1. Table R402.1.2 or Table R402.1.3 and manufacturer's instructions.
2. Floor framing members that are part of the *building thermal envelope* shall be air sealed to maintain a *continuous air barrier*.
3. One of the following methods:

3.1. ~~Installation~~ *Cavity insulation* shall be installed to maintain permanent contact with the underside of the subfloor decking ~~in accordance with manufacturer instructions to maintain required *R*-value or readily fill the available cavity space~~.

3.2. ~~Floor framing cavity~~ *Cavity insulation* shall be ~~permitted~~ installed to ~~be in~~ maintain contact with the top side of sheathing separating the cavity and the unconditioned space below. Insulation shall extend from the bottom to the top of all perimeter floor framing members ~~and the framing members shall be air sealed~~.

3.3. A combination of *cavity insulation* and *continuous insulation* shall be installed ~~so~~ such that the *cavity insulation* ~~is in~~ maintains contact with the top side of the *continuous insulation* ~~that is installed on~~ and the *continuous insulation* maintains contact with the underside of the ~~floor framing~~ structural floor system ~~separating the cavity and the unconditioned space below. The *R*-values of the cavity and continuous insulation components or the R-value of continuous insulation only shall equal the required insulation component *R*-values for floors. Cavity insulation~~ . Insulation shall extend from the bottom to the top of all perimeter floor framing members ~~and the framing members shall be air sealed~~.

3.4 *Continuous insulation* shall be installed to maintain contact with the underside of the structural floor system. Insulation shall extend from the bottom to the top of all perimeter floor framing members.

Reason: This proposal responds to the clarifications requested in REPCD1-18-22. (A separate proposal, RED1-230-22 Modification, addresses the request regarding Table R402.5.1.1.) These editorial changes delineate the four possible scenarios and provide parallel language to clarify the similarities and differences between them.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither increase nor decrease the cost of construction.

Editorial clarification only; no change in code requirements; no impact on cost.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: this proposal responds to the clarifications requested in REPCD1-18-22. (A separate proposal, RED1-230-22 Modification, addresses the request regarding Table R402.5.1.1.) These editorial changes delineate the four possible scenarios and provide parallel language to clarify the similarities and differences between them.

Final Hearing Results

RECD1-11-22 AM

RECD1-12-22

Original Proposal

IECC: SECTION 202 (New), R403.1.2, R403.2, R404.5, TABLE R405.4.2(1), APPENDIX RC, SECTION RC101
Proponents:

2024 International Energy Conservation Code [CE Project]

Add new definition as follows:

BIODIESEL BLEND. A homogeneous mixture of hydrocarbon oils and mono alkyl esters of long chain fatty acids.

FUEL GAS. A natural gas, manufactured gas, liquified petroleum gas or a mixture of these.

FUEL OIL. Kerosene or any hydrocarbon oil having a flash point not less than 100°F (38°C).

LIQUID FUEL. A *fuel oil* or biodiesel blend.

Revise as follows:

R403.1.2 Heat pump supplementary heat. Heat pumps having supplementary electric-resistance, *fuel gas*, or *liquid fuel* ~~fuel oil heat system~~heating systems shall have controls that are configured to prevent supplemental heat operation when the capacity of the heat pump compressor can meet the heating load. ~~Limit supplemental~~ Supplemental heat operation shall be limited to only ~~those times when~~ where one of the following applies:

1. The vapor compression cycle cannot provide the necessary heating energy to satisfy the thermostat setting.
2. The heat pump is operating in defrost mode.
3. The vapor compression cycle malfunctions.
4. The thermostat malfunctions.

R403.2 Hot water boiler temperature reset. Other than where equipped with tankless domestic water heating coils, the~~The~~ manufacturer shall equip each gas, *liquid fuel* ~~oil~~ and electric boiler ~~(other than a boiler equipped with a tankless domestic water heating coil~~)with automatic means of adjusting the water temperature supplied by the boiler ~~to ensure~~so that incremental change of the inferred heat load will cause an incremental change in the temperature of the water supplied by the boiler. This can be accomplished with outdoor reset, indoor reset or water temperature sensing.

R404.5 Electric Readiness. Water heaters, household clothes dryers and cooking appliances that use*fuel gas* or *liquid fuel* ~~conventional tops and conventional oven fossil fuelSystems using fossil fuel: water heaters, household clothes dryers, conventional cooking tops or conventional ovens~~ shall comply with ~~the requirements of~~ Sections R404.5.1 through R404.5.4.

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS
Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	Solar absorptance = 0.75.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	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: as specified in Table R402.1.2, with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	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 an aperture of 1 ft^2 per 300 ft^2 of 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 as specified in Table R402.1.2.	As proposed
Vertical fenestration other than opaque doors	Total area[h] = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. (b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: 0.92 − (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 − (0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 5.0 air changes per hour. Climate Zones 3 through 8: 3.0 air changes per hour.	The measured air exchange rate.[a]

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area, ft^2. N_{br} = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Energy recovery shall not be assumed for mechanical ventilation.	The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal $(1/e_f) \times [0.0876 \times CFA + 65.7 \times (N_{br} + 1)]$ where: e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ CFA = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed
Internal gains	IGain, in units of Btu/day per dwelling unit, shall equal $17{,}900 + 23.8 \times CFA + 4{,}104 \times N_{br}$ where: CFA = conditioned floor area, ft^2. N_{br} = number of bedrooms.	Same as standard reference design.
Internal mass	Internal mass for furniture and contents: 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.3, located on the interior side of the walls.	As proposed
	For other walls, ceilings, floors, and interior walls: wood frame construction.	As proposed
Heating systems[d, e]	For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC—Commercial Provisions. Capacity: sized in accordance with Section R403.7.	As proposed
	~~Non-electric Natural gas, propane~~*Fuel gas* and *liquid fuel* ~~fuel oil~~ furnaces: Complying with 10 CFR §430.32	As proposed
	~~Non-electric Natural gas, propane~~*Fuel gas* and *liquid fuel* ~~fuel oil~~ boilers: Complying with 10 CFR §430.32	As proposed
Cooling systems[d, f]	As proposed. Capacity: sized in accordance with Section R403.7.	As proposed
Service water heating[d, g]	As proposed. Use, in units of gal/day = $25.5 + (8.5 \times N_{br})$ where: N_{br} = number of bedrooms.	As proposed Use, in units of gal/day = $25.5 + (8.5 \times N_{br}) \times (1 - HWDS)$ where: N_{br} = number of bedrooms. $HWDS$ = factor for the compactness of the hot water distribution system.

Compactness ratio[i] factor		HWDS
1 story	2 or more stories	
> 60%	> 30%	0
> 30% to ≤ 60%	> 15% to ≤ 30%	0.05
> 15% to ≤ 30%	> 7.5% to ≤ 15%	0.10
< 15%	< 7.5%	0.15

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Thermal distribution systems	Duct insulation: in accordance with Section R403.3.1. A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. Duct location: same as proposed design. **Exception:** For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area at a pressure of differential of 0.1 inch w.g. (25 Pa).	Duct location: as proposed. Duct insulation: as proposed. As tested or, where not tested, as specified in Table R405.4.2(2).
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F.	Same as standard reference design.
Dehumidistat	Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None. Where the proposed design utilizes a mechanical ventilation system with latent heat recovery: Dehumidistat type: manual, setpoint = 60% relative humidity. Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.	Same as standard reference design.

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, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouses, the following formula shall be used to determine glazing area:

$AF = A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

APPENDIX RE

ALL-ELECTRIC RESIDENTIAL BUILDINGS

SECTION RE102
GENERAL DEFINITIONS

COMBUSTION EQUIPMENT.
Any equipment or appliance used for space heating, service water heating, cooking, clothes drying and/or lighting that uses*fuel gas* or *liquid fuel* ~~fuel gas or fuel oi~~l.

~~**FUEL GAS.** A natural gas, manufactured gas, liquified petroleum gas or a mixture of these~~.

Add new definition as follows:

FUEL OIL. Kerosene or any hydrocarbon oil having a flash point not less than 100°F (38°C).

Reason: Based on multiple approved RED1’s and IRCED1’s in this round (IRCED1-10, 340, 292, 116, 335) and the prior round, there are inconsistencies in how we reference ‘fuels’ that need to be resolved. This proposal resolves those inconsistencies by creating a new term “liquid fuel” that is inclusive of traditional heating oils but also expanded to clearly also include biodiesel blends.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
NONE

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Based on multiple approved RED1’s and IRCED1’s in this round (IRCED1-10, 340, 292, 116, 335) and the prior round, there are inconsistencies in how we reference ‘fuels’ that need to be resolved. This proposal resolves those inconsistencies by creating a new term “liquid fuel” that is inclusive of traditional heating oils but also expanded to clearly also include biodiesel blends.

Final Hearing Results

RECD1-12-22 AM

RECD1-13-22

Original Proposal

IECC RE: TABLE R408.2

Proponents:

2024 International Energy Code [RE] [RE Project] R3

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4 except Marine	Climate Zone 4 Marine	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total TC	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total TC	0	1	1	2	~~2~~1	~~3~~2	~~3~~2	~~3~~2	~~3~~2
R408.2.1.1(3)	>7.5% reduction in total TC	0	1	2	2	2	~~3~~2	3	43	43
R408.2.1.1(4)	>10% reduction in total TC	1	1	2	3	3	4	4	5	5
R408.2.1.1(5)	>15% reduction in total TC	1	2	2	4	4	5	6	7	8
R408.2.1.1(6)	>20% reduction in total TC	2	4	4	5	6	7	8	9	11
R408.2.1.1(7)	>30% reduction in total TC	3	6	6	8	8	11	12	13	16
R408.2.1.2(2)	U-factor and SHGC for vertical fenestration per Table R408.2.1	1	1	1	~~1~~2	1	1	1	~~2~~1	
R408.2.1.3	Roof reflectance (roof is part of the *building thermal envelope* and directly above cooled, conditioned space)	1	1	0	0	0	0	0	0	0
R408.2.1.3	Roof reflectance (roof is above an unconditioned space that contains a duct system)	1	1	0	0	0	0	0	0	0
R408.2.1.4	Reduced air leakage	1	1	1	2	1	3	NA	NA	NA
R408.2.2(1)[b]	Ground source heat pump	4	8	12	19	14	25	32	35	46
R408.2.2(2)[b]	High Performance Cooling (Option 1)	5	4	3	2	1	1	1	1	1
R408.2.2(3)[b]	High Performance Cooling (Option 2)	6	4	3	2	1	1	1	1	1
R408.2.2(4)[b]	High Performance Gas furnace (Option 1)	NA	NA	NA	NA	NA	6	7	7	NA
R408.2.2(5)[b]	High Performance Gas furnace (Option 2)	0	1	2	4	3	NA	NA	NA	8
R408.2.2(6)[b]	High Performance Gas furnace (Option 3)	0	1	1	3	NA	NA	NA	NA	NA
R408.2.2(7)[b]	High Performance Gas furnace and cooling (Option 1)	5	5	4	5	NA	NA	NA	NA	NA
R408.2.2(8)[b]	High Performance Gas furnace and cooling (Option 2)	6	5	5	6	NA	NA	NA	NA	NA
R408.2.2(9)[b]	High Performance Gas furnace and heat pump (Option 1)	13	12	9	7	NA	NA	NA	NA	NA
R408.2.2(10) b	HIgh Performance Heat pump with electric resistance backup (Option 1)	13	12	11	12	NA	NA	NA	NA	NA
R408.2.2(11) b	High Performance Gas furnace and cooling (Option 3)	NA	NA	NA	NA	4	6	7	7	9
R408.2.2(12) b	High Performance Gas furnace and cooling (Option 4)	NA	NA	NA	NA	5	7	8	8	10

R408.2.2(13) b	High Performance Gas furnace and heat pump (Option 2)	NA	NA	NA	NA	8	0	-1	-3	-7
R408.2.2(14) b	High Performance Heat pump with electric resistance backup (Option 2)	NA	NA	NA	NA	8	12	13	14	16
R408.2.3(1) (a)[d]	Gas-fired storage water heaters(option 1)	~~7~~8	~~6~~7	~~5~~7	~~3~~5	~~3~~6	~~2~~4	~~2~~4	3	~~1~~2
R408.2.3(1) (b)[d]	Gas Fired Storage Water Heater(option 2)	9	8	8	6	7	5	4	4	3
R408.2.3(2) (a)[d]	Gas-fired instantaneous water heaters (option 1)	10	9	9	6	7	5	5	4	3
R408.2.3(2) (b)[d]	Gas-fired instantaneous water heaters (option 2)	11	10	9	6	7	6	5	4	3
R408.2.3(3) (a)[d]	Electric water heaters (option 1)	12	11	11	8	8	5	4	4	3
R408.2.3(3) (b)[d]	Electric water heaters (option 2)	12	11	11	8	8	5	4	4	3
R408.2.3(4)[d]	Electric water heaters (option 3)	11	11	11	8	8	5	4	4	3
R408.2.3(5) (a)[d]	Electric water heaters (option 4)	8	10	11	8	11	7	5	5	
R408.2.3(5) (b)[d]	Electric water heaters (option 5)	9	11	12	8	11	7	6	5	4
R408.2.3(5)[d]	Electric water heaters (option 6)	12	11	11	8	8	5	4	4	3
R408.2.3(6) (a)[d]	Solar hot water heating system (option 1)	~~4~~13	~~5~~13	~~6~~13	~~6~~9	~~6~~8	~~6~~5	~~5~~4	~~5~~4	~~4~~3
R408.2.3(6) (b)[d]	Solar hot water heating system (option 2)	10	9	9	6	7	6	5	4	3
R408.2.3.1 [c]	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.4(1)[c]	More efficient distribution system	~~4~~3	~~6~~4	~~7~~5	~~10~~7	~~10~~8	~~12~~10	~~13~~10	~~15~~10	~~16~~14
R408.2.4(2)[c]	100% of *duct systems* in conditioned space	~~4~~2	~~6~~3	~~8~~4	~~12~~6	~~12~~7	~~15~~9	~~17~~9	~~19~~9	~~20~~13
R408.2.4(3)[c]	≥80% of ductwork inside *conditioned space*	2	3	3	5	6	7	7	7	9
R408.2.4(4)[c]	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.5(1)	ERV or HRV installed	0	0	0	0	1	3	2	2	2
R408.2.5(2)[c]	≤2.0 ACH50 with ERV or HRV installed	~~1~~0	~~4~~0	~~5~~0	~~10~~4	~~10~~4	~~13~~8	5	5	5
R408.2.5(3)[c]	≤2.0 ACH50 with a *balanced ventilation system*	~~2~~0	~~3~~0	~~2~~0	~~4~~0	~~4~~0	~~5~~0	4	4	4
R408.2.5(4)[c]	≤1.5 ACH50 with ERV or HRV installed	~~2~~0	~~4~~0	~~6~~0	~~12~~6	~~12~~5	~~15~~10	9	9	9
R408.2.5(5)[c]	≤1.0 ACH50 with ERV or HRV installed	~~2~~0	~~5~~0	~~6~~1	~~14~~7	~~14~~6	~~17~~12	12	12	12
R408.2.6[a]	Energy efficient appliances	~~9~~1	~~8~~1	~~8~~1	~~7~~1	~~7~~1	~~5~~1	~~5~~0	~~5~~0	~~4~~0
R408.2.7	On-site renewable energy measures	17	16	17	11	11	9	8	7	4
R408.2.8	Off-site renewable energy measures	71	65	62	55	46	41	43	41	39
R408.2.8b	Off-site renewable energy measure	1	1	1	1	1	1	1	1	1
R408.2.9[c]	Demand responsive thermostat	1	1	1	1	1	1	1	1	1
R408.2.11	Whole home lighting control	~~1~~0	~~1~~0	~~1~~0	~~1~~0	~~1~~0	~~1~~0	~~1~~0	~~1~~0	~~1~~0

R408.2.12	Higher efficacy lighting	~~1~~0	~~1~~0	~~1~~0	~~1~~0	~~1~~0	~~1~~0	~~1~~0	~~1~~0	~~1~~0

a. Where the measure is selected, each dwelling unit, sleeping unit, and common areas where the measure is applicable must have the measure installed.

b. Where multiple heating or cooling systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

c. Where the measure is selected, each dwelling unit and sleeping unit must comply with the measure.

d. Where the measure is selected, each dwelling unit shall be served by a water heater meeting the applicable requirements. Where multiple service water heating systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

SEER2: Seasonal Energy Efficiency Ratio, HSPF2: Heating Season Performance Factor, EER2: Energy Efficiency Ratio, COP: Coefficient of Performance

Reason: See PNNL methodology posted in 6.29.23 IECC R Agenda

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
See PNNL methodology posted in 6.29.23 IECC R Agenda

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Through analysis done by PNNL provides credit values for provisions in Section R408.

Final Hearing Results

RECD1-13-22 AM

RECPI-2-21

Original Proposal

IRC: TABLE N1105.4.2(1)

Proponents: Richard Potts, IECC Residential Consistency and Administration Subcommittee (ieccreadmin@iccsafe.org)

2021 International Residential Code

Revise as follows:

TABLE N1105.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

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, °C = (°F – 32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences, and for~~townhouses~~ townhouse units, the following formula shall be used to determine glazing area:

. $AF = A_S \times FA \times F$

. where:

. AF = Total glazing area.

. A_S = Standard reference design total glazing area.

. FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

. F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

. and where:

. Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

. Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

. Below-grade boundary wall is any thermal boundary wall in soil contact.

. Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

Reason: Last cycle, ADM5-19 Part 2 revised the IRC by dividing the term "townhouse" into either "townhouse" for the entire building, or "townhouse unit" for individual dwelling units in a townhouse. Although I had previously reviewed each occurrence of the term "townhouse" in the IRC at that time to make changes that appeared necessary to fully execute the terminology improvement under ADM5-19, I committed to repeat this review when the committee discussed that change. Initially, it was my intent to list each occurrence in the IRC in a public comment last cycle and explain the basis for using one term vs. the other. That time consuming exercise no longer seems necessary, given that the 2021 IRC has since been published with ADM5-19 included based on membership action on a public comment submitted by the Washington Association of Building Officials that overturned the committee recommendation.

Given that the term "townhouse" applies to a structure containing three or more "townhouse units," and by extension, it therefore applies to each individual townhouse unit in a townhouse building, I found only this one section in the IRC requiring further action in my opinion. This review and proposal fulfills my commitment to revisit this issue, and anyone with additional concerns is welcome to contact me to discuss drafting a floor amendment for consideration at the committee action hearing if any other changes are considered necessary.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The change is considered to be editorial to update terminology without changing intent or application of the code.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The proposal is intended to correlate the term “Townhouse Unit” with the provisions of the latest adoption of the IRC. The proposal was submitted by the Code Correlation Committee. Footnote H in Table N1105.4.2(1) would be modified in the proposal.

Final Hearing Results

RECPI-2-21 AS

RECPI-8-21

Original Proposal

IECC®: R401.3, R406.7.2.2, ICC Chapter 06

Proponents: Ian Finalyson, IECC RE Econ Modeling Metrics Subcommittee, IECC Residential Economics Modeling Whole Building Metrics Subcommittee

2021 International Energy Conservation Code

Revise as follows:

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

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls*, *crawl space walls* and floors and ducts outside *conditioned spaces*.
2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required duct system and building envelope air leakage testing performed on the building.
4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score and CO2e Index, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted and the compliance path used.

R406.7.2.2 Confirmed compliance report for a certificate of occupancy. A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address or other *building site* identification.
2. Declaration of ERI and CO2e Index on title page and on building plans.
3. The name of the individual performing the analysis and generating the report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
6. A final confirmed certificate indicating that the confirmed rated design of the built home complies with Sections R406.2 and R406.4. The certificate shall report the energy features that were confirmed to be in the home, including: component-level insulation *R*-values or *U*-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water-heating equipment installed. Where on-site renewable energy systems have been installed on or in the home, the certificate shall report the type and production size of the installed system.

ICC

International Code Council, Inc.
500 New Jersey Avenue NW6th Floor
Washington, DC 20001

ANSI/RESNET/ICC 301 ~~—2019~~2022	Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units using an Energy Rating Index-Includes Addendum B

Reason: As stated in the Executive Summary of the "Path Forward on Energy and Sustainability to Confront a Changing Climate," reduction of greenhouse gas emissions is part of our mission on this Committee. This proposal is a simple step toward that goal, by simply reporting an index, similar to ERI, that helps a builder/homeowner understand the performance of their home with respect to GHG. The software that calculates an ERI in 2024 IECC R406 path will be done so in accordance with ANSI 301-2022. That Standard requires software to list this CO2e Index on labels & certificates. It is intended to be published in time for reference within the 2024 IECC to include an update to GHG emission factors (Addendum B).

This proposal doesn't mandate a maximum CO2e Index although it paves the way for a future proposal to do so.

It would also be possible to report GHG emissions, as calculated in accordance with the same standard, if the concept of the CO2e Index is too new to receive enough support.Until ANSI 301-2022 is published, this approved Addendum D to ANSI 301-2019 is being shared, to provide context for the CO2e Index, which will be modified by Addendum B above.

https://www.resnet.us/wp-content/uploads/FS_301-2019AdndmD_webpost.docx

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither increase nor decrease the cost of construction since the reporting of this value is already part of compliance with the referenced Standard.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The subcommittee determined there was benefit in adding a metric to the Certificate (R401.3) that demonstrates GHG emissions. There was modest opposition due to adding an unenforceable metric with uncertain value. After healthy discussion the Econ SC voted largely in favor of including a CO2e index when utilizing the R406 ERI Compliance Alternative.

Final Hearing Results

RECPI-8-21 AS

RECPI-10-21

Original Proposal

IECC®: R408.2.3, Table R408.2.3 (New)

Proponents: John Hensley, IECC RE HVACR & Water Heating Subcommittee, IECC RE HVACR & Water Heating Subcommittee (ieccrehvacr@iccsafe.org)

2021 International Energy Conservation Code

Revise as follows:

R408.2.3 Reduced energy use in service water-heating option. The hot water system shall meet one of the ~~following~~ efficiencies in Table R408.2.3~~:~~.

1. ~~Greater than or equal to 82 EF fossil fuel service water-heating system~~.
2. ~~Greater than or equal to 2.0 EF electric service water-heating system~~.
3. ~~Greater than or equal to 0.4 solar fraction solar water-heating system~~.

Add new text as follows:

Table R408.2.3 Service water-heating efficiencies

OPTION	WATER HEATER	SIZE	TYPE	EFFICIENCY
1.	Gas-fired storage water heaters	≤55 gallons	Medium Draw Pattern	UEF≥0.64
	Uniform Energy Factor (UEF)		High Draw Pattern	UEF≥0.68
	First-hour rating FHR≥51 gallons per hour	>55 gallons	Medium Draw Pattern	UEF≥0.78
			High Draw Pattern	UEF≥0.80
2.	Gas-fired instantaneous water-heater	-	-	UEF≥0.87
3.	Electric water heaters	-	Integrated HPWH	UEF≥3.30
	Uniform Energy Factor (UEF)	-	Integrated HPWH, 120 Volt/15 Amp Circuit	UEF≥2.20
	First-hour rating FHR≥45 gallons per hour	-	Split-system HPWH	UEF≥2.20
4.	Solar water heaters	-	Electric backup	SUEF≥3.00
	Solar uniform energy factor (SUEF)	-	Gas backup	SUEF≥1.80

Reason: Original Proposal REPI-138-21 Proponent and AHRI have been working on this Proposal for months to gain consensus on a modification. After months of discussion both the Proponent and AHRI came back to the subcommittee with similar but still different modifications. After long discussion the subcommittee voted to Disapprove the modified version presented by the Proponent and Approve the version presented by AHRI. This created a committee Proposal listed and submitted separately. Proposal RECPI-10-21.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

code change proposal will neither increase nor decrease the cost of construction

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: provides better clarity of efficiency requirements based on equipment type and draw pattern.

Final Hearing Results

RECPI-10-21	AS

RECPI-11-21

Original Proposal

IECC®: SECTION 202 (New), APPENDIX RC, SECTION RC101, SECTION RC202 (New), RC101.1, RC102.1, RC401.2 (New), RC401.3 (New), SECTION RC102, RC406.1 (New), RC406.2 (New), RC406.3 (New), RC102.2, RC406.4.1 (New), RC406.5 (New), TABLE RC102.2, RC406.6 (New), RC406.7 (New), ASHRAE Chapter 06 (New)

Proponents: Mike Stone, Chair,, IECC Residential Electrical Subcommittee (ieccreelectrical@iccsafe.org)

2021 International Energy Conservation Code

Add new definition as follows:

ENERGY RATING INDEX (ERI). A numerical integer value that represents the relative energy performance of a Rated Home as compared with the energy performance of the *ERI Reference Design*, where an ERI value of 100 represents the energy performance of the*ERI Reference Design* and an ERI value of 0 represents a home with zero net energy performance.

Revise as follows:

APPENDIX RC
ZERO NET ENERGY RESIDENTIAL BUILDING PROVISIONS

SECTION RC101
COMPLIANCE

Add new text as follows:

SECTION RC202
GENERAL DEFINITIONS

Add new definition as follows:

COMMUNITY RENEWABLE ENERGY FACILITY (CREF). A facility that produces energy from*renewable energy resources* and that is qualified as a community energy facility under applicable jurisdictional statutes and rules.

FINANCIAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT (FPPA). A financial arrangement between a renewable electricity generator and a purchaser wherein the purchaser pays or guarantees a price to the generator for the project's renewable generation. Also known as a financial power purchase agreement and virtual power purchase agreement.

PHYSICAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT (PPPA). A contract for the purchase of renewable electricity from a specific renewable electricity generator by a purchaser of renewable electricity.

Revise as follows:

RC4~~1~~01.1 ~~Compliance~~Scope. ~~Existing residential buildings shall comply with Chapter 5. New residential buildings shall comply with Section RC102.~~This appendix applies to new *residential buildings*.

Delete without substitution:

~~**RC102.1 General.** New *residential buildings* shall comply with Section RC102.2.~~

Add new text as follows:

RC401.2 Application. Residential buildings shall comply with Section R406.

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

RC401.3 Certificate. [no change, same as R401.3]

Revise as follows:

SECTION RC~~102~~406
ZERO NET ENERGY RESIDENTIAL BUILDINGS

Add new text as follows:

RC406.1 Scope. [no change, same as R406.1]

RC406.2 ERI compliance. Compliance based on the ERI requires that the rated design meets one of the following:

1. The requirements of the sections indicated within Table R406.2 and Sections R406.3 through R406.7, or
2. The requirements of ASHRAE/IES Standard 90.2, including:
   - 2.1. The ERI requirements of ASHRAE/IES 90.2 Table 6-1 without the use of on-site power production (OPP),
   - 2.2 The requirements of Sections R402.4.1.1, R402.4.1.2, R406. R406.3, R404.4 (Electric Readiness), R404.4 (Electric Vehicle Power Transfer Infrastructure), and
   - 2.3 The maximum ERI including adjusted OPP of Table RC406.5 determined in accordance with RC406.4.

RC406.3 Building thermal envelope. [no change, same as R406.3]

Revise as follows:

RC~~102.2~~406.4 Energy Rating Index ~~zero energy score~~. The Energy Rating Index (ERI) not including renewable energy resources shall be determined in accordance with ANSI/RESNET/ICC 301.~~Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RC102.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:~~

1. ~~ERI value not including on-site power production (OPP) calculated in accordance with RESNET/ICC 301~~.
2. ~~ERI value including on-site power production calculated in accordance with RESNET/ICC 301 with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.~~

The Energy Rating Index (ERI) including renewable energy resources shall be determined in accordance with ANSI/RESNET/ICC 301, except where electrical energy is provided from a community renewable energy facility (CREF) or contracted from a physical or financial renewable energy power purchase agreement that meets requirements of RC406.4.1, on-site power production (OPP) shall be adjusted in accordance with Equation 4-2.

Adjusted OPP = OPP_{kWh} + $CREF_{kWh}$ + ~~REPC~~$PPPA_{kWh}$ + $FPPA_{kWh}$ **(Equation ~~RC-1~~4-2)**

where: OPP_{kWh} = Annual electrical energy from *on-site renewable energy*, in units of kilowatt-hours (kWh).

$CREF_{kWh}$ =**~~Community Renewable Energy Facility power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from a community renewable energy facility that is qualified under applicable state and local utility statutes and rules,~~**

~~**and that allocates bill credits to the rated home.**~~Annual electrical energy from a *community renewable energy facility (CREF*), in units of kilowatt-hours (kWh).
~~**REPC**~~$PPPA_{kWh}$ =~~**Renewable Energy Purchase Contract power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from an energy facility that generates energy with photovoltaic, solar thermal, geothermal energy or wind systems, and that is demonstrated by an energy purchase contract or lease with a duration of not less than 15 years.**~~Where not included as OPP, the annual electrical energy contracted from a *physical renewable energy power purchase agreement*, in units of kilowatt-hours (kWh).
$FPPA_{kWh}$ = Where not included as OPP, the annual electrical energy contracted from a *financial renewable energy power purchase agreement* (FPPA), in units of kilowatt-hours (kWh).

Add new text as follows:

RC406.4.1 Power purchase agreement contract. The renewable energy shall be delivered or credited to the building site under an energy contract with a duration of not less than 10 years. The contract shall be structured to survive a partial or full transfer of ownership of the building property.

RC406.5 ERI-based compliance. Compliance based on an ERI analysis requires that the *rated proposed design* and confirmed built dwelling be shown to have an ERI less than or equal to both values indicated in Table RC406.5 when compared to the *ERI reference design.*

Revise as follows:

TABLE RC~~102.2~~406.5 MAXIMUM ENERGY RATING INDEX[a]

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPPRENEWABLE ENERGY	ENERGY RATING INDEX INCLUDING ADJUSTED OPP (as proposed)
0	42	0
1	4342	0
2	4542	0
3	4742	0
4	4742	0
5	4742	0
6	4642	0
7	4642	0
8	4642	0

~~a. The building shall meet the requirements of Table R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or R402.1.3 of the *2015 International Energy Conservation Code*.~~

Add new text as follows:

RC406.6 Verification by approved agency. [no change, same as R406.6]

RC406.7 Documentation. [no change, same as R406.7]

Add new standard(s) as follows:

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

ASHRAE/IES 90.2-2018	Energy-Efficient Design of Low-Rise Residential Buildings, Including approved addenda (Addenda A (approved Jan 2021), B (June 2021) and D (February 2022))

Reason: This member proposal combines approved proposals to Appendix RC for context, and then adds other beneficial edits to improve this Appendix and its adoptability by an AHJ by making it more similar to R406.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal simply clarifies requirements and thus will result in no additional cost for compliance with the Appendix where adopted.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal consolidates the zero-net sections which have been approved by the full consensus committee to date. It is located within the appendix. It has added additional code section references which are required which results in a more cohesive appendix.

Final Hearing Results

RECPI-11-21	AS

RED1-1-22

Original Proposal

IECC: APPENDIX RC, SECTION RC101, RC101.1, RC101.2, RC101.3, RC101.4, SECTION RC 102 (New), RC102, RC103, RC103.1 (New), RC103.1, RC103.2, RC103.3, RC103.3.1, RC103.4, TABLE RC103.3, RC103.5, RC103.6

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

APPENDIX RC
ZERO NET ENERGY RESIDENTIAL BUILDING PROVISIONS

SECTION RC101
GENERAL

Revise as follows:

RC101.1 ~~General~~Scope. This appendix applies to new ~~residential~~ *residential* *buildings*.

~~**RC101.2 Scope.** [no change, same as R406.1]~~

RC101.3~~2~~ Application. *Residential buildings* ~~Residential buildings~~ shall comply with Section R406.

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

RC101.4~~3~~ Certificate. [no change, same as R401.3]

Add new text as follows:

SECTION RC 102
GENERAL DEFINITIONS

Revise as follows:

~~**RC102 GENERAL DEFINITIONS.**~~ COMMUNITY RENEWABLE ENERGY FACILITY (CREF). A facility that produces energy from ~~renewable energy resources~~ *renewable energy resources* and that is qualified as a community energy facility under applicable jurisdictional statutes and rules.FINANCIAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT (FPPA) . A financial arrangement between a renewable electricity generator and a purchaser wherein the purchaser pays or guarantees a price to the generator for the project's renewable generation. Also known as a "financial power purchase agreement" and "virtual power purchase agree-ment." PHYSICAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT (PPPA). A contract for the purchase of re-newable electricity from a specific renewable electricity generator by a purchaser of renewable electricity.

SECTION RC103
ZERO NET ENERGY RESIDENTIAL BUILDINGS

Add new text as follows:

RC103.1 Scope. . [no change, same as R406.1]

Revise as follows:

RC103.~~1~~2 ERI compliance (Replace R406.2). Compliance based on the ERI requires that the rated design meets one of the following:

1. The requirements of the sections indicated within Table R406.2 and Sections R406.3 through R406.7, or
2. The requirements of ASHRAE/IES Standard 90.2, including:
   - 2.1 The ERI requirements of ASHRAE/IES 90.2 Table 6-1 without the use of on-site power production (OPP),
   - 2.2 The requirements of Sections R402.4.1.1, R402.4.1.2, R406.3, R404.5 (Electric Readiness), R404.7 (Electric Vehicle Power Transfer Infrastructure), and
   - 2.3 The maximum ERI including adjusted OPP of Table RC103.~~3~~ 5 determined in accordance with RC103.4 ~~3~~.

RC103.3~~2~~ Building thermal envelope. [no change, same as R406.3]

RC103.~~3~~4 Energy Rating Index ~~zero net energy score~~. The Energy Rating Index (ERI) not including renewable energy resources shall be determined in accordance with RESNET/ICC 301.The Energy Rating Index (ERI) including renewable energy resources shall be determined in accordance with ANSI/RESNET/ICC 301, except where electrical energy is provided from a community renewable energy facility (CREF) or contracted from a physical or financial renewable energy power purchase agreement that meets requirements of RC406.4.1, on-site power production (OPP) shall be adjusted in accordance with Equation RC-1.

$$\text{Adjusted OPP} = OPP_{kWh} + CREF_{kWh} + PPPA_{kWh} + FPPA_{kWh}$$ **(Equation RC-1)**

OPP_{kWh} = Annual electrical energy from on-site renewable energy, in units of kilowatt-hours (kWh).
CREF $_{kwh}$ = Annual electrical energy from a community renewable energy facility (CREF), in units of kilowatt-hours (kWh).
$PPPA_{kwh}$ = Where not included as OPP, the annual electrical energy contracted from a physical renewable energy power purchase agreement, in units of kilowatt-hours (kWh).
$FPPA_{kwh}$ = Where not included as OPP, the annual electrical energy contracted from a financial renewable energy power purchase agreement (FPPA), in units of kilowatt-hours (kWh).

RC103.4~~3~~.1 Power purchase agreement contract. The renewable energy shall be delivered or credited to the building site under an energy contract with a duration of not less than 10 years. The contract shall be structured to survive a partial or full transfer of ownership of the building property.

RC103.5~~4~~ ERI-based compliance. Compliance based on an ERI analysis requires that the *rated design* and confirmed built dwelling be shown to have an ERI less than or equal to both values indicated in Table RC103.5~~3~~ when compared to the *ERI reference design*.

TABLE RC103.5~~3~~ MAXIMUM ENERGY RATING INDEX[a]

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING RENEWABLE ENERGY	ENERGY RATING INDEX INCLUDING ADJUSTED OPP
0	42	0
1	42	0
2	42	0
3	42	0
4	42	0
5	42	0
6	42	0
7	42	0
8	42	0

RC103.6~~5~~ Verification by approved agency. [no change, same as R406.6]

RC103.7~~6~~ Documentation. [no change, same as R406.7]

Reason: This Public Comment is intended as a clean-up (errata) to ensure Appendix RC is the same version as approved (RECPI-11). RC101 was intended to only have 3 sections, with the same exact headings as R401 (Scope, Application, Certificate).

RC102 has some missing italicized words and some quotes and hyphens that need to be removed.

RC103 was intended to have the same 7 sub-sections as R406, so a Scope section is added as RC103.1 and other section numbers updated accordingly. Also "zero energy score" was intended to be struck from the Energy Rating Index sub-heading. Defined words were intended to be italicized, so those are corrected here.

Bibliography: None, however RECPI-11 from the CAR supports the changes in this PC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
NA

Public Hearing Results

Committee Action **As Modified**

Committee Reason: approve to align with prior Main Committee action on RECPI-11

Final Hearing Results

RED1-1-22 AM

RED1-3-22

Original Proposal

IECC: SECTION 202

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

GRADE PLANE. A reference plane representing the average of the finished ground level adjoining the building at all exterior walls. Where the finished ground level slopes away from the exterior wall, the reference plane ~~shall be~~ is established by the lowest points within the area between the building and the lot line or, where the lot line is more than 6 feet (1829 mm) from the building between the structure and a point 6 feet (1829 mm) from the building.

Reason: Requirements do not belong in definitions; definitions are intended to be explanatory.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No effect on construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Committee supported. Questioned whether this has been submitted for commercial. Proponent submit if necessary

Final Hearing Results

RED1-3-22 AS

RED1-6-22

Original Proposal

IECC: AISI Chapter 06

Proponents: Jonathan Humble, American Iron and Steel Institute, American Iron and Steel Institute (jhumble@steel.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

AISI

American Iron and Steel Institute
25 Massachusetts Avenue, NW, Suite 800
Washington, DC 20001

AISI S250-~~21~~ 22	North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing, with Supplement 1, dated 2022

Reason: Supplement #1 - 2022 modified Section B4.2 Standard Truss Framing equations by removing the parenthesis in the denominator, which was not intended to be included, in order to correctly illustrate the equation. No other modifications were made to Standard S250.

Bibliography: AISI S250-21w/S1-22 North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing, American Iron and Steel Institute, Washington, DC 2022.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This modification to Standard S250 corrected an error tot he 2021 edition.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Necessary change to update the standard

Final Hearing Results

RED1-6-22	AS

RED1-7-22

Original Proposal

IECC: RESNET Chapter 06

Proponents: Ryan Meres, RESNET, RESNET (ryan.meres@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

RESNET

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

ANSI/RESNET/ICC 301–2022: Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units using an Energy Rating Index--includes Addendum A Approved July 28, 2022; Addendum B Approved October 12, 2022 and Addendum C

Reason: Since the publication of ANSI/RESNET/ICC 301-2022, RESNET's SDC 300 has approved new addenda.

Addendum A- provides language regarding the ownership of renewable energy certificates.

Addendum B- provides updated calculations for estimating carbon emissions of homes and creates a new CO2e index.

Addendum C- provides several improvements to the following: Ceiling Area, Interior Shade, Multi-systems, Onsite Battery. It also provides updates to incorporate the new federal equipment equipment testing/labeling requirements for SEER2/HSPF2.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These new addenda to Standard 301 will not increase the cost of construction. Standard 301 is referenced in R406 which is an optional compliance pathway in the IECC.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: SC feels this proposal provides the most up-to-date RESNET language in the IECC

Final Hearing Results

RED1-7-22 AS

RED1-8-22

Original Proposal

IECC: SECTION R101, R101.1, R101.2, 101.2.1 (New)
Proponents: Mike Nugent, Chair, BCAC (bcac@iccsafe.org)

2024 International Energy Conservation Code [RE Project]

SECTION R101
SCOPE AND GENERAL REQUIREMENTS

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

R101.2 Scope (Not subject to public input). This code applies to the design and construction of detached one- and two-family dwellings and multiple single-family dwellings (townhouses) and Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane.

Add new text as follows:

101.2.1 Appendices. Provisions in the appendices shall not apply unless specifically adopted.

Reason: Appendices are in all of the codes except for IZC. The intent is to put information about their adoption for inclusion in the same location in all of the codes immediately following the section on scope. This is already the case in the IBC, IFC, IMC, IPSDC and IWUIC. ADM7-22 has added this section to ICCPC, IGCC, IPMC, and ISPSC. This section was relocated in the IEBC, IFGC, IPC and IRC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This is an editorial coordination item.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal provide consistency with the other International Codes regarding appendices

Final Hearing Results

RED1-8-22	AS

RED1-9-22

Original Proposal

IECC: SECTION R101, R101.1, R101.2, R101.3, R101.5, R101.5.1, SECTION R102 (New), R101.4, R101.4.1, R108.3, R108.2, R108.1, R108.1.1, R108.1.2, R107.1, SECTION R107, SECTION R108

Proponents: Mike Nugent, Chair, BCAC (bcac@iccsafe.org)

2024 International Energy Conservation Code [RE Project]

SECTION R101
SCOPE AND GENERAL REQUIREMENTS

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

R101.2 Scope (Not subject to public input). This code applies to the design and construction of detached one- and two-family dwellings and multiple single-family dwellings (townhouses) and Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane.

R101.3 Intent (Not subject to public input). The International Energy Conservation Code - Residential Provisions provide market-driven, enforceable requirements for the design and construction of residential buildings, providing minimum efficiency requirements for buildings that result in the maximum level of energy efficiency that is safe, technologically feasible, and life cycle cost effective, considering economic feasibility, including potential costs and savings for consumers and building owners, and return on investment. Additionally, the code provides jurisdictions with optional supplemental requirements, including requirements that lead to achievement of zero energy buildings, presently, and, through glidepaths that achieve zeroenergy buildings by 2030 and on additional timelines sought by governments, and achievement of additional policy goals as identified by the Energy and Carbon Advisory Council and approved by the Board of Directors. The code may include non-mandatory appendices incorporating additional energy efficiency and greenhouse gas reduction resources developed by the Code Council and others. Requirements contained in the code will include, but not be limited to, prescriptive- and performance-based pathways. The code will aim to simplify code requirements to facilitate the code's use and compliance rate. The code is updated on a three-year cycle with each subsequent edition providing increased energy savings over the prior edition. The IECC residential provisions shall include an update to Chapter 11 of the International Residential Code. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this intent. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Revise as follows:

~~R101.5~~ R101.4 Compliance. *Residential buildings* shall meet the provisions of IECC–Residential Provisions. *Commercial buildings* shall meet the provisions of IECC–Commercial Provisions.

~~R101.5.1~~ R101.4.1 Compliance materials. The *code official* shall be permitted to approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this code.

Add new text as follows:

SECTION R102
APPLICABILITY

Revise as follows:

~~R101.4~~ R102.1 Applicability. Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.

~~R101.4.1~~ R102.1.1 Mixed residential and commercial buildings. Where a *building* includes both *residential* building and *commercial building* portions, each portion shall be separately considered and meet the applicable provisions of the IECC–Commercial Provisions or IECC–Residential Provisions.

~~R108.3~~ R102.2 Other laws. The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law.

~~R108.2~~ R102.3 Application of references. References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this code.

~~R108.1~~ R102.4 Referenced codes and standards. The codes and standards referenced in this code shall be those indicated in Chapter 6, and such codes and standards shall be considered as part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections ~~R108.1.1~~ R102.4.1 and ~~R108.1.2~~ R102.4.1.

~~R108.1.1~~ R102.4.1 Conflicts. Where conflicts occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.

~~R108.1.2~~ R102.4.2 Provisions in referenced codes and standards. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

~~R107.1~~ R102.5 ~~General~~ Partial invalidity. If a portion of this code is held to be illegal or void, such a decision shall not affect the validity of the remainder of this code.

Delete without substitution:

~~SECTION R107~~ ~~VALIDITY~~

~~SECTION R108~~ ~~REFERENCED STANDARDS~~

Reason: Right now many jurisdictions delete Chapter 1 of the codes and write their own unified Administrative provisions. Part of the reason for this is that it is not easy to see where the administrative provisions are similar or different. Chapter 1 of the I-codes should be different where applicable. However, if the administrative provisions are the same, it is important for the authority having jurisdiction to be able to identify that quickly. As we work on this throughout the codes, it is hoped that jurisdictions will use the Chapter 1's in the relative code.

The intent of this change is to have the provision in Section 101, Scope and General Requirements, and Section 102, Applicability, to contain the same basic points for all the codes. This will make compliance easier. For the IECC, this would involve some reorganization, including movement of the sections dealing with references standards (R108) and validity (R107). There are no changes to requirements. A similar proposal was submitted for IECC Commercial and was accepted.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is a reorganization of administrative provisions with no change to technical requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal aligns with the other I-codes

Final Hearing Results	
RED1-9-22	AS

RED1-10-22

Original Proposal

IECC: SECTION 103 (New), 103.1 (New), 103.2 (New), 103.3 (New)

Proponents: Mike Nugent, Chair, BCAC (bcac@iccsafe.org)

2024 International Energy Conservation Code [RE Project]

Add new text as follows:

SECTION 103
CODE COMPLIANCE AGENCY

103.1 Creation of enforcement agency. The [INSERT NAME OF DEPARTMENT] is hereby created and the official in charge thereof shall be known as the authority having jurisdiction (AHJ). The function of the agency shall be the implementation, administration and enforcement of the provisions of this code.

103.2 Appointment. The authority having jurisdiction (AHJ) shall be appointed by the chief appointing authority of the jurisdiction.

103.3 Deputies. In accordance with the prescribed procedures of this jurisdiction and with the concurrence of the appointing authority, the authority having jurisdiction (AHJ) shall have the authority to appoint a deputy authority having jurisdiction (AHJ) , other related technical officers, inspectors and other employees. Such employees shall have powers as delegated by the authority having jurisdiction (AHJ).

Reason: This section include provisions for the creation of the code compliance agency. Similar language is in the IBC, IFC, IPC, IMC, IFGC, IEBC, IPMC, IPSDC, IWUIC, IRC and IGCC.

The department's responsibilities are more than just 'enforcement' of the code. The fill in the blank for the name allows for the agency to develop a name appropriate to their jurisdiction and responsibilities. This also allows for the code official to appoint staff where needed.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is an editorial change with no change to construction requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal aligns with the other I-codes.

Final Hearing Results

RED1-10-22	AS

RED1-11-22

Original Proposal

IECC: R103.2.2

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

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R103.2.2 Solar-ready system. Where a *solar-ready zone* is provided, the ~~The~~ construction documents shall provide details for dedicated roof area, structural design for roof dead and live load, and routing of conduit or pre-wiring from solar-ready zone to electrical service panel or plumbing from solar-ready zone to service water heating system.

Reason: New section 404.6 contains requirements for renewable energy infrastructure. However, it also contains 7 exceptions where new residential buildings will not have to install infrastructure:

"Exceptions:

1. A dwelling unit with a permanently installed on-site renewable energy system.

2. A dwelling unit with a solar-ready zone area that is less than 500 square feet (46 m2) of roof area oriented between 110 degrees and 270 degrees of true north.

3. A dwelling unit with less than 500 square feet (46m2) of roof area oriented between 110 degrees and 270 degrees of true north.

4. Dwelling units where 50 percent of the solar-ready area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the building for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.

5. A dwelling unit that complies with Appendix RC.

6. A dwelling unit with a renewable energy power purchase agreement with a duration of not less than 15 years from a utility or a community renewable energy facility and for not less than 80 percent of the estimated whole-building electric use on an annual basis.

7. A dwelling unit less than or equal to 1,500 square feet (139 m2) of living space floor area located above grade plane."

Since there will be there are cases where a solar-ready system will not be installed, there needs to be language in R103.2.2 to account for the exceptions.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal only deals with the content of construction documents.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Solar ready zone is a defined term. This section should apply whether the solar ready zone is required by R404.6 or provided voluntarily.

Final Hearing Results

RED1-11-22 AM

RED1-12-22

Original Proposal

IECC: R105.2.2, R105.2.3

Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R105.2.2 Framing and air barrier rough-in inspection. Air barrier inspections at framing and rough-in shall be made before application of air permeable insulation and shall verify compliance with the code ~~as to: fenestration properties such as *U*-factor and SHGC and proper installation; air leakage controls as required by the code;~~ and *approved* plans and specifications. Exterior air barriers ~~may~~ shall be permitted to be inspected after insulation is installed.

R105.2.3 Insulation and fenestration rough-in inspection. Inspections at insulation and fenestration rough-in shall be made before application of interior finish and shall verify compliance with the code as to: types of insulation and corresponding R-values and their correct location and proper installation; fenestration properties such as U-factor and SHGC and proper installation.

Reason: This proposed change removes duplicative requirements. The language in R105.2.2 to "fenestration properties such as U-factor and SHGC and proper installation" is very similar to the language in R105.2.3 that states "types of insulation and corresponding R-values and their correct location and proper installation; fenestration properties such as U-factor and SHGC and proper installation." Duplicative requirements can lead to issues in the field with interpreting the intent of the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The change is editorial and will not change the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: agree with proponent reason statement to remove duplicative requirements. Leaving the term “and” provides flexibility.

Final Hearing Results

RED1-12-22 AM

RED1-13-22

Original Proposal

IECC: R105.2.3, R105.2.4, R105.2.5, R105.2.6

Proponents: Christopher McWhite, Town of Smithfield, Region VI (cmcwhite@me.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

~~**R105.2.3**~~ **R105.2.6 Insulation and fenestration rough-in inspection.** Inspections at insulation and fenestration rough-in shall be made before application of interior finish and shall verify compliance with the code as to: types of insulation and corresponding R-values and their correct location and proper in-stallation; fenestration properties such as U-factor and SHGC and proper installation.

~~**R105.2.4**~~ **R105.2.3 Plumbing rough-in inspection.** Inspections at plumbing rough-in shall verify compliance as required by the code and *approved* plans and specifications as to types of insulation and corresponding *R*-values and protection, and required controls. Where required, inspections shall verify pathways for routing of plumbing from solar-ready zone to service water heating system.

~~**R105.2.5**~~ **R105.2.4 Mechanical rough-in inspection.** Inspections at mechanical rough-in shall verify compliance as required by the code and *approved* plans and specifications as to installed HVAC equipment type and size, required controls, system insulation and corresponding *R*-value, system air leakage control, programmable thermostats, dampers, whole-house ventilation, and minimum fan efficiency.

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

~~**R105.2.6**~~ **R105.2.5 Electrical rough-in inspection.** Inspections at electrical rough-in shall verify compliance as required by the code and the approved plans and specifications as to the locations, distribution, and capacity of the electrical system. Where the solar-ready zone is installed for electricity generation, inspections shall verify conduit or pre-wiring from solar-ready zone to electrical panel.

Reason: Renumbering the sections is not really a problem. Also, the Committee got it right by adding the electrical inspection language so the local inspector has guidance on what to inspect. The issue is that many inspectors view section 105 as the intended inspections order. By locating the insulation and fenestration ahead of the MEP rough inspections reverses the logical order and can have the unintended effect of obscuring in-wall systems with insulation. The intent of this change is to reorder the inspections so as to remain consistent with the logical order of inspections currently being done by inspectors.

Bibliography: I am a career, 22 year Building Code Official who has served communities in five states from the Midwest, to the South, and now in New England. Through The Rhode Island Building Code Standards Committee, I am accepted as a certified Building Official; *R.I.G.L. Ch. 23-27.3 §107.5*. Through The International Code Council, I am exam certified as a Certified Building Official, Housing Code Official, Combination Residential Building Inspector, and a Residential and Commercial Plans Examiner. Through the State of Massachusetts I am a certified/licensed Inspector of Buildings/Building Commissioner. Currently I am working as the Department Head Building and Zoning Official in the Town of Smithfield Rhode Island. Here we are committed to our communities' development through partnerships with local and statewide organizations, institutions, and people who are dedicated and/or focused on the process of maintaining existing buildings and constructing new edifices with the goal of making an ever safer built community. I am committed to pursuing improved life safety in residential and commercial structures and the judicious enforcement of current building code and its referenced standards through effective leadership both within the builders and design community and with the professional staff I have the honor to lead. My personal goal is the building of a team of amicable, fair, ethical, and consistently equitable Officials utilizing State and Local building regulations while also judiciously incorporating relevant 28 CFR, ADA requirements. My role is also to communicate these goals with political bodies, large stakeholder investors in high profile projects, local community projects, and simple renovations with homeowners, without parity. I am also a decades-long member of the International Code Council, the non-profit agency that develops and publishes the building Codes. I've twice served as a selected committee member for code development on the national level and I am currently serving as an elected, Governing Board Member with one ICC Membership Council while chairing a subcommittee in another.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is a simple reordering of code sections and will not have an effect on the cost of construction.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: agree with logical order this provides

Final Hearing Results

RED1-13-22	AS

RED1-14-22

Original Proposal

IECC: R105.2.4
Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R105.2.4 Plumbing rough-in inspection. Inspections at plumbing rough-in shall verify compliance as required by the code and *approved* plans and specifications as to types of insulation and corresponding *R*-values and protection, and required controls. Where solar-ready zone is provided for a solar thermal system ~~required~~, inspections shall verify pathways for routing of plumbing from solar-ready zone to service water heating system.

Reason: This proposal adds clarity by coordinating requirements of the section with applicable definition. Solar-ready zone is defined as "A section or sections of the roof or building overhang designated and reserved for the future installation of solar photovoltaic or solar thermal system." Therefore, plumbing rough-in inspection applies only where the solar-ready zone is designated for a solar thermal system.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal is only providing clarification and would not change the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: the proposal with the modification clarifies that the plumbing rough-in inspection is required where a solar thermal system is provided

Final Hearing Results

RED1-14-22	AM

RED1-16-22

Original Proposal

IECC: R105.4, R105.4.1 (New); IECC: R105.4.1.1 (New), R105.4.1.2 (New), R105.4.1.3 (New), R105.4.1.4 (New); IECC: R105.4.2 (New)
Proponents: Robert Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

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

Add new text as follows:

R105.4.1 Authorization of approved third- party inspection agency. . An *approved* third-party inspection agency shall provide all requested information for the code official to determine that the agency meets the applicable requirements specified in Sections R105.4.1.1 through R105.4.1.3 and to authorize its work in the jurisdiction.

2024 International Energy Conservation Code [CE Project]

Add new text as follows:

R105.4.1.1 Independence. An *approved* third-party inspection agency shall be an independent business identity. The agency shall perform its duties in accordance with the scope of delegated responsibilities established by the *code official*. The agency shall disclose to the *code official* any conflicts of interest including where fees for service are derived. The agency shall acknowledge in writing that it is only authorized to work within the scope of delegated responsibilities.

R105.4.1.2 Equipment. An *approved* third-party inspection agency shall have adequate equipment to perform inspections and tests required by the *code official* and this code. All testing equipment shall be periodically calibrated as required by the manufacturer, testing standards used in this code, or certifications held by the approved third-party inspection agency.

R105.4.1.3 Personnel. Personnel assigned by an *approved* third-party inspection agency to perform inspections and testing shall be trained or credentialed and documentation of training or credentials shall be available to *code official* upon request.

R105.4.1.4 Delegated authority. Where *approved*, a third-party inspection agency shall have the authority to perform delegated inspections and determine compliance or noncompliance of work with *approved construction documents*.

2024 International Energy Conservation Code [RE Project]

Add new text as follows:

R105.4.2 Approved third-party inspection agency reporting. An *approved* third-party inspection agency shall keep records of delegated inspections, tests, and compliance documentation required by this code. The agency shall submit reports of delegated inspections and tests to the *code official* and to the owner or owner's representative. Reports shall indicate the compliance determination for the inspected or tested work based on *approved construction document*. A final report documenting required delegated inspections and tests, and correction of any discrepancies noted in the inspections or tests, shall be submitted, with other required compliance documentation, at a time required by the *code official*.

Reason: Reason Statements:

In relation to the International Energy Conservation Code, third-party inspection agencies and building officials currently have a variety of ideas regarding what should constitute the work of the agency. For the ERI path, for example, many Raters understand that they must develop an ERI score, but do not fully understand their relationship to inspection of other requirements in the IECC. Jurisdictions having authority, are often either abdicating inspections or believe that Rater's are looking at mandatory inspection items. In addition, the creation of a HERS Index score is different from the creation of an ERI score. A HERS Index score is an asset rating which allows for the derating of the R-value of poorly installed insulation in the energy model, as the objective is to benchmark the energy performance of the home on the HERS Index scale. An IECC ERI evaluation of the installation of Insulation does not allow for the deration of poorly installed insulation. If insulation is not installed in accordance with the manufactures instruction and the guidance given in Table R402.4.1.1, then the installation should fail inspection and be reinstalled until it meets the mandatory requirement of the code. This disconnect in understanding is the genesis of this code change proposal.

There are three aspects of the relationship that are specifically troublesome within the context of IECC enforcement and which this proposal addresses.

1. That the Approved third party works at the discretion of the Authority having jurisdiction. If the AHJ does not like the work that is being done the have the complete ability to refuse to accept compliance inspections and reports from a third Party. Clarifying this working relationship should also make it understood that regardless of who is paying the third party they are working at the pleasure of the AHJ and no one else. In addition, clarification of this relationship will enable better energy code enforcement and allow jurisdictions to meaningfully address the workforce shortage within their jurisdictions.

2. Assurance that a transfer of authority is established so that a third-party inspection agency is authorized to fail or pass the inspections they perform and that the party being inspected clearly understands that authority.

3. The code official must clearly establish what is needed from the third-party inspection agency.

4. Lastly, anything inspected by a third-party agency must be reported to the code official and the owner's representative

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

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not increase cost but better allocates dollars currently being spent to ensure that the job being undertaken by approved third party inspection agencies truly meets the needs of the authority having jurisdiction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Provides better guidance to utilize 3rd party inspection agencies to comply with the code. There were concerns raised by some in attendance that will likely address during the PC2 period.

Final Hearing Results

RED1-17-22

Original Proposal

IECC: SECTION R110, R110.1, R110.2, R110.3, R110.4

Proponents: Mike Nugent, Chair, BCAC (bcac@iccsafe.org)

2024 International Energy Conservation Code [RE Project]

SECTION R110
MEANS OF APPEALS

R110.1 General. In order to hear and decide appeals of orders, decisions or determinations made by the *code official* relative to the application and interpretation of this code, there shall be and is hereby created a board of appeals. The board of appeals shall be appointed by the applicable governing authority and shall hold office at its pleasure. The board shall adopt rules of procedure for conducting its business and shall render all decisions and findings in writing to the appellant with a duplicate copy to the code official.

Revise as follows:

R110.2 Limitations on authority. An application for appeal shall be based on a claim that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an equivalent or better form of construction is proposed. The board shall not have authority to waive requirements of this code ~~or interpret the administration of this code~~.

R110.3 Qualifications. The board of appeals shall consist of members who are qualified by experience and trainingon matters pertaining to the provisions of this code and are not employees of the jurisdiction.

R110.4 Administration. The code official shall take ~~immediate~~ action without delay in accordance with the decision of the board.

Reason: The intent of this proposal is coordination for the means of appeals within the family of codes. Most of this was accomplished through ADM40-19 during the last cycle. Comments during the testimony, from the code development committees and subsequent discussions have suggested some improvements.

Limitation on authority. The deletion of ‘or interpret the administration of this code’ is proposed to be deleted so that the board could consider appeals on any part of the codes.

Qualifications: The phrase for experience and training is slightly different in each code. Adding this idea to all codes would provide consistency.

Administration: This modification is to revise Section R110.4 to so that the term 'immediate' is replaces with 'without delay' as a reasonable compromise for a building official to react promptly to a board of appeals decision, without having to respond immediately following the meeting.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
These are administration requirements, so there will be no change in construction requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal coordinates the language in this section with the family of codes

Final Hearing Results	
RED1-17-22	AS

RED1-27-22

Original Proposal

IECC: APPENDIX RG (New), RG101 (New), RG405.2 (New), RG406.5 (New), R406.5 (New), RG408.2 (New)

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com); Mark Lyles, New Buildings Institute, California IOUs (markl@newbuildings.org)

2024 International Energy Conservation Code [RE Project]

Add new text as follows:

APPENDIX RG
2024 IECC Stretch Code

RG101
COMPLIANCE

RG405.2 Simulated building performance compliance. Compliance based on simulated building performance requires that a *building* comply with of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total *building thermal envelope* thermal conductance TC, shall be less than or equal to the *building thermal envelope* thermal conductance TC using the prescriptive U-factors and F-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and 1.15 in Climate Zones 3 through 8 in accordance with Equation 4-2 and Section R402.1.5. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

   For Climate Zones 0-2: $TC_{Proposed\ design} \leq 1.08 \times TC_{Prescriptive\ reference\ design}$ **(Equation 4-2)**

   For Climate Zones 3-8: $TC_{Proposed\ design} \leq 1.15 \times TC_{Prescriptive\ reference\ design}$

3. For each *dwelling unit* with one or more fuel burning appliances for space heating or water heating, or both, the annual energy cost of the *dwelling unit* shall be less than or equal to 70 percent of the annual energy cost of the *standard reference design*. For all other *dwelling units*, the annual energy cost of the *dwelling unit* shall be less than or equal to 75 percent of the annual energy cost of the *standard reference design*. For each *dwelling unit* with greater than 5,000 square feet (465 m^2) of *living space* located above grade plane, the annual energy cost of the *dwelling unit* shall be reduced by an additional 5 percent of annual energy cost of the *standard reference design*. Energy prices shall be taken from an *approved* source, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations.

Exceptions:

1. The energy use based on source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multipliers for electricity shall be 2.51. The source energy multiplier for fuels other than electricity shall be 1.09.
2. The energy use based on site energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost.

RG406.5 ERI-based compliance. Compliance based on an ERI analysis requires that the *rated design* and each confirmed as-built *dwelling unit* be shown to have an ERI less than or equal to the applicable value indicated in Table R406.5 where compared to the *ERI reference design* as follows:

1. Where on-site renewables are not installed, the maximum ENERGY RATING INDEX NOT INCLUDING OPP applies.
2. Where on-site renewables are installed, the maximum ENERGY RATING INDEX INCLUDING OPP applies.

Exceptions:

1. Where the ERI analysis excludes OPP, the maximum ENERGY RATING INDEX NOT INCLUDING OPP shall be permitted.
2. For *buildings* with twenty or more *dwelling units*, where approved by the *code official*, compliance shall be permitted using the Average Dwelling Unit Energy Rating Index, as calculated in accordance with ANSI/RESNET/ICC 301.

R406.5 MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP	ENERGY RATING INDEX WITH OPP
0-1	46	27
2	46	26
3	45	24
4	48	32
5	49	37
6	48	39
7	47	43
8	47	43

RG408.2 Additional energy efficiency credit requirements. *Residential buildings* shall earn not less than twenty credits from not less than two measures specified in Table R408.2. Five additional credits shall be earned for dwelling units with more than 5,000 square feet (465 m2) of *living space* located above *grade plane*. To earn credit as specified in Table R408.2 for the applicable *Climate Zone*, each measure selected for compliance shall comply with the applicable subsections of Section R408. Each *dwelling unit* or *sleeping unit* shall comply with the selected measure to earn credit. Interpolation of credits between measures shall not be permitted.

Reason: This glide path appendix is being offered as a simple option for jurisdictions to adopt to exceed the energy performance 2024 IECC on their "glide path" to net zero energy. To attain that additional performance, this Appendix has three sections that would replace the corresponding sections in the main body of the code: one section from each Compliance option (Prescriptive, Simulated Performance, and ERI).

Where changes are made throughout the public comment period to these three copied sections, those changes would be intended to be updated here as well.

Bibliography: None

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

For jurisdictions that adopt this code, local building construction costs at the time of adoption should be considered to determine cost-effectiveness.

Public Hearing Results

Committee Action	**As Modified**

Committee Reason: support a Glide Path Appendix as an optional pathway for AHJ’s to adopt in order to achieve higher energy conservation without yet requiring net-zero performance or renewable installations. Compared to the version in the monograph, the Proponent had modified the ERI Max values to reflect 10% reduction below 2024 IECC ERI values without OPP and to revise the ERI Max values with OPP, based on recent PNNL analysis.

Final Hearing Results	
RED1-27-22	AM

RED1-28-22

Original Proposal

IECC: APPENDIX RH (New), RH101 (New), SECTION 202 (New), RH102 (New), RH401.2 (New), RH401.3 (New), RH406.2 (New), RH406.7.2.2 (New)

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

Add new text as follows:

APPENDIX RH
Operational Carbon Rating and Energy Reporting

RH101
GENERAL DEFINITIONS

Add new definition as follows:

$CO2_e$ INDEX. A numerical integer value, calculated in accordance with ANSI / RESNET / ICC 301 that represents the relative Carbon Dioxide equivalence (CO_2e) emissions of a *rated design* as compared with the CO_2e emissions of the CO_2e reference design and where an Index value of 100 represents the CO_2e performance of the CO_2e reference design and an Index value of 0 (zero) represents a home that emits zero net CO_2e annually.

Add new text as follows:

RH102
COMPLIANCE

RH401.2 Application. Residential buildings shall comply with Section R406.

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

RH401.3 Certificate. A permanent certificate shall be completed by the builder or other *approved* party and posted on a wall in the space where the furnace is located, a utility room or an *approved* location inside the *building*. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory *label*, service disconnect *label* or other required labels. The certificate shall indicate the following:

1. The predominant R-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls, crawl space walls* and floors and ducts outside *conditioned spaces*.
2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the *building thermal envelope*, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required duct system and *building thermal envelope* air leakage testing performed on the *building*.

4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate "gas-fired unvented room heater," "electric furnace" or "baseboard electric heater," as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where on-site *photovoltaic* panel systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score and CO_2e Index, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted.
8. Where a *solar-ready zone* is provided, the certificate shall indicate the location, and dimensions.

RH406.2 ERI and CO2e Index compliance. Compliance based on the ERI and *CO_{2e} Index* requires that the *rated design* and as-built *dwelling unit* meet all of the following:

1. The requirements of the sections indicated within Table R406.2.
2. Maximum ERI values indicated in Table R406.5.
3. For all-electric dwelling units, maximum $CO2_e$ Index of 65, not including OPP, determined in accordance with ANSI/RESNET/ICC 301. For mixed-fuel *dwelling units*, a maximum $CO2_e$ Index established at the time of adoption of this Appendix by the authority having jurisdiction based on the $CO2_e$ emissions data specific to the jurisdiction.

RH406.7.2.2 Confirmed compliance report for a certificate of occupancy. . A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address or other *building site* identification.
2. Declaration of ERI and CO_2e Index on title page and on building plans.
3. The name of the individual performing the analysis and generating the report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the*ERI* reference design and the as-built *dwelling unit*.
6. A final confirmed certificate indicating that the as-built building has been verified to comply with Sections R406.2, R406.4, and R406.5. The certificate shall report the energy features that were confirmed to be in the building, including: component-level insulation R-values or *U*-factors; results from any required duct system and*building thermal envelope* air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water-heating equipment installed. The certificate shall report the estimated dwelling unit energy use by fuel type, inclusive of all end-uses. Where on-site renewable energy systems have been installed on or in the building, the certificate shall report the type and production size of the installed system.

Reason: As stated in the Executive Summary of the "Path Forward on Energy and Sustainability to Confront a Changing Climate," reduction of greenhouse gas emissions is part of our mission on this Committee. This proposal is a step toward that goal, by reporting an index, similar to ERI, that helps a builder/homeowner understand the performance of their home with respect to GHG. The calculation of this CO2e index has no added cost and requires no additional effort by the builder or rater. The same software that calculates an ERI in 2024 IECC R406 path will be done so in accordance with ANSI 301-2022. That Standard requires software to list this CO2e Index on labels & certificates. It will be published in time for reference within the 2024 IECC to include an update to GHG emission factors (Addendum B).

This proposal also provides an achievable but maximum CO2e Index and adds the reporting of energy use such that GHG emissions could be calculated separately, if other metrics are being used by the jurisdiction to document GHG performance.

Bibliography: None

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither increase nor decrease the cost of construction since the reporting of this value is already part of compliance with the referenced Standard.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: support the Carbon Rating Appendix as an optional pathway for AHJ's to adopt in order to demonstrate reductions in operational carbon. Based on discussion, a motion to modify the max CO2e Index was made, increasing it to 65 from 55.alues without OPP and to revise the ERI Max values with OPP, based on recent PNNL analysis.

Final Hearing Results

RED1-28-22	AM

RED1-31-22

Original Proposal

IECC: SECTION 202

Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

SIMULATED BUILDING PERFORMANCE. A process in which the proposed building design is compared to a*standard reference design* for the purposes of estimating relative energy use ~~against a baseline~~ to determine code compliance.

Reason: This proposal clarifies the definition. The *standard refence design* is the baseline.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is a clarification of intent.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The deleted words are redundant, because the standard reference design is the baseline.

Final Hearing Results

RED1-31-22	AS

RED1-32-22

Original Proposal

IECC: Table R402.4.1.1 (New)
Proponents: Robert Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

Table R402.4.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION a.

COMPONENT	AIR BARRIER AND AIR SEALING CRITERIA	INSULATION INSTALLATION CRITERIA
HVAC Register boots	HVAC supply and return register boots that penetrate the *building thermal envelope* shall be sealed to the subfloor, wall covering, or ceiling penetrated by the boot.	HVAC supply and return register boots located in the *building's thermal envelope* shall be buried in or surrounded by insulation.Insulation shall be fitted tightly aroundHVAC supply and return register boots located in the *buildings thermal envelope to maintain its required assembly R-value per section R401.2*

Reason: This proposal was approved as modified by the committee. However, only the approved changes to the Insulation installation criteria were listed in the released draft of the IECC for public comment. There were also approved changes to the Air Barrier side of the table that were not reflected in the released draft of the IECC for public comment. This Public ensures that there is a record of everything that was approved by the committee as an errata to the released draft of the IECC for public comment.

In addition the Public comment addes “and air Sealing” to the table header so it now would read, “Air Barrier And Air Sealing Criteria” to better reflect the purpose of the table.

The proposal as originally written and approved requires that all supply and return registers be sealed to the surface they are penetrating. The origin of this air sealing requirement comes from ENERGY STAR, who has demonstrated that energy loss is associated with duct boot installation in three ways: 1) if the boot directly penetrates the thermal envelope, such as a duct boot coming from a ventilated attic into the house; 2) when air that should be delivered to the conditioned space is redirected into building cavities when it hits the register cover; 3) when Venturi pressure, sometimes called the Coanda effect, is created and pulls air into the building cavity as it is being delivered into the room. See Bibliography for more)

Read more here, **https://www.achrnews.com/articles/128615-why-dirt-streaking-occurs-around-vents**

By not being able to deliver the HVAC designed volume of air to the rooms of the house, the occupant is often left with no other choice than to raise the thermostat set point temperature in the winter and to lower it in the summer. This causes energy inefficiencies while not correcting their comfort issue. In addition, building cavities are often connected to unconditioned space which increases duct leakage to the outside, as well as other inefficiencies. Therefore, I believe that it is an important energy and building durability issue. This needs to be addressed at this time because many builders and contractors have experience implementing this in part, if not in whole, and this proposal finished what the code has been intending when it barrowed this requirement from the Energy Star program.

There have not been insulation requirements associated with duct boots in the past which continues to make this a significant code change proposal. Ensuring that our building cavities are insulated properly is imperative when duct boots are placed in them, and this proposal directly addresses that issue at the termination of the duct boot and the substrate it passes through.

Lastly, this proposal aligns with ENERGY STAR requirements that are the basis of the creation of this table that has been adopted by the IECC.

6. Duct Quality Installation: See Bibliography from more information

6.4.1 In addition, all duct boots sealed to the finished surface, Rater-verified at final. 39

Cost Statement:

§ As the committee noted this proposal changes the scope of the requirement and therefore should slightly increase the cost of execution. However, the proposed in reality offers better clarity and expansion of existing requirements.

Bibliography: Read more here, **https://www.achrnews.com/articles/128615-why-dirt-streaking-occurs-around-vents**

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

The proposed language may possibly increase the cost of construction a small amount due to the application of additional caulk but the benefits to the energy performance of the system far out way the small incremental cost. For Energy Star builders there would be no increase in cost.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: based on committee action on REPI-50-21.

Final Hearing Results

RED1-32-22	AS

RED1-35-22
Original Proposal

IECC: R405.1, R405.2

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

R405.1 Scope. This section establishes criteria for compliance using simulated building performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water-heating energy only.

Revise as follows:

R405.2 Simulated building performance compliance. Compliance based on ~~total~~ simulated building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total building thermal envelope UA, which is the sum of the U-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and 1.15 in Climate Zones 3 through 8 in accordance with Equation 4-2. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

(Equation 4-2)

$$\text{For Climate Zones 0-2: } UA_{\text{Proposed design}} \leq 1.08 \text{ x } UA_{\text{Prescriptive reference design}}$$

$$\text{For Climate Zones 3-8: } UA_{\text{Proposed design}} \leq 1.15 \text{x } UA_{\text{Prescriptive reference design}}$$

3. For buildings without a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 85 percent of the annual energy cost of the *standard reference design*. For buildings with a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 80 percent of the annual energy cost of the standard reference design. For dwelling units with greater than 5,000 square feet (465 m^2) of living space floor area located above grade plane, the annual energy cost of the proposed design shall be reduced by an additional 5 percent of annual energy cost of the standard reference design. Energy prices shall be taken from ~~a~~ an *approved* source ~~*approved* by the *code official*~~, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

   Exceptions:

   1. The energy use based on source energy expressed in Btu or Btu per square foot of*conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multipliers for all energy sources shall be obtained from ASHRAE Standard 105 (Tables K2, K4, or K8) or from another data source approved by the *code official*.
   2. The energy use based on site energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost for an all-electric building with on-site renewable energy installed.

Reason: R404.6.2 is an inappropriate reference; it violates intent of the IECC-R as specified in Section 105 by mandating compliance with voluntary adoption appendix of the IECC- commercial code. This is inconsistent with commitments made by the ICC to industry and does not accommodate locations where the IECC-C is not adopted.

It is a sloppy code structure with no regard for the people who use the code for design, building, or regulation. We need to do better work.

R401.3(5) already requires detailed information about onsite solar energy systems; redundant documentation is not needed.

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

Some redundant documentation is eliminated which should save some $.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Modified proposal removed technical changes and resolved editorial concerns to clarify "simulated building performance" and "approved" source.

Final Hearing Results

RED1-35-22	AM

RED1-43-22
Original Proposal

IECC: R405.2
Proponents: Alisa McMahon, sel, self (mcmahon.gbac@cox.net)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R405.2 Simulated performance compliance. Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total building thermal envelope UA, which is the sum of the U-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and 1.15 in Climate Zones 3 through 8 in accordance with Equation 4-2. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

   (Equation 4-2)

   $$\text{For Climate Zones 0-2: } UA_{\text{Proposed design}} \leq 1.08 \times UA_{\text{Prescriptive reference design}}$$
   $$\text{For Climate Zones 3-8: } UA_{\text{Proposed design}} \leq 1.15 \times UA_{\text{Prescriptive reference design}}$$

3. ~~For buildings without a fuel burning appliance foreither space heating or water heating, the annual energy cost of the proposed design that is shall be less than or equal to 85 percent of the annual energy cost of the *standard reference design*.~~ For buildings with ~~a~~ one or more fuel burning appliances for space heating, ~~or~~ water heating, or both, the annual energy cost of the proposed design ~~that is~~ shall be less than or equal to 80 percent of the annual energy cost of the standard reference design. For all other buildings, the annual energy cost of the proposed design shall be less than or equal to 85 percent of the annual energy cost of the standard reference design. For dwelling units with greater than 5,000 square feet (465 m^2) of living space floor area located above grade plane, the annual energy cost of the proposed design shall be reduced by an additional 5 percent of annual energy cost of the standard reference design. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

   Exceptions:

   1. The energy use based on source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multipliers for all energy sources shall be obtained from ASHRAE Standard 105 (Tables K2, K4, or K8) or from another data source approved by the *code official*.
   2. The energy use based on site energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost for an all-electric building with on-site renewable energy installed.

Reason: The PCD #1 language creates a nonsensical situation where if one appliance is fuel burning and one is not, both sentences and both conditions apply: 85% and 80%. For the provision to make sense, the first sentence must make clear that no fuel burning appliances are present.

It doesn't work to say: "the annual energy cost that is . . ." The first two sentences have been changed to match the structure of the third sentence: "the annual energy cost shall be . . ."

There may be another proposal that addresses “buildings” versus “dwelling units” in this section.

Alternative Options (first two sentences only):

3. For buildings without a fuel burning appliance for space heating and without a fuel burning appliance for water heating, the annual energy cost of the proposed design shall be less than or equal to 85 percent of the annual energy cost of the *standard reference design*. For buildings with a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design shall be less than or equal to 80 percent of the annual energy cost of the standard reference design.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial change.

Public Hearing Results

Committee Action	**As Modified**

Committee Reason: This proposal resolves the ambiguity and the grammar problem.

Final Hearing Results

RED1-43-22	AM

RED1-54-22

Original Proposal

IECC: TABLE R405.2, R408.1, RE103.1

Proponents: Glen Clapper, National Roofing Contractors Association, National Roofing Contractors Association (gclapper@nrca.net)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR SIMULATED BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
~~R401.2.5~~	~~Additional energy efficiency~~
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Attic knee or pony wall
R402.2.4	Eave baffle
R402.2.5.1	Access hatches and doors
R402.2.9	Basement walls
R402.2.9.1	Basement wall insulation installation
R402.2.10.1	Slab-on-grade floor insulation installation
R402.2.11.1	Crawl space wall insulation installations
R402.5.1.1	Installation
R402.5.1.2	Testing
R402.5.2	Fireplaces
R402.5.3	Fenestration air leakage
R402.5.4	Room containing fuel burning applicances
R402.5.5	Recessed lighting
R402.5.6	Air-sealed electrical and communication outlet boxes
R402.6	Maximum fenestration *U*-factor and SHGC
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3	Duct systems
R403.4	Mechanical system piping insulation
R403.5 except Section R403.5.2 (staff note: this needs to be fixed with hot water pipe insulation)	Service hot water system
R403.5.2	Hot water pipe insulation

R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice system controls
R403.11	Energy consumption of pools and spas
R403.12	Portable spas
R403.13	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.5	Electric readiness
R404.6	Renewable energy infrastructure
R404.7	Electric Vehicle power transfer infrastructure

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

R408.1 Scope. This section establishes additional efficiency credits to achieve additional energy efficiency~~in accordance with Section R401.2.5~~.

RE103.1 Application. Residential buildings shall be *all-electric buildings* and comply with ~~Section R401.2.5 and~~ either Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4.

Reason: Section R401.2.5 has been deleted in the current code change proposal draft and therefore is a ghost reference.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This code change proposal will neither increase nor decrease the cost of construction as it appears to be editorial.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Clean up to remove redundant language.

Final Hearing Results

RED1-54-22 AS

RED1-56-22

Original Proposal

IECC: TABLE R405.2, TABLE R406.2

Proponents: Gary Klein, President, Gary Klein and Associates, Inc., Self (gary@garykleinassociates.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR SIMULATED BUILDING PERFORMANCE

Portions of table not shown remain unchanged.

SECTION[a]	TITLE
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3	Duct systems
R403.4	Mechanical system piping insulation
R403.5 except Section R403.5.2 (staff note: this needs to be fixed with hot water pipe insulation)	Service hot water system
R403.5.2	Hot water pipe insulation
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice system controls
R403.11	Energy consumption of pools and spas
R403.12	Portable spas
R403.13	Residential pools and permanent residential spas

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

Portions of table not shown remain unchanged.

SECTION[a]	TITLE
General	
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3	Duct systems
R403.4	Mechanical system piping insulation
R403.5 except Section R403.5.2 (staff note: this needs to be fixed with hot water pipe insulation)	Service hot water systems

R403.5.2	Hot water pipe insulation
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice system controls
R403.11	Energy consumption of pools and spas
R403.12	Portable spas
R403.13	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.5	Electric readiness
R404.6	Renewable energy infrastructure
R404.7	Electric Vehicle power transfer infrastructure

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

Reason: Due to two REPI's affecting the same text in Table R405.2 and Table R406.2, staff noted a conflict that would need to be addressed via Public Comment. This Public Comment proposes to remove the dedicated row for HW pipe insulation and also remove the text "except Section R403.5.2 (staff note: this needs to be fixed with hot water pipe insulation)"

This would be consistent with the approved REPI which added the row for HW pipe insulation, such that the insulation requirement is met even when using a modeling pathway.

Bibliography: None.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Since this is clarifying a previously approved REPI, this public comment has no additional cost impact.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The purpose of this proposal is to resolve the Staff Note shown in the Public Comment draft in Table R405.2 and Table R406.2, which points out a conflict between the rows for service hot water system requirements and hot water pipe insulation requirements.

Final Hearing Results

RED1-56-22 AS

RED1-65-22

Original Proposal

IECC: CHAPTER 2 [RE], SECTION R202, SECTION 202, CHAPTER 4 [RE], SECTION R406, R406.1, R406.2, TABLE R406.2, R406.3, R406.4, R406.5, TABLE R406.5, R406.6, R406.7, R406.7.1, R406.7.2, R406.7.2.1, R406.7.2.2, R406.7.3, R406.7.4, R406.7.5, R406.7.6, CHAPTER 6 [RE], 6 ANSI, ANSI Chapter 06 (New)

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

CHAPTER 2 [RE] DEFINITIONS

SECTION R202 GENERAL DEFINITIONS

Revise as follows:

ENERGY RATING INDEX (ERI). A numerical integer value that represents the relative energy performance of a *rated design* ~~Rated Home~~ or constructed *dwelling unit* as compared with the energy performance of the *ERI Reference Design*, where an ERI value of 100 represents the energy performance of the *ERI Reference Design* and an ERI value of 0 represents a *rated design* or constructed *dwelling unit* ~~home~~ with zero net energy performance.

ERI REFERENCE DESIGN. A version of the *rated design* that meets the minimum requirements of the 2006 *International Energy Conservation Code*.

Revise as follows:

RATED DESIGN. A description of the proposed ~~*building*~~ *dwelling unit* used to determine the energy rating index.

CHAPTER 4 [RE] RESIDENTIAL ENERGY EFFICIENCY

SECTION R406 ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

Revise as follows:

R406.1 Scope. This section establishes criteria for compliance using an Energy Rating Index (ERI) analysis. Such analysis shall be limited to *dwelling units*. Spaces other than *dwelling units* in Group R-2, R-3, or R-4 buildings shall comply with Sections R402 through R404.

R406.2 ERI compliance. Compliance based on the ERI requires that the *rated design* and as-built *dwelling unit* meets~~s~~ all of the following:

1. The requirements of the sections indicated within Table R406.2.
2. Maximum ERI values indicated in Table R406.5.

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.4	Eave baffle
R402.2.5.1	Access hatches and doors
R402.2.9	Basement walls
R402.2.9.1	Basement wall insulation installation
R402.2.10.1	Slab-on-grade floor insulation installation
R402.2.11.1	Crawl space wall insulation installation
R402.5.1.1	Installation
R402.5.1.2	Testing
R402.5.2	Fireplaces
R402.5.3	Fenestration air leakage
R402.5.4	Rooms containing fuel burning appliances
R402.5.5	Recessed lighting
R402.5.6	Air-sealed electrical and communication outlet boxes(air sealed boxes)
R406.3	Building thermal envelope
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3	Duct systems
R403.4	Mechanical system piping insulation
R403.5 except Section R403.5.2(staff note: this needs to be fixed with hot water pipe insulation)	Service hot water systems
R403.5.2	Hot water pipe insulation
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice system controls
R403.11	Energy consumption of pools and spas
R403.12	Portable spas
R403.13	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

R404.5	Electric readiness
R404.6	Renewable energy infrastructure
R404.7	Electric Vehicle power transfer infrastructure

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

R406.3 Building thermal envelope. The proposed total building thermal envelope UA, which is sum of *U*-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive *U*-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and by 1.15 in Climates Zones 3 through 8, in accordance with Equation 4-3. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

(Equation 4-3)

$$\text{For Climate Zones 0-2: } UA_{\text{Proposed design}} \leq 1.08 \times UA_{\text{Prescriptive reference design}}$$

$$\text{For Climate Zones 3-8: } UA_{\text{Proposed design}} \leq 1.15 \times UA_{\text{Prescriptive reference design}}$$

R406.4 Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with ANSI/RESNET/ICC 301. The mechanical ventilation rates used for the purpose of determining the ERI shall not be construed to establish minimum ventilation requirements for compliance with this code. Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the building site shall not be included in the *ERI reference design* or the *rated design*.

Revise as follows:

R406.5 ERI-based compliance. Compliance based on an ERI analysis requires that the*rated* ~~*proposed*~~ *design* and each confirmed as-built *dwelling unit* be shown to have an ERI less than or equal to the appropriate value indicated in Table R406.5 when compared to the*ERI reference design* as follows:

1. Where on-site renewables are not installed, the maximum ENERGY RATING INDEX NOT INCLUDING OPP applies.
2. Where on-site renewables are installed, the maximum ENERGY RATING INDEX INCLUDING OPP applies.

Exceptions:1. Where the ERI analysis excludes OPP, the maximum ENERGY RATING INDEX NOT INCLUDING OPP shall be permitted. 2. For buildings with twenty or more*dwelling units*, where *approved* by the code official, compliance shall be permitted using the Average Dwelling Unit Energy Rating Index, as calculated in accordance with ANSI/RESNET/ICC 301.

TABLE R406.5 MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP	ENERGY RATING INDEX WITH OPP
0-1	51	40
2	51	40
3	50	40
4	53	40
5	54	40
6	53	40
7	52	40
8	52	40

Revise as follows:

R406.6 Verification by approved agency. Verification of compliance with Section R406 as outlined in Sections R406.4 and R406.5~~6~~ shall be completed by an *approved* third party. Verification of compliance with Section R406.2 shall be completed by the authority having jurisdiction or an *approved* third-party inspection agency in accordance with Section R105.4.

R406.7 Documentation. Documentation of the software used to determine the ~~ERI~~ *ERI* and the parameters for the *ERI Reference Design* ~~*residential building*~~ shall be in accordance with Sections R406.7.1 through R406.7.4.

R406.7.1 Compliance software tools. Software tools used for determining *ERI* ~~ERI~~ shall be ~~*Approved* Software Rating Tools~~ *approved* software rating tools as defined by ~~in accordance with~~ ANSI/RESNET/ICC 301. Software vendors shall publish, on a publicly available website, documentation that the software tool has been validated using the Class II, Tier 1 test procedure in ANSI/ASHRAE Standard 140.

R406.7.2 Compliance report. Compliance software tools shall generate a report that documents that the ~~home and the ERI score~~ *ERI* of the *rated design* and as-built *dwelling unit* complies with Sections R406.2, R406.3, R406.4 and R406.5~~4~~. Compliance documentation shall be created for the proposed design and shall be submitted with the application for the building permit. Confirmed compliance documents of the as-built *dwelling unit* shall be created and submitted to the code official for review before a certificate of occupancy is issued. Compliance reports shall include information in accordance with Sections R406.7.2.1 and R406.7.2.2.

R406.7.2.1 Proposed compliance report for permit application. Compliance reports submitted with the application for a building permit shall include the following:

1. Building street address, or other *building site* identification.
2. Declare ERI on title page and building plans.
3. The name of the individual performing the analysis and generating the compliance report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the *ERI reference design* and~~/or~~ the *rated design* ~~home~~.
6. A certificate indicating that the proposed design has an ERI less than or equal to the appropriate score indicated in Table R406.5 when compared to the *ERI reference design*. The certificate shall document the building component energy specifications that are included in the calculation, including: component level insulation *R*-values or *U*-factors; assumed duct system and building envelope air leakage testing results; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation, and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
7. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated *dwelling unit* ~~home~~.

R406.7.2.2 Confirmed compliance report for a certificate of occupancy. A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address or other *building site* identification.
2. Declaration of ERI on title page and on building plans.
3. The name of the individual performing the analysis and generating the report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the *ERI reference design* and~~/or~~ the as-built *dwelling unit* ~~rated home~~.
6. A final confirmed certificate indicating that the as-built building ~~confirmed rated design of the built home~~ complies with Sections R406.2, R406.4 and R406.5 ~~4~~. The certificate shall report the energy features that were confirmed to be in the building ~~home~~, including: component-level insulation *R*-values or *U*-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water-heating equipment installed. Where on-site renewable energy systems have been installed on or in the building ~~home~~, the certificate shall report the type and production size of the installed system.

R406.7.3 Renewable energy certificate (REC) documentation. Where renewable energy power production is included in the calculation of an ERI, documentation shall comply with Section R404.4.

R406.7.4 Additional documentation. The *code official* shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the *ERI reference design*.
2. A certification signed by the builder providing the building component characteristics of the *rated design.*
3. Documentation of the actual values used in the software calculations for the *rated design*.

R406.7.5 Specific approval. Performance analysis tools meeting the applicable subsections of Section R406 shall be *approved*. Documentation demonstrating the approval of performance analysis tools in accordance with Section R406.7.1 shall be provided.

Revise as follows:

R406.7.6 Input values. Where calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from ANSI/RESNET/ICC 301.

CHAPTER 6 [RE]
REFERENCED STANDARDS

Add new standard(s) as follows:

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

R406.7.1	ANSI/ASHRAE 140-20172020 **Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs**

Reason: Similar to a clean-up proposal for R405, R406 needs to be clear for multifamily that an ERI is only performed on a dwelling unit and that common spaces are still subject to the other code requirements in R402 through R404.

In addition, for large MF, the average ERI of all dwelling units in the building should be permitted to be used to demonstrate compliance with the maximum ERI (rather than each indvidual dwelling unit being required to meet the max ERI).

Finally, some edits are made to maintain consistency, use defined terms, and underscore that the as-built dwelling unit is also required to be compliant, not just the 'rated design' ERI.

Bibliography: None

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

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Public Hearing Results

Committee Action **As Modified**

Committee Reason: support the clarifying edits and the modification to require common spaces comply with R402 through R404. Consistent with action on RECD1-8, the sub-committee also supported the new requirement for software to document that the ASHRAE Standard 140 tests had been performed.

Final Hearing Results

RED1-65-22 AM

RED1-67-22

Original Proposal

IECC: R406.5

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R406.5 ERI-based compliance. Compliance based on an ERI analysis requires that the*rated proposed design* and confirmed built dwelling be shown to have an ERI less than or equal to the ~~appropriate~~ applicable value indicated in Table R406.5 ~~when~~ where compared to the *ERI reference design as follows:*

1. Where on-site renewables are not installed, the maximum ENERGY RATING INDEX NOT INCLUDING OPP applies.
2. Where on-site renewables are installed, the maximum ENERGY RATING INDEX INCLUDING OPP applies.

Exception: Where the ERI analysis excludes OPP, the maximum ENERGY RATING INDEX NOT INCLUDING OPP shall be permitted.

Reason: Editorial:

1. "Appropriate" is not appropriate, it is subjective.
2. "When" is only time specific. "Where" is condition - including time - specific.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Editorial improvements

Final Hearing Results

RED1-67-22	AS

RED1-71-22

Original Proposal

IECC: SECTION R408, R408.1, R408.2, TABLE R408.2, R408.2.1, R408.2.1.1, R408.2.1.2, R408.2.1.3, R408.2.1.4 (New)

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

SECTION R408
ADDITIONAL EFFICIENCY REQUIREMENTS

Revise as follows:

R408.1 Scope. This section establishes additional efficiency credits to achieve additional energy efficiency in accordance with Section R401.2.1~~5~~.

R408.2 Additional energy efficiency credit requirements . No less than t~~T~~wo ~~of the additional~~ measures shall be selected from Table R408.2 that meet or exceed a total of ten credits. Five additional credits shall be selected for dwelling units with greater than 5,000 square feet (465 m^2) of living space floor area located above grade plane. Each measure selected shall meet the relevant subsections of Section R408 and receive credit as specified in Table R408.2 for the specific Climate Zone. For *dwelling units* in Group R-2 buildings, where applicable, the requirements shall be met in each dwelling unit in order to receive credit. Interpolation of credits between measures shall not be permitted.

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Portions of table not shown remain unchanged.

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 4C	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total UA	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total UA	0	1	1	2	2	3	3	3	3
R408.2.1.1(3)	>7.5% reduction in total UA	0	1	2	2	2	3	3	4	4
R408.2.1.1(4)	>10% reduction in total UA									
R408.2.1.1(5)	>15% reduction in total UA									
R408.2.1.1(6)	>20% reduction in total UA									
R408.2.1.1(7)	>30% reduction in total UA									
R408.2.1.2(1)	0.22 U-factor windows	1	2	2	3	3	4	4	4	5
R408.2.1.2(2)	U-factor and SHGC for windows per Table R408.2.1	1	1	1	0	0	0	0	1	2
R408.2.1.3	Cool Roof	TBD	TBD	TBD	TBD	TBD	0	0	0	0
R408.2.1.4	Reduced air leakage	TBD	TBD	TBD	TBD	TBD	TBD	0	0	0

R408.2.1 Enhanced envelope options. For the enhanced envelope credits, t~~T~~he *building thermal envelope* shall ~~meet the requirements~~ comply with one or more of the following:

1. Either Section R408.2.1.1 or R408.2.1.2. Credit shall only be permitted from one measure.
2. Section R408.2.1.3.
3. Section R408.2.1.4.

R408.2.1.1 Enhanced envelope performance ~~UA~~. The ~~proposed~~ total building thermal envelope thermal conductance TC~~UA~~shall be calculated in accordance with Section R402.1.5 and it shall be reduced by not less than the percentage indicated in Table R408.2 in comparison to the reference building.~~shall meet one of the following:~~

1. ~~Not less than 2.5 percent of the total UA of the *building thermal envelope*.~~
2. ~~Not less than 5 percent of the total UA of the *building thermal envelope*.~~
3. ~~Not less than 7.5 percent of the total UA of the *building thermal envelope*.~~

R408.2.1.2 Improved fenestration. Vertical fenestration shall meet one of the following:

1. U-factor equal to or less than 0.22.
2. U-factor and SHGC equal or less than that specified in Table R408.2.1.2.

R408.2.1.3 Roof reflectance. Roofs shall comply with one or more of the options in Table R408.2.1.3.

Add new text as follows:

R408.2.1.4 Reduced air leakage. For the reduced air leakage credit, the building shall have a measured air leakage rate no less than 2.0 ACH50 and no greater than 2.5 ACH50 or the *dwelling units* in the building shall have an average measured*air leakage* rate no greater than 0.24 cfm50/ft^2. .

Reason: This public comment proposes credit for achieving airtightness below the prescriptive air leakage rates in CZ 0-5, as defined in Section R402.5.1.3. However, this credit is not being proposed for values less than 2.0 ACH50 given that another R408 section provides credit for that level airtightness when combined with balanced ventilation. In addition, this credit is not being proposed where sampling is used in Group R-2 buildings, but instead a whole building test could be used to earn this credit.

Other edits are editorial to provide better clarity of the original intent of this section.

Bibliography: None.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Where selected as a measure, some additional labor cost associated with the greater attention to air-sealing practices would be applicable. Where not deemed cost-effective, this measure simply would not be selected.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies language in R408.2.1.1 to align with prior action on RED1-79. Introduces reduced air leakage credit for achieving air tightness below the prescriptive air leakage rates and a comparable air leakage reduction credit for R-2 occupancies in R408 in CZ 0-5.

Final Hearing Results

RED1-71-22 AM

RED1-73-22

Original Proposal

IECC: R408.1; IECC: R408.2; IECC: TABLE R408.2, R408.2.3, R408.2.3 (New)
Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

R408.1 Scope. This section ~~establishes~~ <u>provides</u> additional efficiency <u>measures and</u> credits ~~to achieve additional energy efficiency in accordance~~ <u>required to comply</u> with Section ~~R401.2.5~~<u>R401.2.1</u>.

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R408.2 Additional energy efficiency credit requirements . ~~Two of the additional~~ <u>*Residential buildings* shall earn not less than ten credits from not less than two</u> measures ~~shall be selected from~~ <u>specified in</u> Table R408.2 ~~that meet or exceed a total of ten credits~~. Five additional credits shall be ~~selected~~ <u>earned</u> for *dwelling units* with ~~greater~~ <u>more</u> than 5,000 square feet (465 m^2) of *living space* ~~floor area~~ located above *grade plane*. <u>To earn credit as specified in Table R408.2 for the applicable Climate Zone, each</u>~~Each~~ measure selected <u>for compliance</u> shall ~~meet~~ <u>comply with</u> the ~~relevant~~ <u>applicable</u> subsections of Section R408 ~~and receive credit as specified in Table R408.2 for the specific Climate Zone~~. <u>Each dwelling unit or sleeping unit shall comply with the selected measure to earn credit</u>.Interpolation of credits between measures shall not be permitted.

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 4C	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total UA	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total UA	0	1	1	2	2	3	3	3	3
R408.2.1.1(3)	>7.5% reduction in total UA	0	1	2	2	2	3	3	4	4
R408.2.1.2(1)	0.22 U-factor windows	1	2	2	3	3	4	4	4	5
R408.2.1.2(2)	U-factor and SHGC for windows per Table R408.2.1	1	1	1	0	0	0	0	1	2
R408.2.2(1)[b]	High performance cooling system option 1	7	6	5	3	3	3	1	1	1
R408.2.2(2)[b]	High performance cooling system option 2	5	5	4	3	3	2	1	1	0
R408.2.2(3)[b]	High performance gas furnace option 1	0	2	3	5	5	7	8	8	10
R408.2.2(4)[b]	High performance gas furnace option 2	0	2	2	4	4	5	7	7	8
R408.2.2(5)[b]	High performance heat pump system option 1	8	7	6	6	6	6	5	5	4
R408.2.2(6)[b]	High performance gas furnace and heat pump system option 1	6	6	5	5	5	5	4	4	3

R408.2.2(7)[b]	High performance gas furnace option 2	0	2	4	6	6	8	7	6	5
R408.2.2(8)[b]	High performance heat pump system option 1									
R408.2.2(9)[b]	High performance heat pump system option 2									
R408.2.2(10)[b]	High performance heat pump system option 3									
R408.2.2(11)[b]	Ground source heat pump									
R408.2.2(12)[b]	Ductless-Single zone									
R408.2.2(13)[b]	Ductless-Multizone (Non-ducted indoor unit)									
R408.2.2(14)[b]	Ductless - Multizone (Ducted or Mixed)									
R408.2.3(1a)[d]	Gas-fired storage water heaters (option 1)									
R408.2.3(1b)[d]	Gas-fired storage water heaters (option 2)									
R408.2.3(2a)[d]	Gas-fired instantaneous water heaters (option 1)									
R408.2.3(2b)[d]	Gas-fired instantaneous water heaters (option 2)									
R408.2.3(3a)[d]	Electric water heaters (option 1)									
R408.2.3(3b)[d]	Electric water heaters (option 2)									
R408.2.3(4)[d]	Electric water heaters (option 3)									
R408.2.3(5a)[d]	Electric water heaters (option 4)									
R408.2.3(5b)[d]	Electric water heaters (option 5)									
R408.2.3(6)[d]	Electric water heaters (option 6)									
R408.2.3(1)	Fossil fuel service water heating system	7	6	5	3	3	2	2	3	1
R408.2.3(2)	High performance heat pump water heating system option 1	12	11	11	8	8	6	5	5	3
R408.2.3(3)	High performance heat pump water heating system option 2	12	12	11	8	8	6	5	5	3
R408.2.3(7a)[d]	Solar hot water heating system (option 1)	4	5	6	6	6	6	5	5	4
R408.2.3(7b)[d]	Solar hot water heating system (option 2)									
R408.2.3(8)[c]	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.4(1)[c]	More efficient distribution system	4	6	7	10	10	12	13	15	16
R408.2.4(2)[c]	100% of ducts in conditioned space	4	6	8	12	12	15	17	19	20
R408.2.4(3)[c]	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.5(1)[c]	2 ACH50 air leakage rate with ERV or HRV installed	1	4	5	10	10	13	15	8	8

R408.2.5(2)[c]	2 ACH50 air leakage rate with balanced ventilation	2	3	2	4	4	5	6	6	6
R408.2.5(3)[c]	1.5 ACH50 air leakage rated with ERV or HRV installed	2	4	6	12	12	15	18	11	11
R408.2.5(4)[c]	1 ACH50 air leakage rate with ERV or HRV installed	2	5	6	14	14	17	21	14	14
R408.2.6[a]	Energy efficient appliances	9	8	8	7	7	5	5	5	4
R408.2.7	Renewable energy measures	17	16	17	11	11	9	8	7	4
R408.2.9[c]	Demand responsive thermostat									

a. Where the measure is selected, each *dwelling unit, sleeping unit,* and *common areas* where the measure is applicable must have the measure installed.

b. Where multiple heating or cooling systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

c. Where the measure is selected, each *dwelling unit* and *sleeping unit* must comply with the measure.

d. Where the measure is selected, each *dwelling unit* shall be served by a water heater meeting the applicable requirements. Where multiple service water heating systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

R408.2.3 Reduced energy use in service water-heating option. For measure numbers R408.2.3 (1) through R408.2.3 (~~5~~7), the installed hot water system shall meet one of the Uniform Energy Factors (UEF) or Solar Uniform Energy Factors (SUEF) in Table R408.2.3. For measure number R408.2.3 (~~6~~8), the *dwelling unit* hot water distribution system shall comply with R408.2.3.1. To field or plan review verify that the system meets the prescribed limit, one of the following must be done:

1. At plan review, referencing ounces of water per foot of tube on plans as per Table R403.5.4.
2. At rough in (plumbing), referencing ounces of water per foot of tube installed as per Table R403.5.4.
3. At final inspection. In accordance with Department of Energy's Zero Energy Ready Home National Specification (Rev. 07 or higher) footnote on Hot water delivery systems.

R408.2.3 Service water-heating efficiencies

Portions of table not shown remain unchanged.

Measure Number	Water Heater	Size and Draw Pattern	Type	Efficiency
R408.2.3(1)(b)	Gas-fired storage water heaters (option 2)	Rated input capacity > 75,000 Btu/h	UEF >= 0.86 or E_t >= 94%	
R408.2.3(6)	Electric water heaters (option 6)	Rated input capacity >12 kW	COP >= 3.00	

UEF = Uniform Energy Factor, E_t = Thermal Efficiency, COP = Coefficient of Performance

Reason: This change removes the words "of the." Those words are unnecessary.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This change is editorial and will have no impact on construction costs.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: the modification further clarifies the language; provides additional direction for implementation in MF buildings; coordinates with other proposals that have been approved for this section.

Final Hearing Results	
RED1-73-22	AM

RED1-79-22

Original Proposal

IECC: TABLE R408.2, R408.2.1.1

Proponents: Amy Boyce, Institute for Market Transformation, Energy Efficient Codes Coalition (EECC) (amy.boyce@imt.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 4C	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total UA	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total UA	0	1	1	1	2	3	3	3	3
R408.2.1.1(3)	>7.5% reduction in total UA	0	1	2	2	2	3	3	4	4
R408.2.1.1(4)	>10% reduction in total UA	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.1.1(5)	>15% reduction in total UA	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.1.1(6)	>20% reduction in total UA	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.1.1(7)	>30% reducction in total UA	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.1.2(1)	0.22 U-factor windows	1	2	2	3	3	4	4	4	5
R408.2.1.2(2)	U-factor and SHGC for windows per Table R408.2.1	1	1	1	0	0	0	0	1	2
R408.2.1.3	Cool Roof	TBD	TBD	TBD	TBD	TBD	0	0	0	0
R408.2.2(1)	High performance cooling system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(2)	High performance cooling system option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(3)	High performance gas furnace option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(4)	High performance gas furnace option 2	0	0	0	0	0	TBD	TBD	TBD	0
R408.2.2(5)	High performance gas furnace and cooling system option 2	TBD	TBD	TBD	TBD	TBD	0	0	0	TBD
R408.2.2(6)	High performance gas furnace and heat pump system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(7)	High performance gas furnace option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(8)	High performance heat pump system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(9)	High performance heat pump system option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(10)	High performance heat pump system option 3	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(11)	Ground source heat pump	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(12)	Ductless - Single zone	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(13)	Ductless - Multizone (Non-ducted indoor unit)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(14)	Ductless - Multizone (Ducted or Mixed)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

R408.2.3(1)	Gas-fired storage water heaters	7	6	5	3	3	2	2	3	1
R408.2.3(2)	Gas-fired instantaneous water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(3)	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(4)	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(5)	Solar hot water heating system	4	5	6	6	6	6	5	5	4
R408.2.3(6)	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.4(1)	More efficient distribution system	4	6	7	10	10	12	13	15	16
R408.2.4(2)	100% of ducts in conditioned space	4	6	8	12	12	15	17	19	20
R408.2.4(3)	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.5(1)	2 ACH50 air leakage rate with ERV or HRV installed	1	4	5	10	10	13	15	8	8
R408.2.5(2)	2 ACH50 air leakage rate with balanced ventilation	2	3	2	4	4	5	6	6	6
R408.2.5(3)	1.5 ACH50 air leakage rated with ERV or HRV installed	2	4	6	12	12	15	18	11	11
R408.2.5(4)	1 ACH50 air leakage rate with ERV or HRV installed	2	5	6	14	14	17	21	14	14
R408.2.6	Energy efficient appliances	9	8	8	7	7	5	5	5	4
R408.2.7	Renewable energy measures	17	16	17	11	11	9	8	7	4
R408.2.9	Demand responsive thermostat	1	1	1	1	1	1	1	1	1

R408.2.1.1 Enhanced envelope performance ~~UA~~. The proposed total building thermal envelope thermal conductance~~UA~~ shall be calculated for the proposed building in accordance with Section R402.1.5 andit shall be reduced by not less than the percentage indicated in Table R408.2 in comparison to the reference building.~~shall meet one of the following:~~

1. ~~Not less than 2.5 percent of the total UA of the *building thermal envelope*.~~
2. ~~Not less than 15 percent of the total UA of the *building thermal envelope*.~~
3. ~~Not less than 30 7.5 percent of the total UA of the *building thermal envelope*.~~

Reason: This proposal encourages code users to further improve the efficiency of the permanent thermal envelope by awarding credit for UA improvements of 15% and 30% as compared to the prescriptive baseline. We do not oppose the current UA improvement options (2.5%, 5%, 7.5%), but we are concerned that the current options are not differentiated enough from each other and do not capture enough of the potential envelope UA improvements possible. We recommend either adding these additional levels of credit or replacing two of the smaller increments with larger credits (as proposed above). A 15-30% improvement in Total UA is feasible and should be recognized in the code. Credit values are based on an analysis provided by Pacific Northwest National Laboratories.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal neither increases nor decreases the cost of construction. Because the Total UA improvements are among several optional improvements in Section R408, they will not impact the overall cost of construction. We trust that code users will select the optimal combination of options under R408 for code compliance and cost-effectiveness.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal expands the availability of credits for additional improvements in total UA

Final Hearing Results	
RED1-79-22	AM

RED1-89-22

Original Proposal

IECC: RC103.3, RC103.3.1

Proponents: Diana Burk, New Buildings Institute, New Buildings Institute (diana@newbuildings.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

RC103.3 Energy Rating Index zero net energy score. The Energy Rating Index (ERI) not including renewable energy resources shall be determined in accordance with RESNET/ICC 301.The Energy Rating Index (ERI) including renewable energy resources shall be determined in accordance with ANSI/RESNET/ICC 301, except where electrical energy is provided from a community renewable energy facility (CREF) or contracted from a physical or financial renewable energy power purchase agreement that meets requirements of RC406.4.1, on-site power production (OPP) shall be adjusted in accordance with Equation RC-1.

(Equation RC-1)

$$\text{Adjusted OPP} = OPP_{kWh} + CREF_{kWh} + \cancel{\frac{CL_{yrs}}{15}}\ \cancel{(}PPPA_{kWh} + FPPA_{kWh}\cancel{)}$$

where:

OPP_{kWh} = Annual electrical energy from on-site renewable energy, in units of kilowatt-hours (kWh).

CREF $_{kwh}$ = Annual electrical energy from a community renewable energy facility (CREF), in units of kilowatt-hours (kWh)P. PPA_{kwh} = Where not included as OPP, the annual electrical energy contracted from a physical renewable energy power purchase agreement, in units of kilowatt-hours (kWh).
$FPPA_{kwh}$ = Where not included as OPP, the annual electrical energy contracted from a financial renewable energy power purchase agreement (FPPA), in units of kilowatt-hours (kWh).

RC103.3.1 ~~Power purchase agreement~~ Renewable energy contract. The renewable energy shall be delivered or credited to the building site under an energy contract with a duration of not less than ~~10~~15 years. The contract shall be structured to survive a partial or full transfer of ownership of the building property.

Reason: This amendment creates greater equivalence between the amount of power procured by an off-site renewable energy contract and that provided throughout the life of an on-site renewable energy system, which can operate for up to 25-30 years. It requires buildings with contract lengths shorter than 15 years to purchase the same amount of power over the shorter contract length as would be purchased in a 15-year contract or produced in 15 years by an onsite system. This approach parallels the draft commercial 2024 IECC which requires building owners with contract lengths between 10 and 15 years to procure an equivalent total amount of renewable energy as building owners with a 15-year contract. Finally, this amendment amends the section title to be consistent with a similar section title in the commercial IECC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change proposal will neither increase or decrease the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Consistent with duration of purchased power in other parts of code and simplify requirement to avoid equation of original proposal.

Final Hearing Results	
RED1-89-22	AM

RED1-91-22

Original Proposal

IECC: RP (New), RP101 (New), RP102 (New), RP103 (New), RP103.1 (New), RP103.1.1 (New), RP103.1.1.1 (New), RP103.2 (New), RP103.1.3 (New), TABLE RP103.1.3 (New); IRCECC: RP103.1.1.1 (New)

Proponents: Michael Tillou, Pacific Northwest National Lab, Pacific Northwest National Lab (michael.tillou@pnnl.gov)

2024 International Energy Conservation Code [RE Project]

Add new text as follows:

RP
On-Site Renewable Energy

RP101 SCOPE. These provisions shall apply where on-site renewable energy is required.

RP102 GENERAL DEFINITION. POTENTIAL SOLAR ZONE AREA. The combined area of any steep-sloped roofs oriented between 90 degrees and 300 degrees of true north and any low-sloped roofs where the *annual solar access* is 70 percent or greater. **ANNUAL SOLAR ACCESS.** The ratio of annual solar insolation with shade to the annual solar insolation without shade. Shading from obstructions located on the roof or any other part of the building are not included in the determination of *annual solar access*. Shading from existing permanent natural or person-made obstructions that are external to the building, including but not limited to trees, hills, and adjacent structures, are included in *annual solar access* calculations.**PHYSICAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT.** A contract for the purchase of renewable electricity from a specific renewable electricity generator to a purchaser of renewable electricity.

RP103
ON-SITE RENEWABLE ENERGY

RP103.1 General. Buildings shall shall comply with Section R401.2 and the requirements of this section.

RP103.1.1 Installed capacity. An on-site renewable energy system shall be installed on, or at the site of, the building with a peak rated capacity, measured under standard test conditions, in accordance with one of the following:

1. For one- and two- family dwellings, townhouses and other Group R-3 occupancies, the peak rated capacity shall be no less than 2kW.
2. For Group R-2 or R-4 residential buildings, the peak rated capacity shall be no less than 0.75 W/ft2 multiplied by the gross conditioned floor area.
3. Where a building includes both commercial occupancies and R-2 or R-4 occupancies required to comply with this Code, the peak capacity shall be no less than 0.75 W/ft^2 multiplied by the gross conditioned floor area of the Group R-2 and R-4 occupancies.

The capacity of installed on-site renewable energy systems used to comply with this Appendix shall be in addition to the total capacity of installed on-site renewable energy systems used to comply with all other requirements of this Code.

Exceptions:

1. A building with a permanently installed domestic solar water heating system sized with a solar savings fraction of not less than 0.5 based on the total service water heating load of all residential occupancies.
2. One and two family dwellings, townhouses and other Group R-3 Occupancies in climate zone 4C, 5C or 8.
3. Group R-2 or R-4 occupancies in climate zone 8.
4. Buildings where the potential solar zone area is less than 300 square feet (28 m^2)

5. Buildings with a physical renewable energy power purchase agreement with a duration of not less than 15 years from a utility or a community renewable energy facility and for not less than 80 percent of the estimated whole-building electric use on an annual basis. This exception shall not apply where off-site renewable energy credits are used to comply with the requirements of Section R408.
6. Buildings that demonstrate compliance in accordance with Section RP103.1.1.1

RP103.1.1.1 Alternate capacity determination. Where compliance is demonstrated in accordance with Section R405 Simulated Building Performance and the proposed design and standard reference design are adjusted in accordance with Items (1) and (2), the required capacity of the installed renewable energy systems shall be permitted to differ.

1. Proposed Design.Where applicable, the proposed design shall comply with one of the following:
   1.1 Where one or more systems providing on-site renewable energy are included in the construction documents, the systems shall be modeled in the proposed design with a design capacity not greater than the required capacity in accordance with Section RP103.1.1. A combination of on-site renewable energy systems shall be permitted to be included in the proposed design.

   1.2 Where no on-site renewable energy systems are specified in the construction documents, no on-site renewable energy systems shall be modeled in the proposed design.
2. Standard Reference Design. Where applicable, the standard reference design shall comply with one of the following:
   2.1 Where a proposed design includes one or more on-site renewable energy systems the same systems shall be modeled identically in the standard reference design except the total rated capacity of all systems shall be equal to the required capacity in accordance with Section RP103.1.1. Where more than one type of on-site renewable energy system is modeled, the total capacity of each system shall be allocated in the same proportion as in the proposed design.

   2.2 Where the proposed design does not include any on-site renewable energy systems, an unshaded photovoltaic system shall be modeled in the standard reference design in accordance with the performance criteria in Table RP103.1.1.1(1).

RP103.2 Renewable energy certificate (REC) documentation. Where *RECs* are associated with *renewable energy* power production required by Section RP103.2 or RP103.3, documentation shall comply with Section R404.4 Renewable energy certificate (REC) documentation.

RP103.1.3 ERI With OPP Requirements. Where compliance is demonstrated in accordance with Section R406.5 using the Energy Rating Index With OPP, a project shall comply with the requirements of this Appendix if the rated proposed design and confirmed built dwelling are shown to have an ERI less than or equal to the values in Table RP103.1.3.

TABLE RP103.1.3 MAXIMUM ENERGY RATING INDEX INCLUDING OPP

CLIMATE ZONE	ENERGY RATING INDEX WITH OPP
0-1	35
2	34
3	33
4	40
5	43
6	43
7 & 8	46

Add new text as follows:

RP103.1.1.1 PERFORMANCE CRITERIA FOR STANDARD REFERENCE DESIGN PHOTOVOLTAIC SYSTEMS

CRITERIA	DESIGN MODEL
Size	Rated capacity no less than required in accordance with Section RP103.1.1.
Module type	Crystalline Silicon Panel with a glass cover, 19.1% nominal efficiency and temperature coefficient (Tc Power) of -0.37%/°C,
Array type	Rack mounted array with installed nominal operating cell temperature (INOCT) of 103°F (45°C).
Total system losses (DC output)	11.3%
Tilt	0-degrees (mounted horizontally)
Azimuth	180 degrees

Reason: On-site electricity generation using photovoltaics is a key technology for reducing greenhouse gas emissions associated with Commercial and Residential buildings. According to the most recent assessment by the National Renewable Energy Lab (NREL) the cost of installed photovoltaics in 2020 was 3% lower than in 2019 and 65-70% lower than the cost of similar sized systems in 2010. With the continued drop in cost of installing on-site PV the cost per kilowatt hour of PV generated electricity is at parity with grid purchased electricity in many States throughout the country. This proposal describes requirements for prescriptive solar PV that must be installed at the time of construction. Analysis by PNNL shows that on-site renewable electricity generation is cost effective across all low-rise multifamily buildings and most single family and one or two unit townhouses. The analysis was done using each of the Residential prototypes in each ASHRAE climate zone. The capacity requirements were established by calculating the highest on-site solar PV capacity that limited electricity export back to the grid. The threshold used for determining these capacities was a grid export limit of less than 0.5% of total annual building electricity consumption. A review of the hourly results showed it was unrealistic to set a hard limit of zero overproduction. When calculating cost effectiveness no credit was taken for electricity that was exported back to the grid. The calculation of grid exports was done on an hourly basis. The proposed requirements reduce purchased energy from the electrical grid which will help reduce green house gas emissions and energy costs for building owners.

PVs provide substantial benefits to the consumer and society by helping to reduce GHG emissions associated with electricity generation. PV market growth combined with a cleaner grid will support goals of reduced GHG emissions established across the U.S. and others by federal agencies, as well as many states and local governments.

This public comment is in direct response to the feedback provided by the full Residential Committee that REPI-114 be brought back as an optional Appendix.

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

PNNL prepared a cost effectiveness analysis of the proposed changes as part of the original REPI-114 submission in October 2021. This original analysis of residential building solar PV cost effectiveness was calculated using the Life Cycle Cost methodology established by Pacific Northwest National Lab for determining National and State cost effectiveness of the 2021 International Energy Conservation Code. The DOE methodology accounts for the benefits of energy-efficient home construction over the life of a typical mortgage, balancing initial costs against longer term energy savings. The Life-Cycle Cost methodology provides a full accounting over a 30-year period of the cost savings, considering energy savings, the initial investment financed through increased mortgage costs, tax impacts, and residual values of energy efficiency measures. The installed cost of solar PV was based on costs reported in the U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020 published by NREL in 2021. Installed costs were scaled based on solar PV capacity from 2kW up to 200kW and applied based on the calculated capacity required for each prototype in each climate zone. The proposed solar PV capacities were shown to be cost effective for R occupancies in each ASHRAE climate zone except for climate zone 8 and for single family residences in all climate zones except 4C, 5C and 8.An updated analysis was provided to the full committee in May 2022 using the IECC Residential cost effectiveness methodology. The results of that analysis by climate zone are provided below. The analysis has not been updated to reflect any change in the national average cost of small-scale renewables or to capture the impact of the Inflation Reduction Act passed in November 2022 that included renewable tax credits through 2032.

Single Family Dwellings																
	1A	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
PV Capacity (kW)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PV Generation (kWh)	3,189	3,082	3,480	3,000	3,651	3,458	2,669	3,593	2,304	2,510	3,154	2,355	2,611	2,775	2,444	1,885
PV Cost @ 3.55	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100	$ 7,100
IECC Cost effectiveness @ $3.55 per Watt																
3.84% Real w/o SCC	$2,956	$2,617	$3,881	$2,356	$4,424	$3,811	$1,305	$4,239	$146	$800	$2,845	$308	$1,121	$1,642	$591	($1,185)
3% Real w/o SCC	$2,164	$1,884	$2,927	$1,669	$3,374	$2,869	$802	$3,223	($154)	$386	$2,073	($20)	$650	$1,080	$213	($1,251)
7% Real w/o SCC	$871	$692	$1,358	$555	$1,645	$1,321	$0.30	$1,547	($611)	($266)	$812	($525)	($97)	$178	($376)	($1,312)
3.84% Real w/ SCC	$4,542	$4,149	$5,611	$3,848	$6,239	$5,531	$2,632	$6,026	$1,292	$2,048	$4,414	$1,479	$2,419	$3,022	$1,806	($247)
3% Real w/ SCC	$3,750	$3,417	$4,657	$3,161	$5,190	$4,589	$2,130	$5,009	$992	$1,634	$3,641	$1,151	$1,949	$2,460	$1,428	($314)
7% Real w/ SCC	$2,457	$2,225	$3,089	$2,047	$3,460	$3,041	$1,328	$3,334	$535	$982	$2,381	$646	$1,202	$1,558	$839	($375)

Low-Rise Multifamily																
	1A	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
PV Capacity (kW)	16.22	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2
PV Generation (kWh)	25,921	25,050	28,286	24,388	29,675	28,108	21,699	29,208	18,728	20,403	25,634	19,145	21,221	22,554	19,863	15,322
PV Cost @ 2.26/W	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673	$ 36,673
IECC Cost effectiveness @ $2.26 per Watt																
3.84% Real w/o SCC	$45,279	$42,513	$52,789	$40,410	$57,201	$52,224	$31,871	$55,717	$22,436	$27,755	$44,367	$23,760	$30,353	$34,586	$26,040	$11,619
3% Real w/o SCC	$35,929	$33,648	$42,124	$31,914	$45,762	$41,658	$24,871	$44,539	$17,089	$21,476	$35,177	$18,181	$23,619	$27,110	$20,062	$8,167
7% Real w/o SCC	$20,320	$18,862	$24,280	$17,753	$26,606	$23,982	$13,251	$25,824	$8,276	$11,081	$19,840	$8,975	$12,451	$14,683	$10,177	$2,574
3.84% Real w/ SCC	$58,170	$54,971	$66,857	$52,539	$71,959	$66,203	$42,663	$70,244	$31,750	$37,902	$57,116	$33,281	$40,907	$45,803	$35,919	$19,239
3% Real w/ SCC	$48,821	$46,106	$56,192	$44,043	$60,521	$55,637	$35,662	$59,065	$26,403	$31,623	$47,926	$27,702	$34,173	$38,327	$29,940	$15,788
7% Real w/ SCC	$33,212	$31,320	$38,348	$29,883	$41,364	$37,961	$24,043	$40,350	$17,591	$21,228	$32,589	$18,496	$23,005	$25,900	$20,056	$10,194

The installed cost of photovoltaic systems was based on published NREL cost data that was furhter adjusted to account for streamlined permitting under the NREL SolarApp+ program and to account for differences between retrofit and new construction costs. A cost of $3.55 per installed watt was used for 2kW array capacity and $2.26 per installed watt was used for a 16kW array capacity.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The committee worked together to come to consensus on the placement of renewable energy prescriptive requirements in an appendix while allowing options for improved efficiency to offset, some or all, of the renewable energy requirement. This proposal is consistent with requests from the Consensus Committee last spring.

Final Hearing Results

RED1-91-22 AM

RED1-94-22

Original Proposal

IECC: R103.2.2

Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R103.2.2 Solar-ready system. The construction documents shall ~~provide details for~~ indicate dedicated roof area for a solar-ready zone, ~~structural design for~~ roof dead load, ~~and~~roof live load, ground snow load, and routing of conduit or pre-wiring from solar-ready zone to electrical service panel or plumbing from solar-ready zone to service water heating system.

Reason: This proposal clarifies the provisions and aligns structural load documentation requirements with other ICC codes.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal will have no change on construction cost.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Primarily editorial. Coordinates structural language with IRC.

Final Hearing Results

RED1-94-22	AM

RED1-107-22

Original Proposal

IECC: R403.10

Proponents: Nick Thompson, City of Aspen, Colorado Chapter ICC (nick.thompson@cityofaspen.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.10 Roof and gutter deicing controls. Roof and gutter deicing systems, including but not limited to self-regulating cable, shall include automatic controls that are configured to shut off the system when the outdoor temperature is above 40°F (4.4°C) ~~maximum~~ and shall include one of the following:

1. A moisture sensor configured to shut off the system in the absence of moisture, or
2. ~~A programmable timer configured to shut off the system for 8 hours minimum at night~~. A daylight sensor or other means configured to shut off the system between sunset and sunrise.

Reason: Aligns with the commercial section C403.14.3 which has improved grammar and sets the control option #2 to better meet the intent- which is to have the system off when the sun isn't shining.

The intent of roof and gutter deicing is to prevent ice dams from causing water damage to the building. Ice dams occur when roof eaves, valleys, and gutters get ice buildup from a combination of flowing water and freezing conditions. Ice on a roof or gutter is not a problem in and of itself. The problem is when liquid water flow occurs and is blocked from draining properly by ice. Water flow during freezing conditions occurs chiefly from the sun, thus the provision for controls to shut off the system at night. A moisture sensor is provided as an option for the designer if there is concern for free water flow during nighttime hours. If there is no water flow (moisture), there is no need to keep drainage pathways clear as there is no water to drain. To clarify the original reason statement, ice damming can occur even on new buildings built to current code provisions, such as warm roofs that are unvented.

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

The options provided are cost effective. There are many variables in judging payoff, including temperature, energy cost, and system size. Assuming $0.14 kWh electricity cost and $250 conservative install cost (including $75 in parts), in climate zone 7 a 200W system pays off in one year compared to one without controls left on all summer. If turned off all summer, a 390W system pays off in 1 year. 390W is about 50 LF of heat tape, which is a very small system. Many building management systems (BMS) are currently capable of time of day based control.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: the changes to the charging language were not needed. However, the edit to item #2 provided better clarity without reducing options.

Final Hearing Results

RED1-110-22

Original Proposal

IECC: R404.1.2, R404.1.3, R404.1.4, TABLE R404.1

Proponents: Glenn Heinmiller, Lam Partners, International Association of Lighting Designers (glenn@lampartners.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.1.2 Exterior lighting power requirements. The total exterior connected lighting power shall be not greater than the exterior lighting power allowance calculated in accordance with Section R404.1.3. The total exterior connected lighting power shall be the total maximum rated wattage of all lighting that is powered through the energy service for the building.

Exceptions: Lighting used for the following applications shall not be included.

1. Lighting *approved* ~~because of~~ for safety reasons ~~considerations~~.
2. Emergency lighting that is automatically off during normal operations
~~2.~~ 3. Exit signs.
~~3.~~ 4. Specialized signal, directional and marker lighting associated with transportation.
5. Lighting for athletic playing areas
~~4.~~ 6. Temporary lighting.
7. Lighting used to highlight features of art, public monuments and the national flag
~~5.~~ 8. Lighting for water features and swimming pools.
~~6.~~ 9. Lighting controlled from within *sleeping units* and *dwelling units*.
10. Lighting of the exterior means of egress as required by the *International Building Code.*

R404.1.3 Exterior lighting power allowance. The total area or length of each area type multiplied by the value for the area type in Table R404.1 shall be the lighting power (watts) allowed for each area type. For area types not listed, the area type that most closely represents the proposed use of the area shall be selected. The total exterior lighting power allowance (watts) shall be the sum of the base site allowance plus the watts from each area type.

R404.1.4 Additional exterior lighting power. Additional exterior lighting power allowance shall be available for the building facades at 0.075 W/ft^2 (0.807 w/m^2) of gross above-grade wall area. This additional power allowances shall be used only for the luminaires serving the facade and shall not be used to increase any other lighting power allowance.

Revise as follows:

TABLE R404.1 LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

Base site allowance	400 280 watts
Uncovered parking areas and drives	0.4 0.026 W/ft^2
Building Grounds	
Walkways and ramps less than 10 feet wide	0.50 W/linear foot
Walkways and ramps 10 feet wide or greater, plaza areas, special feature areas	0.10 0.049 W/ft^2

Dining areas	0.65 0.273 W/ft^2
Stairways	0.70 W/ft^2 Exempt
Pedestrian tunnels	0.12 0.110 W/ft^2
Landscaping	0.04 0.025 W/ft^2
Building Entrances and Exits	
Pedestrian and vehicular entrances and exits	14 9.8 W/linear foot of opening
Entry canopies	0.25 0.126 W/ft^2

For SI: 1 watt per square foot = 10.76 w/m^2, 1 foot = 304.8 mm.

Reason: This proposal revises these sections and the table to match the equivalent requirements in IECC-C Public Comment Draft #1. Additional exceptions from IECC-C were added that could apply to these Group R occupancies

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These changes do not affect the cost of lighting equipment required to meet code

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: add applicable provisions from IECC-C to IECC-R

Final Hearing Results

RED1-110-22 AS

RED1-111-22

Original Proposal

IECC: R404.2, R404.2.1, R404.2.2

Proponents: Glenn Heinmiller, Lam Partners, International Association of Lighting Designers (glenn@lampartners.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.2 Interior lighting controls. All permanently installed luminaires shall be controlled as required in Sections R404.2.1 and R404.2.2.

Exception: Lighting controls shall not be required for safety or security lighting ~~fixtures~~:

R404.2.1 Habitable spaces. All permanently installed luminaires in habitable spaces shall be controlled with a<u>*manual*</u> *dimmer* or <u>with</u> an *automatic shut-off control* that automatically turns off lights within 20 minutes after all occupants have left the space and shall incorporate a *manual* control to allow occupants to turn the lights on or off.

R404.2.2 Specific locations. All permanently installed luminaires in garages, unfinished basements, laundry rooms, and utility rooms shall be controlled by an *automatic shut-off control* that automatically turns off lights within 20 minutes after all occupants have left the space and shall incorporate a *manual* control to allow occupants to turn the lights on or off.

Reason: Editorial changes have been made to improve clarity and use the correct the defined terms

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is only an editorial change.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: this proposal was mostly editorial but that the addition of language in 404.2.1 provided additional clarity.

Final Hearing Results

RED1-111-22	AM

RED1-112-22

Original Proposal

IECC: R404.3

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.3 Exterior lighting controls. Exterior lighting ~~controlled from within individual dwelling units~~controls shall comply with Section R404.3.1. ~~Controls for all other exterior lighting shall comply with Sections C405.2.7 of the International Energy Conservation Code – Commercial Provisions instead of Section R404.3.1.~~

Reason: Section R101.5 clearly requires that residential buildings comply with the IECC-R rather than the IECC- commercial provisions.

The original proponent of this section should do the work of incorporating the actual requirements for the benefit of the code user instead of referencing a code that may not be adopted.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There will be no impact if the original proponent actually brings the requirements into the body of the code.

Public Hearing Results

Committee Action	As Modified

Committee Reason: The committee felt that the requirements in R404 were appropriate for multi-family under the residential code. Modifications to the charging language were approved to provide additional clarity.

Final Hearing Results

RED1-112-22	AM

RED1-116-22

Original Proposal

IECC: R404.5

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.5 Electric readiness. Water heaters, household clothes dryers, conventional cooking tops and conventional ovens that use fossil fuel ~~Systems using fossil fuel: water heaters, household clothes dryers, conventional cooking tops or conventional ovens~~shall comply with ~~the requirements of~~ Sections R404.5.1 through R404.5.4

Reason: Performed a colonectomy and otherwise edited for clarity.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial.

Public Hearing Results

Committee Action	**As Modified**

Committee Reason: Edited for clarity. The word “of” was deleted before “…Sections R404.5.1…”.

Final Hearing Results

RED1-116-22	AM

RED1-128-22

Original Proposal

IECC: R404.5.1

Proponents: Shane Hoeper, City of Dubuque, myself (shoeper@cityofdubuque.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.5.1 Cooking ~~products~~appliances. A~~n individual~~ dedicated branch circuit ~~outlet~~ with a rating not less than 2~~5~~40-volts, 40-amperes shall be installed~~,~~ and terminate within three feet of conventional cooking tops, conventional ovens or cooking~~products~~ appliances combining both.

Exception: Cooking ~~products~~ appliances not installed in an individual dwelling unit.

Reason: This edit is intended to clean-up the language used and does not change the intent of the section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This editorial change does not change the cost impact of the code section.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The committee felt that the changes accurately described the type of appliances used for cooking and the technical changes better reflected the electrical requirements.

Final Hearing Results

RED1-128-22 AM

RED1-131-22

Original Proposal

IECC: R404.5.2
Proponents: Shane Hoeper, City of Dubuque, myself (shoeper@cityofdubuque.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.5.2 Household Clothes Dryers. A~~n individual~~ dedicated branch circuit~~ outlet~~ with a rating not less than 240-volts, 30-amperes shall be installed~~,~~ and terminate within three feet (304 mm) of each household clothes dryer.

> **Exception:** Clothes dryers ~~that serve more than one dwelling unit and are located outside of a dwelling unit~~not installed in an individual dwelling unit.

Reason: Editorial changes to be consistent with R404.5.1. Not intended to change the intent of the section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This change is only editorial.

Public Hearing Results

Committee Action	As Submitted

Committee Reason: The committee felt that the changes accurately described the type of appliances used for cooking and the technical changes better reflected the electrical requirements.

Final Hearing Results

RED1-131-22	AS

RED1-137-22

Original Proposal

IECC: R404.6.1.3

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.6.1.3 Electrical service reserved space. The main electrical service panel shall have a reserved space for a dual pole circuit breaker and shall be labeled "For Future ~~Solar~~Renewable Electric." The reserved space shall be at the opposite (load) end of the busbar from the primary energy source.

Reason: There are other renewable energy systems than solar, even on rooftops.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: language open to all types of renewables.

Final Hearing Results

RED1-137-22	AS

RED1-138-22

Original Proposal

IECC: R404.6.1.4

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.6.1.4 Electrical interconnection. An electrical junction box shall be installed within 24 inches (610 mm) of the main electrical service panel and shall be connected to a capped roof penetration sleeve or a location in the attic that is within 3 feet (914 mm) of the solar-ready zone by a ~~minimum~~ not less than 1 inch (25 mm) nonflexible metallic conduit or permanently installed wire as*approved* ~~by the code official~~. Where the interconnection terminates in the attic, the location shall be not less than 12 inches (35 mm) above ceiling insulation. Both ends of the interconnection shall be labeled "For Future ~~Solar~~ Renewable Electric".

Reason: There are other renewable energy systems than solar and some fit on roofs. Edited for preferable code language.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal clarifies the requirements for location and labeling of the electrical interconnection for future renewable energy installations. Similar to RED1-137-22, it changes the wording "Solar" to "Renewable".

Final Hearing Results

RED1-138-22	AS

RED1-145-22

Original Proposal

IECC: R404.7, R404.7.1, R404.7.2, R404.7.3, R404.7.4.1, R404.7.4, R404.7.5.1

Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org); Patricia Chawla, Austin Energy, Austin Energy (patricia.chawla@austinenergy.com); Michael Stone, National Electrical Manufacturers Association, NEMA (mike.stone@nema.org); Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com); Robert Raymer, California Code Consultants, Leading Builders of America (rraymer@cbia.org); Rick Tempchin, Alliance for Transportation Electrification, Senior Advisor (rick@evtransportationalliance.org); Emily Kelly, ChargePoint, ChargePoint (emily.kelly@chargepoint.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.7 Electric Vehicle Power Transfer Infrastructure. ~~New automobile parking spaces for one- and two-family dwellings and townhouses shall be provided in accordance with Sections R404.7.1 through R404.7.5.~~ New residential automobile parking spaces for ~~R-2 occupancies~~ residential buildings shall be provided with electric vehicle power transfer infrastructure in accordance with Sections R404.7.1 through R404.7.5.

R404.7.1 Quantity. New one- and two-family dwellings and townhouses with a designated attached or detached garage or other onsite private parking provided adjacent to the dwelling unit shall be provided with one EV-capable, EV-ready, or EVSE ~~installed~~ space per dwelling unit. R-2 occupancies or allocated parking for R-2 occupancies in mixed-use buildings shall be provided with an EV capable space, EV ready space, or EVSE space for 40 percent of each dwelling units or automobile parking spaces, whichever is less.

R404.7.2 EV Capable Spaces. Each EV capable space used to meet the requirements of Section R404.7.1 shall comply with all of the following:

1. A continuous raceway or cable assembly shall be installed between an enclosure or outlet located within ~~3~~ 6 feet (~~914~~ 1828 mm) of the EV capable space and a suitable panelboard or other onsite electrical distribution equipment.
2. Installed raceway or cable assembly shall be sized and rated to supply a minimum circuit capacity in accordance with R404.7 ~~4.~~ 5.
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have sufficient dedicated space and spare electrical capacity for a 2-pole circuit breaker or set of fuses.
4. The electrical enclosure or outlet and the electrical distribution equipment directory shall be marked: "For future electric vehicle supply equipment (EVSE)."

R404.7.3 EV Ready Spaces. Each branch circuit serving EV ready spaces shall comply with all of the following:

1. Terminate at an outlet or enclosure, located within ~~3~~ 6 feet (~~914~~ 1828 mm) of each EV ready space it serves and marked "For electric vehicle supply equipment (EVSE)".
2. ~~Have~~ Be served by an ~~a minimum~~ electrical distribution system and circuit capacity in accordance with ~~R404.7.4~~ Section R404.7.5.
3. Be designated on ~~T~~ the panelboard or other electrical distribution equipment directory ~~shall designate the branch circuit~~ as "For electric vehicle supply equipment (EVSE)." ~~and the outlet or enclosure shall be marked "For electric vehicle supply equipment (EVSE)."~~

~~R404.7.4.1~~ R404.7.4 ~~Circuit capacity management~~ EVSE Spaces. ~~The capacity of each branch circuit serving multiple EVSE spaces, EV ready space or EV capable spaces designed to be controlled by an energy management system providing load management in accordance with NFPA 70, shall have a capacity of not less than 2.7 kVA per space.~~ An installed EVSE with multiple output connections shall be permitted to serve multiple EVSE spaces. Each EVSE serving either a single EVSE space or multiple EVSE spaces shall comply with the following:

1. Be served by an electrical distribution system in accordance with Section R404.7.5
2. Have a nameplate charging capacity of not less than 6.2 kVA (or 30A at 208/240V) per EVSE space served. Where an EVSE serves three or more EVSE spaces and is controlled by an energy management system in accordance with Section R404.7.5, the nameplate charging capacity shall be not less than 2.1 kVA per EVSE space served.
3. Be located within ~~3~~ 6 feet (~~914~~ 1828 mm) of each EVSE space it serves.
4. Be installed in accordance with NFPA 70 and be listed and labeled in accordance with UL 2202 or UL 2594.

~~R404.7.4~~ R404.7.5 ~~Circuit Capacity~~ Electrical distribution system capacity. ~~For one- and two-family dwellings and townhouses, the capacity of electrical infrastructure~~ The branch circuits and electrical distribution systemserving each EV capable space, EV ready space and EVSE space used to comply with Section R404.7.1 shall ~~have a rated capacity not less than 8.3 kVA (or 40A at 208/240V) for each EV capable space, EV ready space or EVSE space it serves. Where a circuit is shared or managed it shall be in accordance with NFPA 70. For R-2 occupancies, the capacity of electrical infrastructure serving each EV capable space, EV ready space and EVSE space shall~~ comply with one of the following:

1. ~~A branch circuit shall have a rated capacity not less than 8.3kVA (or 40A at 208/240V) for each EV capable space, EV ready space or EVSE space it serves.~~ Sized for a calculated EV charging load of not less than 6.2 kVA per EVSE, EV ready, or EV capable space. Where a circuit is shared or managed it shall be in accordance with NFPA 70.
2. ~~The requirements of R404.7.4.1.~~ The capacity of the electrical distribution system and each branch circuit serving multiple EVSE spaces, EV ready spaces, or EV capable spaces designed to be controlled by an energy management system in accordance with NFPA 70, shall be sized for a calculated EV charging load of not less than 2.1 kVA per space. Where an energy management system is used to control EV charging loads for the purposes of this section, it shall not be configured to turn off electrical power to EVSE or EV ready spaces used to comply with Section R404.7.1.

Exceptions:

1. Where the local electric distribution entity has certified in writing that it is not able to provide 100 percent of the necessary distribution capacity within 2 years after the estimated date of the certificate of occupancy. The required EV charging infrastructure shall be reduced based on the available existing electric distribution capacity.
2. Where substantiation has been approved that meeting the requirements of Section R404.7.5 ~~4.1~~ will alter the local utility infrastructure design requirements on the utility side of the meter so as to increase the utility side cost to the builder or developer by more than $400.00 per dwelling unit.

~~**R404.7.5.1 EVSE minimum charging rate.** Each installed EVSE shall comply with one of the following~~:

~~1. Be capable of charging at a rate of not less than 6.2 kVA (or 30A at 208/240V)~~.

~~2. Where serving EVSE spaces allowed to have a circuit capacity of not less than 2.7 kVA in accordance with R404.7.4.1 and controlled by an energy management system providing load management, be capable of simultaneously charging each EVSE space at a rate of not less than 2.1 kVA.~~

Reason: The intent of this public comment is not to make substantive changes to the essential requirements for EV charging, but is intended to improve the clarity, usability and enforceability of the EV charging section of the code. The only change to the requirements loosens the location requirement. This public comment was developed as a consensus proposal with input from several stakeholders as part of discussions by a working group. The edits do several things:

- Since the section was created by two separate proposals for single-family and multifamily, the code ended up with redundant language. The proposal removes and consolidates the redundant langue for better clarity.
- There are several editorial changes to make the language more internally consistent and more understandable.
- The language has been clarified that capacity requirements are not just for branch circuits, but for the whole electrical distribution system. This is particularly important for clarity and enforceability of the load managed capacity section.
- Section R404.7.4 Circuit Capacity. has been renamed and renumbered R404.7.5 Electrical distribution system capacity. The new location is more logical. The new name reflects the reality that capacity requirements apply to the whole electrical distribution system

and not just individual branch circuits. This section has been modified for greater clarity and technical soundness. The existing language creates confusion because it sets requirements for the capacity of the distribution system that take into account the safety factors in the electrical code. This creates confusion because it is not always clear that those safety factors have already been applied and users might think that they need to still apply those factors. It is also problematic because the electrical code could change the safety and sizing requirements for distribution systems serving EV loads, introducing inconsistencies. The edit changes the focus to the minimum functional requirements of the EV charging infrastructure: the amount of power available. It changes to the requirement to the minimum EV charging load that the distribution system needs to be sized for. It leaves all of the sizing calculations and safety factors up to the electrical designer and electrical code. This has the additional benefit of aligning the numbers in the capacity section with the functional requirements for EVSE.

- The existing Section R404.7.4.1 has been simplified and incorporated into R404.7.5.
- The content of R404.7.5.1 EVSE minimum charging rate has been moved to a more logical location (section R404.7.4) it has also been modified for greater clarity. The "capable of charging at a minimum rate" (in kW), consistently caused confusion. The PC replaces that with a requirement for minimum nameplate charging capacity. This is better aligned with the way that electric equipment capacities are denoted. It also allows the unit to be kVA, which is the appropriate unit for capacity (as opposed to kW) and aligns better with modifications made to how capacity requirements have been modified below. The section is also clear about what the minimum nameplate rating needs to be for load managed EVSE with multiple connections.
- The working group considered 3 feet to be overly restrictive and inconsistent with the requirements used by some jurisdictions. Therefore, the location requirement for all EV space types has been changed to 6 feet.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change will not change the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: the efficiency gains from level 2 charging equipment and the avoided costs of future retrofit were sufficient to place these requirements within the body of the code, per the guidance given to the subcommittee.

Final Hearing Results

RED1-145-22	AS

RED1-154-22

Original Proposal

IECC: CHAPTER 4 [RE], R404.7.1, R404.7.4

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

CHAPTER 4 [RE]
RESIDENTIAL ENERGY EFFICIENCY

Revise as follows:

R404.7.1 Quantity. New one- and two-family dwellings and townhouses with a designated attached or detached garage or other onsite private parking provided adjacent to the dwelling unit shall be provided with one EV-capable, EV-ready, or EVSE installed space per dwelling unit. R-2 occupancies or allocated parking for R-2 occupancies in mixed-use buildings shall be provided with an EV capable space, EV ready space, or EVSE space for 40 percent of each dwelling units or automobile parking spaces, whichever is less.**<u>Exceptions:</u>**

1. <u>Where the local electric distribution entity has certified in writing that it is not able to provide 100 percent of the necessary distribution capacity within 2 years after the estimated date of the certificate of occupancy. The required EV charging infrastructure shall be reduced based on the available existing electric distribution capacity.</u>
2. <u>Where substantiation has been approved that meeting the requirements of Section R404.7.4.1 will alter the local utility infrastructure design requirements on the utility side of the meter so as to increase the utility side cost to the builder or developer by more than $400.00 per dwelling unit.</u>

R404.7.4 Circuit Capacity. For one- and two-family dwellings and townhouses, the capacity of electrical infrastructure serving each EV capable space, EV ready space and EVSE space shall have a rated capacity not less than 8.3 kVA (or 40A at 208/240V) for each EV capable space, EV ready space or EVSE space it serves. Where a circuit is shared or managed it shall be in accordance with NFPA 70. For R-2 occupancies, the capacity of electrical infrastructure serving each EV capable space, EV ready space and EVSE space shall comply with one of the following:

1. A branch circuit shall have a rated capacity not less than 8.3kVA (or 40A at 208/240V) for each EV capable space, EV ready space or EVSE space it serves. Where a circuit is shared or managed it shall be in accordance with NFPA 70.
2. The requirements of R404.7.4.1.

~~Exceptions:~~

1. ~~Where the local electric distribution entity has certified in writing that it is not able to provide 100 percent of the necessary distribution capacity within 2 years after the estimated date of the certificate of occupancy. The required EV charging infrastructure shall be reduced based on the available existing electric distribution capacity.~~
2. ~~Where substantiation has been approved that meeting the requirements of Section R404.7.4.1 will alter the local utility infrastructure design requirements on the utility side of the meter so as to increase the utility side cost to the builder or developer by more than $400.00 per dwelling unit.~~

Reason: The exceptions for the local electrical utility's lack of capacity are misplaced in the circuit capacity section. They instead should be located in the quantity section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change simply relocates provisions.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: the language change to capacity is more appropriate and the exceptions are well placed in this section.

Final Hearing Results

RED1-154-22	AS

RED1-157-22

Original Proposal

IECC: R404.7.4

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

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.7.4 Circuit Capacity. For one- and two-family dwellings and townhouses, the capacity of electrical infrastructure serving each EV capable space, EV ready space and EVSE space shall have a rated capacity not less than 8.3 kVA (or 40A at 208/240V) for each EV capable space, EV ready space or EVSE space it serves. Where a circuit is shared or managed it shall be in accordance with NFPA 70. For R-2 occupancies, the capacity of electrical infrastructure serving each EV capable space, EV ready space and EVSE space shall comply with one of the following:

1. A branch circuit shall have a rated capacity not less than 8.3kVA (or 40A at 208/240V) for each EV capable space, EV ready space or EVSE space it serves. Where a circuit is shared or managed it shall be in accordance with NFPA 70.
2. The requirements of R404.7.4.1.

Exceptions:

1. Where the local electric distribution entity has certified in writing that it is not able to provide 100 percent of the necessary distribution capacity within 2 years after the estimated date of the certificate of occupancy. The required EV charging infrastructure shall be reduced based on the available existing electric distribution capacity.
2. Where substantiation has been approved that meeting the requirements of Section R404.7.4.1 will alter the local utility infrastructure design requirements on the utility side of the meter so as to increase the utility side cost to the builder or developer by more than ~~$400.00~~ $450.00 per dwelling unit.

Reason: This proposed change is suggested to adjust the nominal value in Exception 2 to account for current (2022) inflation and to account for projected inflation in 2023 and 2024. Using data and projections from the following web sites:

https://www.usinflationcalculator.com/inflation/current-inflation-rates/
https://www.federalreserve.gov/monetarypolicy/fomcprojtabl20221214.htm
https://www.bls.gov/cpi/

Inflation in the US (as of November 2022) was 7.1% over the 12 month period from November 2021 to November 2022. The December Federal Reserve projection for personal consumption expenditures (PCE) inflation is 3.1% for 2023 and 2.5% in 2024.

Using these values for inflation and projected inflation yields the following results:

$400.00 * 1.071 (7.1% inflation in 2022) = $428.40

$428.40 * 1.031 (3.1% inflation in 2023) = $441.68

$441.68 * 1.025 (2.5% inflation in 2024) = $452.72

This proposal rounds down the value to $450 for ease of use in the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposed change only adjusts a value in an exception to account for inflation.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The committee felt that the change is in line with inflation measures and provides a fair value for the future.

Final Hearing Results

RED1-157-22	AS

RED1-166-22

Original Proposal

IECC: SECTION R408, R408.1, R408.2, TABLE R408.2, R408.2.10 (New)
Proponents: Michael Jouaneh, Lutron Electronics Co., Inc., Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

2024 International Energy Conservation Code [RE Project]

SECTION R408
ADDITIONAL EFFICIENCY REQUIREMENTS

R408.1 Scope. This section establishes additional efficiency credits to achieve additional energy efficiency in accordance with Section R401.2.5.

R408.2 Additional energy efficiency credit requirements . Two of the additional measures shall be selected from Table R408.2 that meet or exceed a total of ten credits. Five additional credits shall be selected for dwelling units with greater than 5,000 square feet (465 m^2) of living space floor area located above grade plane. Each measure selected shall meet the relevant subsections of Section R408 and receive credit as specified in Table R408.2 for the specific Climate Zone. Interpolation of credits between measures shall not be permitted.

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Portions of table not shown remain unchanged.

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 4C	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.10	Whole home lighting control	1	1	1	1	1	1	1	1	1

Add new text as follows:

R408.2.10 Whole Home Lighting Control. The dwelling unit shall have a switch by the main entrance that turns off all the permanently installed interior lighting or have a lighting control system that has the capability to turn off all permanently installed interior lighting from remote locations.**Exceptions**:1. Up to 5% of the total lighting power may remain uncontrolled.2. Spaces where lighting is controlled by a count-down timer or *occupant sensor control.*

Reason: This proposal is similar to one that was submitted as a mandatory requirement for the base energy code but was rejected by the consensus committee even though it was approved and recommended by the PLR subcommittee. I believe this provision makes sense as an optional energy credit. This would provide a lighting option in the energy credit section. Currently there are no lighting options in the energy credit section.

This proposal is similar to what is mandatory in ASHRAE 90.2-2018 and similar to what has been approved so far for dwelling units in the energy credits section of the IECC 2024 commercial energy code. The intent to require lighting to have a control system or smart light fixtures such that the lighting can be shut-off from the exit or remote locations (e.g., using a phone app). This control strategy will save energy by allowing occupants to shutoff the lighting as they leave (or while they are away) so that unneeded lighting is not left on when no one is home. In the U.K. this feature is called "the last man out button". Note that the intent is for lighting to have the capability to be shutoff, not mandate lighting be shutoff.

Bibliography: ASHRAE 90.2 section 7.5.3. http://ashrae.iwrapper.com/ASHRAE_PREVIEW_ONLY_STANDARDS/STD_90.2_2018

FutureResLightingPaper FINAL DRAFT docx - 2018-08-15.pdf (bpa.gov) http://legacy.bpa.gov/EE/Technology/EE-emerging-technologies/Projects-Reports-Archives/Documents/FutureResLightingPaper%20FINAL%20DRAFT%20docx%20-%202018-08-15.pdf
[11% lighting savings from energy management system, cost is $150 at high end. See page 37]

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

Energy savings is 11% and cost $150 per the Bonnaville power study (see bibliography). I calculated scalar ratio on this and got 9.5 with scalar ratio limit of 14.6 so it is cost effective. See attachment. Keep in mind this is one of many optional provisions in the energy credit section and the only lighting one.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: approved the changes with edits to the table to ensure that some values were added.

Final Hearing Results

RED1-166-22	AM

RED1-182-22

Original Proposal

IECC: SECTION 202, TABLE R408.2.1.3; IRCECC: SECTION 202, TABLE N1108.2.1.3

Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

LOW SLOPE~~LOW-SLOPED ROOF~~. A roof slope less than 2 units vertical in 12 units horizontal (17 percent slope).

STEEP SLOPE~~STEEP-SLOPED ROOF~~. A roof slope 2 units vertical in 12 units horizontal (17 percent slope) or greater.

TABLE R408.2.1.3 MINIMUM ROOF REFLECTANCE[a]

ROOF SLOPE	THREE-YEAR AGED SOLAR REFLECTANCE INDEX[b]
Low slope Low-slope	75[b, c]
Steep slope Steep-slope	16

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for solar reflectance shall be assigned a 3-year-aged solar reflectance in accordance with Section R408.2.1.3.1.

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × f^{2}t × °F (12 W/m^2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance.

2024 ENERGY Chapter11

Revise as follows:

LOW SLOPE~~LOW-SLOPED ROOF~~. A roof slope less than 2 units vertical in 12 units horizontal (17 percent slope).

STEEP SLOPE~~STEEP-SLOPED ROOF~~. A roof slope 2 units vertical in 12 units horizontal (17 percent slope) or greater.

TABLE N1108.2.1.3 MINIMUM ROOF REFLECTANCE[a]

ROOF SLOPE	THREE-YEAR AGED SOLAR REFLECTANCE INDEX[b]
Low slope Low-slope	75[b,c]
Steep slope Steep-slope	16

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for solar reflectance shall be assigned a 3-year aged solar reflectance in accordance with Section N1108.2.1.3.1.

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

Reason: This comment changes the new defined terms "low-sloped roof" and "steep-sloped roof" to "low slope" and "steep slope." Doing so aligns these new IECC residential/IRC Chapter 11 terms with the existing IBC definition of "steep slope" [i.e., A roof slope 2 units vertical in 12 units horizontal (17-percent slope) or greater]. The phrase "sloped roof" is not present in the Residential 1st Public Comment Draft (except as the defined terms), so there are no uses of the new terms "low-sloped roof" and "steep-sloped roof" within the 1st Public Comment Draft. "Slope" is used in conjunction with "roof" in three sections (R407.2/N1107.2, Table R408.2.1.3/N1108.2.1.3, and RB103.6/AT103.6), and the changes proposed do not affect interpretation of the provisions of those sections. The change in terms (e.g., "low-sloped roof" to "low slope") also matches the terms and associated definitions appropriately. Finally, this comment changes the hyphenated terms "low-slope" and "steep-slope" to the proposed defined terms "low slope" and "steep slope" in Tables R408.2.1.3. and N1108.2.1.3 to clarify that the defined terms apply.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This comment makes editorial changes to defined terms without any technical effect, so there is no change in cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Provides consistency across codes.

Final Hearing Results

RED1-182-22	AS

RED1-184-22 Part I

Original Proposal

IRCECC: N1102.5.1.2

Proponents: Theresa Weston, The Holt Weston Consultancy, ABAA (Air Barrier Association of America) (holtweston88@gmail.com)

2024 ENERGY Chapter11

Revise as follows:

N1102.5.1.2 Testing and maximum air leakage rate. The *building* or each *dwelling unit* in the building shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 4.0 air changes per hour or 0.22 cfm/ft^2 (1.1 L/s x m^2) of building or dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, ASTM E1827 or ASTM E3158 and reported at a pressure differential of 0.2 inch water gauge (50 Pa). Where required by the *code official*, testing shall be conducted by an*approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the*building thermal envelope* have been sealed.<u>During testing:</u>

1. <u>Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.</u>
2. <u>Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.</u>
3. <u>Interior doors, where installed at the time of the test, shall be open</u>.
4. <u>Exterior or interior terminations for continuous ventilation systems shall be sealed</u>.
5. <u>Heating and cooling systems, where installed at the time of the test, shall be turned off</u>.
6. <u>Supply and return registers, where installed at the time of the test, shall be fully open</u>.

Exceptions:

1. When testing individual dwelling units, an air leakage rate not exceeding 0.27 cubic feet per minute per square foot [1.35 L/s x m^2] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch water gauge (50 Pa), shall be permitted in all climate zones for:
   1.1 Attached single and multiple family building dwelling units.
   1.2 Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.
2. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table N1102.5.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other conditioned spaces in accordance with Sections N1102.2.13 and N1102.4.5, as applicable.
3. Where tested in accordance with N1102.5.1.2, testing of each dwelling unit is not required.

~~During testing:~~

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

2. ~~Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.~~
3. ~~Interior doors, where installed at the time of the test, shall be open~~.
4. ~~Exterior or interior terminations for continuous ventilation systems shall be sealed~~.
5. ~~Heating and cooling systems, where installed at the time of the test, shall be turned off~~.
6. ~~Supply and return registers, where installed at the time of the test, shall be fully open~~.

Mechanical *ventilation* shall be provided in accordance with Section M1505 of this code or Section 403.3.2 of the*International Mechanical Code*, as applicable, or with other*approved* means of *ventilation*.

Reason: This proposal is editorial. It moves the details of testing conditions which should be a part of the section to the end of the section (before the exception list). No technical changes are made.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is an editorial change and does not change any code requirements, and therefore does not change the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Helpful re-organization placing requirements above the exception.

Final Hearing Results

RED1-184-22 Part I AS

RED1-184-22 Part II

Original Proposal

IECC: R402.5.1.2

Proponents: Theresa Weston, The Holt Weston Consultancy, ABAA (Air Barrier Association of America) (holtweston88@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.5.1.2 Testing. The *building* or each *dwelling unit* in the buildingshall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 4.0 air changes per hour or 0.22 cfm/f^{2}t (1.1 L/s x m^2) of building or dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, ASTM E1827 or ASTM E3158 and reported at a pressure differential of 0.2 inch water gauge (50 Pa). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the*building thermal envelope* have been sealed. During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exceptions:

1. When testing individual dwelling units, an air leakage rate not exceeding 0.27 cubic feet per minute per square foot [1.35 L/s x m^2)] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:
   1.1 Attached single and multiple family building dwelling units.
   1.2 Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.
2. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.5.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.13 and R402.4.5, as applicable.
3. Where tested in accordance with R402.5.1.4, testing of each dwelling unit is not required.

~~During testing:~~

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

2. ~~Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.~~
3. ~~Interior doors, where installed at the time of the test, shall be open~~.
4. ~~Exterior or interior terminations for continuous ventilation systems shall be sealed~~.
5. ~~Heating and cooling systems, where installed at the time of the test, shall be turned off~~.
6. ~~Supply and return registers, where installed at the time of the test, shall be fully open~~.

Mechanical ventilation shall be provided in accordance with Section M1505 of the*International Residential Code* or Section 403.3.2 of the *International Mechanical Code*, as applicable, or with other*approved* means of ventilation.

Reason: This proposal is editorial. It moves the details of testing conditions which should be a part of the section to the end of the section (before the exception list). No technical changes are made.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is an editorial change and does not change any code requirements, and therefore does not change the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Helpful re-organization placing requirements above the exception.

Final Hearing Results

RED1-184-22 Part II	AS

RED1-185-22

Original Proposal

IECC: R102.1.1, SECTION 202, R401.3, R402.1.5, R402.2.7, R402.2.9, TABLE R402.5.1.1, R402.5.1.2, R402.5.4, R402.5.6, R403.3.2, R405.2, R405.3.2.1, R405.3.2.2, TABLE R405.4.2(1), TABLE R406.2, R406.3, R406.7.2.1, R406.7.2.2, R408.2.1, R408.2.1.1, R502.2.1, R503.1.1, R503.1.1.4, R503.1.1.6, R503.1.5, R506.1; IRCECC: N1101.4, SECTION 202, N1101.14, N1102.1.5, N1102.2.7, N1102.2.9, N1102.4.5, TABLE N1102.5.1.1, N1102.5.1.2, N1102.5.4, N1102.5.6, N1105.2, N1105.3.2.1, N1105.3.2.2, TABLE N1105.4.2(1), TABLE N1106.2, N1106.3, N1106.7.2.1, N1106.7.2.2, N1108.2.1, N1108.2.1.1, N1108.2.4, N1110.2.1, N1111.1.1, N1111.1.1.4, N1111.1.1.6, N1111.1.5, N1114.1

Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R102.1.1 Above code programs. The *code official* or other authority having jurisdiction shall be permitted to deem a national, state or local energy-efficiency program to exceed the energy efficiency required by this code. *Buildings approved* in writing by such an energy-efficiency program shall be considered to be in compliance with this code where such buildings also meet the requirements identified in Table R405.2 and the proposed total *building thermal envelope* UA, which is the sum of U-factor times assembly area, shall be less than or equal to the *building thermal envelope*~~building thermal envelope~~ UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, 2, and by 1.15 in Climate Zones 3 through 8, in accordance with Equation 4-1. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

$$\text{For Climate Zones 0-2: } UA_{\text{Proposed design}} \leq 1.08 \text{ x } UA_{\text{Prescriptive reference design}}$$
$$\text{For Climate Zones 3-8: } UA_{\text{Proposed design}} \leq 1.15\text{x } UA_{\text{Prescriptive reference design}}$$

CONTINUOUS INSULATION (ci). Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior, or is integral to any opaque surface, of the *building thermal envelope*~~envelope~~.

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

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls*, *crawl space walls* and floors and ducts outside *conditioned spaces.*
2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the *building thermal envelope* ~~building envelope~~, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required duct system and *building thermal envelope* ~~building envelope~~ air leakage testing performed on the building.
4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.

5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted, the compliance path used, and where applicable, the additional efficiency measures selected for compliance with R408.
8. Where a solar-ready zone is provided, the certificate shall indicate the location, and dimensions.

R402.1.5 Component performance alternative. Where the proposed total *building thermal envelope thermal conductance* is less than or equal to the required total *building thermal envelope* ~~building thermal envelope~~ conductance using factors in Table R402.1.2 the *building* shall be considered to be in compliance with Table R402.1.2. The total thermal conductance shall be determined in accordance with Equation 4-1. Proposed *U*-factors and slab-on-grade *F*-factors shall be taken from ANSI/ASHRAE/IES Standard 90.1 Appendix A or determined using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. In addition to total thermal conductance compliance, the SHGC requirements of Table R402.1.2 and the maximum fenestration *U*-factors of Section R402.6 shall be met.

Equation 4-1

$$(\mathrm{Up}\ A + \mathrm{Fp}\ P) \leq (\mathrm{Ur}\ A + \mathrm{Fr}\ P)$$

Up A = the sum of proposed *U*-factors times the assembly areas in the proposed building.
Fp P = the sum of proposed *F*-factors times the slab-on-grade perimeter lengths in the proposed building.
Ur A = the sum of *U*-factors in Table R402.1.2 times the same assembly areas as in the proposed building.
Fr P = the sum of *F*-factors in Table R402.1.2 times the same slab-on-grade perimeter lengths as in the proposed building.

R402.2.7 Steel-frame ceilings, walls and floors. Steel-frame ceilings, walls, and floors shall comply with the *U*-factor requirements of Table R402.1.2. The calculation of the *U*-factor for a steel-framed ceilings and walls in a~~n~~ *building thermal envelope*~~envelope~~ assembly shall be determined in accordance with AISI S250 as modified herein.

1. Where the steel-framed wall contains no cavity insulation, and uses continuous insulation to satisfy the U-factor maximum, the steel-framed wall member spacing is permitted to be installed at any on center spacing.
2. Where the steel-framed wall contains framing spaced at 24 inches (610 mm) on center with a 23 percent framing factor or framing spaced at 16 inches (400 mm) on center with a 25 percent framing factor, the next lower framing member spacing input values shall be used when calculating using AISI S250.
3. Where the steel-framed wall contains less than 23 percent framing factors the AISI S250 shall be used without any modifications.
4. Where the steel-framed wall contains other than standard C-shape framing members the AISI S250 calculation option for other than standard C-shape framing is permitted to be used.

R402.2.9 Basement walls. Basement walls shall be insulated in accordance with Table R402.1.3.

Exception: Basement walls associated with unconditioned basements where all of the following requirements are met:

1. The floor overhead, including the underside stairway stringer leading to the basement, is insulated in accordance with Section R402.1.3 and applicable provisions of Sections R402.2 and R402.2.8.
2. There are no uninsulated duct, domestic hot water, or hydronic heating surfaces exposed to the basement.
3. There are no HVAC supply or return diffusers serving the basement.
4. The walls surrounding the stairway and adjacent to conditioned space are insulated in accordance with Section R402.1.3 and applicable provisions of Section R402.2.
5. The door(s) leading to the basement from conditioned spaces are insulated in accordance with Section R402.1.3 and applicable provisions of Section R402.2, and weatherstripped in accordance with Section R402.5.

6. The *building thermal envelope* ~~building thermal envelope~~ separating the basement from adjacent conditioned spaces complies with Section R402.5.

TABLE R402.5.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the *building thermal envelope* ~~building envelope~~. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	A sealed air barrier shall be installed in any dropped ceiling or soffit to separate it from unconditioned space. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be air sealed with gasketing materials that allow for repeated entrance over time.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier. Access hatches and doors shall be installed and insulated in accordance with Section R402.2.5 Eave Baffles shall be installed in accordance with Section R402.2.4
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, *R*-value, of not less than R-3 per inch. Exterior *building thermal envelope*~~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 framing and skylights, and the jambs of windows and doors, shall be sealed.	Framing cavities around windows, skylights and doors shall be completely filled with insulation or insulated per window manufacturer's instructions.
Rim joists	Rim joists shall include an air barrier. The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement, crawl space, and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.11. Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.11. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.9.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.11.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the *building thermal envelope*~~building thermal envelope~~ to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.8.
Recessed lighting	Recessed light fixtures installed in the *building thermal envelope*~~building thermal envelope~~ shall be air sealed in accordance with Section R402.5.5.	Recessed light fixtures installed in the *building thermal envelope*~~building thermal envelope~~ shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Showers, tubs, and fireplaces adjacent to the *building thermal envelope* ~~building thermal envelope~~	An air barrier shall separate insulation in the *building thermal envelope* from the shower, tub, and fireplace assemblies.	Exterior framed walls adjacent to showers, tubs and fireplaces shall be insulated.
Electrical,communication, and other equipment boxes, housings, and enclosures	Boxes, housing, and enclosures that penetrate the air barrier shall be caulked, taped, gasketed, or otherwise sealed to the air barrier element being penetrated. All concealed openings into the box, housing, or enclosure shall be sealed. The continuity of the air barrier shall be maintained around boxes, housings, and enclosures that penetrate the air barrier. Alternatively, air-sealed boxes shall be installed in accordance with R402.5.6.	Boxes, housing, and enclosures shall be burried in or surrounded by insulation.
HVAC register boots	HVAC supply and return register boots that penetrate *building thermal envelope*~~building thermal envelope~~ shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	HVAC supply and return register boots located in the *building thermal envelope*~~building's thermal envelope~~ shall be buried and surrounded by insulation.
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Common walls or double walls	Air sealing materials recognized in a listed fire-resistance rated common wall or double wall design and installed in accordance with the listing, or air sealing materials recognized in an approved design, shall be used. Common walls or double walls shall be considered an exterior wall for the purposes of air barrier and air sealing application of this Table.	Insulation materials recognized in the listed common wall or double-wall design and installed in accordance with the listing, or insulation materials recognized in the approved design, shall be used.

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

b. Insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

R402.5.1.2 Testing. The *building* or each *dwelling unit* in the buildingshall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 4.0 air changes per hour or 0.22 cfm/f^{2}t (1.1 L/s x m^2) of building or dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, ASTM E1827 or ASTM E3158 and reported at a pressure differential of 0.2 inch water gauge (50 Pa). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the*building thermal envelope* have been sealed.

Exceptions:

1. When testing individual dwelling units, an air leakage rate not exceeding 0.27 cubic feet per minute per square foot [1.35 L/s x m^2)] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:

   1.1 Attached single and multiple family building dwelling units.

   1.2 Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.

2. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, *building thermal envelope*~~building envelope~~ tightness and insulation installation shall be considered acceptable where the items in Table R402.5.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.13 and R402.4.5, as applicable.

3. Where tested in accordance with R402.5.1.4, testing of each dwelling unit is not required.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Mechanical ventilation shall be provided in accordance with Section M1505 of the*International Residential Code* or Section 403.3.2 of the *International Mechanical Code*, as applicable, or with other*approved* means of ventilation.

R402.5.4 Rooms containing fuel-burning appliances. In Climate Zones 3 through 8, where open combustion air ducts provide combustion air to open combustion fuel-burning appliances, the appliances and combustion air opening shall be located outside the *building thermal envelope* or enclosed in a room that is isolated from inside the*building thermal envelope*~~thermal envelope~~. Such rooms shall be sealed and insulated in accordance with the *building thermal envelope*~~envelope~~ requirements of Table R402.1.3, where the walls, floors and ceilings shall meet a minimum of the *basement wall R*-value requirement. The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through *conditioned space* to an *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. Fireplaces and stoves complying with Section R402.5.2 and Section R1006 of the International Residential Code.

R402.5.6 Air-Sealed electrical and communication outlet boxes. Air-sealed electrical and communication outlet boxes that penetrate the air barrier of the *building thermal envelope*~~building thermal envelope~~ shall be caulked, taped, gasketed, or otherwise sealed to the air barrier element being penetrated. Air sealed boxes shall be buried in or surrounded by insulation. Air-sealed boxes shall be tested and marked in accordance with NEMA OS 4. Air-sealed boxes shall be installed in accordance with the manufacturer's instructions .

R403.3.2 Ducts located in conditioned space. For ductwork to be considered inside a *conditioned space,* it shall comply with one of the following:

1. The duct system shall be located completely within the *continuous air barrier* and within the *building thermal envelope* ~~building thermal envelope~~.
2. Ductwork in ventilated attic spaces or unvented attic with vapor diffusion port shall be buried within ceiling insulation in accordance with Section R403.3.3 and all of the following conditions shall exist:
   2.1. The air handler is located completely within the *continuous air barrier* and within the *building thermal envelope*.
   2.2. The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the *building thermal envelope* in accordance with Section R403.3.6, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area* served by the duct system.
   2.3. The ceiling insulation *R*-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the duct.
3. Ductwork located in wall or floor building assemblies separating unconditioned from conditioned space shall comply with the following:
   3.1. A *continuous air barrier* shall be installed as part of the building assembly between the duct and the unconditioned space.
   3.2. Ducts shall be installed in accordance with Section R403.3.1.
   Exception: Where the building assembly cavities containing ducts have been air sealed in accordance with Section R402.5.1, duct insulation is not required.
   3.3. Not less than R-10 insulation, and not less than 50 percent of the required R-value specified in Table R402.1.3, shall be located between the duct and the unconditioned space.
   3.4 For ducts in these building assemblies to be considered within conditioned space, the air handling equipment shall be installed within conditioned space.

R405.2 Simulated performance compliance. Compliance based on total building performance requires that a*proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.

2. The proposed total *building thermal envelope* ~~building thermal envelope~~ UA, which is the sum of the U-factor times assembly area, shall be less than or equal to the *building thermal envelope* ~~building thermal envelope~~ UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and 1.15 in Climate Zones 3 through 8 in accordance with Equation 4-2. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

(Equation 4-2)

$$\text{For Climate Zones 0-2: } UA_{\text{Proposed design}} \leq 1.08 \times UA_{\text{Prescriptive reference design}}$$

$$\text{For Climate Zones 3-8: } UA_{\text{Proposed design}} \leq 1.15 \times UA_{\text{Prescriptive reference design}}$$

3. For buildings without a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 85 percent of the annual energy cost of the *standard reference design*. For buildings with a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 80 percent of the annual energy cost of the standard reference design. For dwelling units with greater than 5,000 square feet (465 m^2) of living space floor area located above grade plane, the annual energy cost of the proposed design shall be reduced by an additional 5 percent of annual energy cost of the standard reference design. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

   Exceptions:

   1. The energy use based on source energy expressed in Btu or Btu per square foot of*conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multipliers for all energy sources shall be obtained from ASHRAE Standard 105 (Tables K2, K4, or K8) or from another data source approved by the *code official*.
   2. The energy use based on site energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost for an all-electric building with on-site renewable energy installed.

R405.3.2.1 Compliance report for permit application. A compliance report submitted with the application for building permit shall include the following:

1. Building street address, or other *building site* identification.
2. The name of the individual performing the analysis and generating the compliance report.
3. The name and version of the compliance software tool.
4. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
5. A certificate indicating that the proposed design complies with Section R405.3. The certificate shall document the building components' energy specifications that are included in the calculation including: component-level insulation *R*-values or *U*-factors; duct system and *building thermal envelope* ~~building envelope~~ air leakage testing assumptions; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
6. Where a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

R405.3.2.2 Compliance report for certificate of occupancy. A compliance report submitted for obtaining the certificate of occupancy shall include the following:

1. Building street address, or other building site identification.
2. Declaration of the simulated building performance path on the title page of the energy report and the title page of the building plans.
3. A statement, bearing the name of the individual performing the analysis and generating the report, indicating that the as-built building complies with Section R405.3.

4. The name and version of the compliance software tool.
5. A site-specific energy analysis report that is in compliance with Section R405.3.
6. A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the confirmed rated design of the built home complies with Section R405.3. The certificate shall report the energy features that were confirmed to be in the home, including component-level insulation *R*-values or *U*-factors; results from any required duct system and *building thermal envelope* ~~building envelope~~ air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation and service water-heating equipment installed.
7. When on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	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: as specified in Table R402.1.2, with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	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 an aperture of 1 ft^2 per 300 ft^2 of 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 as specified in Table R402.1.2.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Vertical fenestration other than opaque doors	Total area[h] = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. (b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: 0.92 - (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 - (0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 5.0 air changes per hour. Climate Zones 3 , 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M where: B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air exchange rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Heat recovery or energy recovery shall be modeled for mechanical ventilation where required by Section R403.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section R403.6.1.	The mechanical ventilation rate[b], Q, shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (8.76 × B × M)/ef where: B and M are determined in accordance with the Air Exchange Rate row of this table. e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of B × M. *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed
Internal gains	IGain, in units of Btu/day per dwelling unit, shall equal 17,900 + 23.8 ×*CFA* + 4,104 × N_{br} where: *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	Same as standard reference design.
Internal mass	Internal mass for furniture and contents: 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the *building thermal envelope*~~building envelope~~ or structure.
Structural mass	For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.3, located on the interior side of the walls.	As proposed
	For other walls, ceilings, floors, and interior walls: wood frame construction.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Heating systems[d, e, j, k]	For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC—Commercial Provisions. Capacity: sized in accordance with Section R403.7.	
	Fuel Type/Capacity: Same as proposed design	As proposed
	Product class: Same as proposed design	As proposed
	Efficiencies:	As proposed
	Heat pump: Complying with 10 CFR §430.32	As proposed
	Non-electric furnaces: Complying with 10 CFR §430.32	As proposed
	Non-electric boilers: Complying with 10 CFR §430.32	As proposed
Cooling systems[d, f, k]	As proposed. Capacity: sized in accordance with Section R403.7.	
	Fuel Type: Electric Capacity: Same as proposed design	As proposed
	Efficiencies: Complying with 10 CFR §430.32	As proposed
Service water heating[d, g, k]	As proposed. Use, in units of gal/day = 25.5 + (8.5 × N_{br}) where: N_{br} = number of bedrooms.	As proposed Use, in units of gal/day = 25.5 + (8.5 × N_{br}) × (1 − *HWDS*) where: N_{br} = number of bedrooms. *HWDS* = factor for the compactness of the hot water distribution system.

Compactness ratio[i] factor		HWDS
1 story	2 or more stories	
> 60%	> 30%	0
> 30% to ≤ 60%	> 15% to ≤ 30%	0.05
> 15% to ≤ 30%	> 7.5% to ≤ 15%	0.10
< 15%	< 7.5%	0.15

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	Fuel Type: Same as proposed design	As proposed
	Rated Storage Volume: Same as proposed design	As proposed
	Draw Pattern: Same as proposed design	As proposed
	Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32	As proposed
	Tank Temperature: 120° F (48.9° C)	Same as standard reference design
Thermal distribution systems	Duct location:	Duct location: as proposed.

Foundation Type	Slab on grade	Unconditioned crawl space	Basement or conditioned crawl space
Duct location (supply and return)	One-story building: 100% in unconditioned attic All other: 75% in unconditioned attic and 25% inside conditioned space	One-story building: 100% in unconditioned crawlspace All other: 75% in unconditioned crawlspace and 25% inside conditioned space	

5 0 % i n s	i d e c o n	d i t i o n	ed space 50% unconditioned attic	
	Duct insulation: in accordance with Section R403.3.1.			Duct insulation: as proposed.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	Duct system leakage to outside: For duct systems serving > 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft2 (9.29 m2) of conditioned floor area. For duct systems serving ≤ 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).	Duct System Leakage to Outside: The measure total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate. **Exceptions:** 1. When duct system leakage to outside is tested in accordance ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered. 2. When total duct system leakage is measured without the air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.
	For hydronic systems and ductless systems a thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies.	For hydronic systems and ductless systems, DSE shall be as specified in Table R405.4.2(2).
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F.	Same as standard reference design.
Dehumidistat	Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None. Where the proposed design utilizes a mechanical ventilation system with latent heat recovery: Dehumidistat type: manual, setpoint = 60% relative humidity. Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.	Same as standard reference design.

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, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design the following assumptions shall be made for both the proposed design and standard reference design.

Fuel Type: Same as the predominant heating fuel type

Rated Storage Volume: 40 Gallons

Draw Pattern: Medium

Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

$AF = A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and
where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the “hot water rectangle”) divided by the floor area of the dwelling.

   1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.

   2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.

   3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.

   4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.

   5. The basement or attic shall be counted as a story when it contains the water heater.

   6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a proposed design with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the standard reference design.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the standard reference design shall be the same as proposed design.

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.4	Eave baffle
R402.2.5.1	Access hatches and doors
R402.2.9	Basement walls
R402.2.9.1	Basement wall insulation installation
R402.2.10.1	Slab-on-grade floor insulation installation
R402.2.11.1	Crawl space wall insulation installation
R402.5.1.1	Installation
R402.5.1.2	Testing
R402.5.2	Fireplaces

R402.5.3	Fenestration air leakage
R402.5.4	Rooms containing fuel burning appliances
R402.5.5	Recessed lighting
R402.5.6	Air-sealed electrical and communication outlet boxes(air sealed boxes)
R406.3	*Building thermal envelope* Building thermal envelope
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3	Duct systems
R403.4	Mechanical system piping insulation
R403.5 except Section R403.5.2(staff note: this needs to be fixed with hot water pipe insulation)	Service hot water systems
R403.5.2	Hot water pipe insulation
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice system controls
R403.11	Energy consumption of pools and spas
R403.12	Portable spas
R403.13	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.5	Electric readiness
R404.6	Renewable energy infrastructure
R404.7	Electric Vehicle power transfer infrastructure

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

R406.3 Building thermal envelope. The proposed total *building thermal envelope*~~building thermal envelope~~ UA, which is sum of *U*-factor times assembly area, shall be less than or equal to the *building thermal envelope*~~building thermal envelope~~ UA using the prescriptive *U*-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and by 1.15 in Climates Zones 3 through 8, in accordance with Equation 4-3. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

(Equation 4-3)

$$\text{For Climate Zones 0-2: } UA_{\text{Proposed design}} \leq 1.08 \times UA_{\text{Prescriptive reference design}}$$

$$\text{For Climate Zones 3-8: } UA_{\text{Proposed design}} \leq 1.15 \times UA_{\text{Prescriptive reference design}}$$

R406.7.2.1 Proposed compliance report for permit application. Compliance reports submitted with the application for a building permit shall include the following:

1. Building street address, or other *building site* identification.

2. Declare ERI on title page and building plans.
3. The name of the individual performing the analysis and generating the compliance report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
6. A certificate indicating that the proposed design has an ERI less than or equal to the appropriate score indicated in Table R406.5 when compared to the ERI reference design. The certificate shall document the building component energy specifications that are included in the calculation, including: component level insulation *R*-values or *U*-factors; assumed duct system and *building thermal envelope* ~~building envelope~~ air leakage testing results; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation, and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
7. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

R406.7.2.2 Confirmed compliance report for a certificate of occupancy. A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address or other *building site* identification.
2. Declaration of ERI on title page and on building plans.
3. The name of the individual performing the analysis and generating the report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
6. A final confirmed certificate indicating that the confirmed rated design of the built home complies with Sections R406.2 and R406.4. The certificate shall report the energy features that were confirmed to be in the home, including: component-level insulation *R*-values or *U*-factors; results from any required duct system and *building thermal envelope* ~~building envelope~~ air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water-heating equipment installed. Where on-site renewable energy systems have been installed on or in the home, the certificate shall report the type and production size of the installed system.

R408.2.1 Enhanced building thermal envelope options. The *building thermal envelope* shall meet the requirements of the following:

1. Section R408.2.1.1 or R408.2.1.2.
2. Section R408.2.1.3.

R408.2.1.1 Enhanced building thermal envelope performance UA. The proposed total *building thermal envelope* ~~building thermal envelope~~ UA shall be calculated in accordance with Section R402.1.5 and shall meet one of the following:

1. Not less than 2.5 percent of the total UA of the *building thermal envelope*.
2. Not less than 5 percent of the total UA of the *building thermal envelope*.
3. Not less than 7.5 percent of the total UA of the *building thermal envelope*.

R502.2.1 Building thermal envelope. New *building thermal envelope* ~~envelope~~ assemblies that are part of the *addition* shall comply with Sections R402.1, R402.2, R402.4.1 through R402.4.5, and R402.5.

Exception: New *building thermal envelope* ~~envelope~~ assemblies are exempt from the requirements of Section R402.5.1.2.

R503.1.1 Building thermal envelope. Alterations of existing *building thermal envelope* ~~building thermal envelope~~ assemblies shall comply with this section. New *building thermal envelope* ~~Building building thermal envelope~~ assemblies that are part of the *alteration* shall comply with Section R402. In no case shall the R-value of insulation be reduced or the U-factor of a *building thermal envelope* ~~building thermal~~

~~envelope~~ assembly be increased as part of a *building thermal envelope*~~building thermal envelope~~ alteration.

Exception: The following alterations shall not be required to comply with the requirements for new construction provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Roof recover.
3. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided that the code does not require the glazing or fenestration assembly to be replaced.
4. An existing building undergoing alterations that is demonstrated to be in compliance with Section R405 or Section R406

R503.1.1.4 Floor alterations. Where an alteration to a floor or floor overhang exposes cavities or surfaces to which insulation can be applied and the floor or floor overhang is part of the *building thermal envelope*~~building thermal envelope~~, the floor or floor overhang shall be brought into compliance with Section R402.1 or an approved design. This requirement shall apply to floor alterations where the floor cavities or surfaces are exposed and accessible prior to construction.

R503.1.1.6 Air barrier. *Building thermal envelope*~~Building thermal envelope~~ assemblies altered in accordance with Section R503.1.1 shall be provided with an air barrier in accordance with Section R402.5. The air barrier shall not be required to be made continuous with unaltered portions of the *building thermal envelope*~~building thermal envelope~~. Testing requirements of Section R402.5.1.2 shall not be required.Content

R503.1.5 Additional Efficiency Packages. Alterations shall comply with Section R506 where the alteration contains replacement of two or more of the following:

1. HVAC unitary systems or HVAC central heating or cooling equipment serving the*work area* of the *alteration*.
2. Water heating equipment serving the *work area* of the *alteration*.
3. 50 percent or more of the lighting fixtures in the*work area* of the *alteration*.
4. 50 percent or more of the area of interior surfaces of the*building thermal envelope* ~~thermal envelope~~ in the *work area* of the *alteration*.
5. 50 percent or more the area of the building's *exterior wall envelope*.

Exceptions:

1. *Alterations* that are permitted with an*addition* complying with Section R502.3.5.
2. *Alterations* that comply with Section R405 or R406.

R506.1 General. Where required in Section R502 or R503, the building shall comply with one or more additional efficiency package options in accordance with the following:

1. Enhanced *building thermal envelope* ~~envelope~~ performance in accordance with Section R408.2.1.
2. More efficient HVAC equipment performance in accordance with Section R408.2.2.
3. Reduced energy use in service water-heating in accordance with Section R408.2.3.
4. More efficient duct thermal distribution system in accordance with Section R408.2.4.
5. Improved air sealing and efficient ventilation system in accordance with Section R408.2.5.

2024 ENERGY Chapter11

Revise as follows:

N1101.4 Above code programs. The *code official* or other authority having*jurisdiction* shall be permitted to deem a national, state or local energy-efficiency program to exceed the energy efficiency required by this code. *Buildings approved* in writing by such an energy-efficiency program shall be considered to be in compliance with this code. The requirements identified in Table N1105.2andthe proposed total *building thermal envelope UA, which is the sum of U-factor times assembly area, shall be less* than or equal to the *building thermal envelope*~~building thermal envelope~~ UA using the prescriptive U-factors from Table N1102.1.2 multiplied by 1.15 in accordance with Equation 4-1. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

$$\underline{UA_{\text{Proposed design}} \leq 1.15 \text{ x } UA_{\text{Prescriptive reference design}}}$$

CONTINUOUS INSULATION (ci). Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior, or is integral to any opaque surface, of the *building thermal envelope*~~envelope~~.

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

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs,*basement walls*, *crawl space walls* and floors, and ducts outside *conditioned spaces*.
2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the *building thermal envelope* ~~building envelope~~, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required duct system and*building thermal envelope* ~~building envelope~~ air leakage testing performed on the building.
4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace, or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency is not required to be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section N1106, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted, the compliance path used, and where applicable, the additional efficiency measures selected for compliance with N1108.
8. Where a solar-ready zone is provided, the certificate shall indicate the location, and dimensions.

N1102.1.5 Component performance alternative. Where the proposed total *building thermal envelope* thermal conductance is less than or equal to the required total *building thermal envelope* ~~building thermal envelope~~ conductance using factors in Table N1102.1.2 the *building* shall be considered to be incompliance with Table N1102.1.2. The total thermal conductance shall be determined in accordance with Equation 11-5. Proposed U-factors and slab-on-grade F-factors shall be taken from ANSI/ASHRAE/IES Standard 90.1 Appendix A or determined using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. In addition to total thermal conductance compliance, the SHGC requirements of Table N1102.1.2 and the maximum fenestration *U*-factors of Section N1102.6 shall be met.

(Equation 11-5)

$$\underline{(Up\ A + F\ P) \leq (Ur\ A + Fr\ P)}$$

Up A = the sum of proposed U-factors times the assembly areas in the proposed building.

Fp P = the sum of proposed F-factors times the slab-on-grade perimeter lengths in the proposed building.
Ur A = the sum of U-factors in Table N1102.1.2 times the same assembly areas as in the proposed building.
Fr P = the sum of F-factors in Table N1102.1.2 times the same slab-on-grade perimeter lengths as in the proposed building.

N1102.2.7 Steel-frame ceilings, walls, and floors. Steel-frame ceilings, walls, and floors shall comply with the*U*-factor requirements of Table N1102.1.2. The calculation of the *U*-factor for a steel- framed ceilings and walls in a~~n~~ *building thermal envelope*~~envelope~~ assembly shall be determined in accordance with AISI S250 as modified herein.

1. Where the steel-framed wall contains no cavity insulation, and uses continuous insulation to satisfy the U-factor maximum, the steel-framed wall member spacing is permitted to be installed at any on center spacing.
2. Where the steel-framed wall contains framing spaced at 24 inches (610 mm) on center with a 23 percent framing factor or framing spaced at 16 inches (400 mm) on center with a 25 percent framing factor, the next lower framing member spacing input values shall be used when calculating using AISI S250.
3. Where the steel-framed wall contains less than 23 percent framing factors the AISI S250 shall be used without any modifications.
4. Where the steel-framed wall contains other than standard C-shape framing members the AISI S250 calculation option for other than standard C-shape framing is permitted to be used.

N1102.2.9 Basement walls. *Basement walls* shall be insulated in accordance with Table N1102.1.3.

Exception: Basement walls associated with unconditioned basements where all of the following requirements are met:

1. The floor overhead, including the underside stairway stringer leading to the basement, is insulated in accordance with Section N1102.1.3 and applicable provisions of Sections N1102.2 and N1102.2.8.
2. There are no uninsulated duct, domestic hot water or hydronic heating surfaces exposed to the basemen.t
3. There are no HVAC supply or return diffusers serving the basemen.t
4. The walls surrounding the stairway and adjacent to conditioned space are insulated in accordance with Section N1102.1.3 and applicable provisions of Section N1102.2.
5. The door(s) leading to the basement from conditioned spaces are insulated in accordance with Section N1102.1.3 and applicable provisions of Section N1102.2, and weatherstripped in accordance with Section N1102.5.
6. The *building thermal envelope* ~~building thermal envelope~~ separating the basement from adjacent conditioned spaces complies with Section N1102.5.

N1102.4.5 Sunroom and heated garage fenestration. *Sunrooms* and heated garages enclosing *conditioned space* shall comply with the fenestration requirements of this code.

Exception: In Climate Zones 2 through 8, for *sunroom s* and heated garages with *thermal isolation* and enclosing *conditioned spac e*, the fenestration *U*-factor shall not exceed 0.45 and the skylight *U*-factor shall not exceed 0.70.

New fenestration separating a sunroom or heated garages with thermal isolation from conditioned space shall comply with the*building thermal envelope* ~~building thermal envelope~~ requirements of this code.

TABLE N1102.5.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the*building thermal envelope* building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	A sealed air barrier shall be installed in any dropped ceiling or soffit to separate it from unconditioned space . Access openings, drop-down stairs or knee wall doors to unconditioned attic spaces shall be air sealed with gasketing materials that allow for repeated entrance over time.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier. Access hatches and doors shall be installed and insulated in accordance with Section N1102.2.5 Eave Baffles shall be installed in accordance with Section N1102.2.4.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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, *R*-value, of not less than R-3 per inch. Exterior *building thermal envelope*~~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 framing and skylights, and the jambs of windows and doors, shall be sealed.	Framing cavities around windows, skylights and doors shall be completely filled with insulation or insulated per window manufacturer's instructions.
Rim joists	Rim joists shall include an air barrier. The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement, crawl space, and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section N1102.2.11. Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section N1102.2.11. Conditioned basement foundation wall insulation shall be installed in accordance with Section N1102.2.9.1. Slab-on-grade floor insulation shall be installed in accordance with Section N1102.2.11.
Shafts, penetrations	Duct and flue shafts and other similar penetrations to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the *building thermal envelope*~~building thermal envelope~~ to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections N1101.10-N1101.12 and N1102.2.8.
Recessed lighting	Recessed light fixtures installed in the *building thermal envelope*~~building thermal envelope~~ shall be air sealed in accordance with Section N1102.5.5.	Recessed light fixtures installed in the *building thermal envelope*~~building thermal envelope~~ shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Showers, tubs, and fireplaces adjacent to the *building thermal envelope* ~~building thermal envelope~~	An air barrier shall separate insulation in the *building thermal envelope* from the shower, tub, and fireplace assemblies.	Exterior framed walls adjacent to showers, tubs and fireplaces shall be insulated.
Electrical,communication, and other equipment boxes, housings, and enclosures	Boxes, housing, and enclosures that penetrate the air barrier shall be caulked, taped, gasketed, or otherwise sealed to the air barrier element being penetrated. All concealed openings into the box, housing, or enclosure shall be sealed. The continuity of the air barrier shall be maintained around boxes, housings, and enclosures that penetrate the air barrier. Alternatively, air-sealed boxes shall be installed in accordance with N1102.5.6.	Boxes, housing, and enclosures shall be burried in or surrounded by insulation.
HVAC register boots	HVAC supply and return register boots that penetrate *building thermal envelope*~~building thermal envelope~~ shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	HVAC supply and return register boots located in the *building thermal envelope*~~building's thermal envelope~~ shall be buried and surrounded by insulation.
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—
Common walls or double walls	Air sealing materials recognized in a listed fire-resistance rated common wall or double wall design and installed in accordance with the listing, or air sealing materials recognized in an approved design, shall be used. Common walls or double walls shall be considered an exterior wall for the purposes of air barrier and air sealing application of this Table.	Insulation materials recognized in the listed common wall or double-wall design and installed in accordance with the listing, or insulation materials recognized in the approved design, shall be used.

For SI: 1 inch = 25.4 mm.

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

b. Insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

N1102.5.1.2 Testing and maximum air leakage rate. The *building* or each *dwelling unit* in the building shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 4.0 air changes per hour or 0.22 cfm/ft^2 (1.1 L/s x m^2) of building or dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, ASTM E1827 or ASTM E3158 and reported at a pressure differential of 0.2 inch water gauge (50 Pa). Where required by the *code official*, testing shall be conducted by an*approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the*building thermal envelope* have been sealed.

Exceptions:

1. When testing individual dwelling units, an air leakage rate not exceeding 0.27 cubic feet per minute per square foot [1.35 L/s x m^2] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch water gauge (50 Pa), shall be permitted in all climate zones for:
   1.1 Attached single and multiple family building dwelling units.
   1.2 Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.
2. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, *building thermal envelope* ~~building envelope~~ tightness and insulation installation shall be considered acceptable where the items in Table N1102.5.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other conditioned spaces in accordance with Sections N1102.2.13 and N1102.4.5, as applicable.
3. Where tested in accordance with N1102.5.1.2, testing of each dwelling unit is not required.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Mechanical *ventilation* shall be provided in accordance with Section M1505 of this code or Section 403.3.2 of the*International Mechanical Code*, as applicable, or with other*approved* means of *ventilation*.

N1102.5.4 Rooms containing fuel-burning appliances. In Climate Zones 3 through 8, where opencombustion airducts provide combustion air to open combustion fuel-burning appliances, the appliances and combustion air opening shall be located outside the *building thermal envelope* or enclosed in a room that is isolated from inside the*building thermal envelope*~~thermal envelope~~. Such rooms shall be sealed and insulated in accordance with the *building thermal envelope*~~envelope~~ requirements of Table N1102.1.3, where the walls, floors and ceilings shall meet a minimum of 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 N1103. The combustion air duct shall be insulated where it passes through *conditioned space* to 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. Fireplaces and stoves complying with Sections N1102.5.2 and R1006.

N1102.5.6 Air-sealed electrical and communication outlet boxes. Air-sealed electrical and communication outlet boxes that penetrate the air barrier of the *building thermal envelope*~~building thermal envelope~~ shall be caulked, taped, gasketed, or otherwise sealed to the air barrier element being penetrated . Air-sealed boxes shall buried in or surrounded by insulation. Air-sealed boxes shall be tested and marked in accordance with NEMA OS 4. Air-sealed boxes shall be installed in accordance with the manufacturer's instructions .

N1105.2 Simulated performance based compliance. Compliance based on simulated building performance requires that a*proposed design* meets all of the following:

1. The requirements of the sections indicated within Table N1105.2.
2. The proposed total *building thermal envelope* ~~building thermal envelope~~ UA, which is the sum of the U-factor times assembly area, shall be less than or equal to the *building thermal envelope* ~~building thermal envelope~~ UA using the prescriptive U-factors from Table N1102.1.2 multiplied by 1.08 in Climate Zones 0, 1 and 2, and 1.15 in Climates Zones 3 through 8, in accordance with Equation 11-6. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

(Equation 11-6)

$$\text{For Climate Zones 0-2: } UA_{\text{Proposed design}} \leq 1.08 \times UA_{\text{Prescriptive reference design}}$$
$$\text{For Climate Zones 3-8: } UA_{\text{Proposed design}} \leq 1.15 \times UA_{\text{Prescriptive reference design}}$$

3. For buildings without a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 85 percent of the annual energy cost of the *standard reference design*. For buildings with a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 80 percent of the annual energy cost of the standard reference design. For dwelling units with greater than 5,000 square feet (465 m^2) of living space floor area located above grade plane, the annual energy cost of the proposed design shall be reduced by an additional 5 percent of annual energy cost of the standard reference design.Energy prices shall be taken from a source *approved*by the *code official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations.

   Exceptions:

   1. The energy use based on source energy expressed in Btu or Btu per square foot of*conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multipliers for all energy sources shall be obtained from ASHRAE Standard 105 (Tables K2, K4, or K8) or from another data source approved by the code official.
   2. The energy use based on site energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost for an all-electric building with on-site renewable energy installed.

N1105.3.2.1 Compliance report for permit application. A compliance report submitted with the application for building permit shall include the following:

1. Building street address, or other *building site* identification.
2. The name of the individual performing the analysis and generating the compliance report.
3. The name and version of the compliance software tool.
4. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
5. A certificate indicating that the proposed design complies with Section N1105.3. The certificate shall document the building components' energy specifications that are included in the calculation, including component-level insulation *R*-values or *U*-factors; duct system and *building thermal envelope* ~~building envelope~~ air leakage testing assumptions; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
6. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

N1105.3.2.2 Compliance report for certificate of occupancy. A compliance report submitted for obtaining the certificate of occupancy shall include the following:

1. Building street address, or other building site identification.
2. Declaration of the simulated building performance path on the title page of the energy report and the title page of the building plans.
3. A statement, bearing the name of the individual performing the analysis and generating the report, indicating that the as-built building complies with Section N1105.3.
4. The name and version of the compliance software tool.
5. A site-specific energy analysis report that is in compliance with Section N1105.3.
6. A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the confirmed rated design of the built home complies with Section N1105.3. The certificate shall report the energy features that were confirmed to be in the home, including component-level insulation *R*-values or *U*-factors; results from any required duct system and *building thermal envelope* ~~building envelope~~ air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation and service water heating equipment installed.
7. Where on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.

TABLE N1105.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table N1102.1.2.	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: as specified in Table N1102.1.2, with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table N1102.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table N1102.1.2.	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 an aperture of 1 ft^2 per 300 ft^2 of 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

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	Orientation: North.	As proposed
	U-factor: same as fenestration as specified in Table N1102.1.2.	As proposed
Vertical fenestration other than opaque doors	Total area[h] = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. (b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table N1102.1.2.	As proposed
	SHGC: as specified in Table N1102.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: 0.92 – (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 – (0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: air changes per hour. Climate Zones 3, 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater thanB x M where:B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air exchange rate is ≥ 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms.The mechanical ventilation system type shall be the same as in the proposed design. Heat recovery or energy recovery shall be modeled assumed for mechanical ventilation where required by Section N1103.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section N1103.6.1..	The mechanical ventilation rate[b] ,Q, shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (8.76 x B x M)/ef where: e_f = the minimum fan efficacy, as specified in Table N1103.6.2, corresponding to the system type at a flow rate of B x M *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed
Internal gains	IGain, in units of Btu/day per dwelling unit, shall equal 17,900 + 23.8 ×*CFA* + 4,104 × N_{br} where: *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	Same as standard reference design.
Internal mass	Internal mass for furniture and contents: 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the *building thermal envelope*~~building envelope~~ or structure.
Structural mass	For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls: as proposed, but with insulation as specified in Table N1102.1.3, located on the interior side of the walls.	As proposed

<table>
<tr><th>BUILDING COMPONENT</th><th colspan="4">STANDARD REFERENCE DESIGN</th><th colspan="3">PROPOSED DESIGN</th></tr>
<tr><td></td><td colspan="4">For other walls, ceilings, floors, and interior walls: wood frame construction.</td><td colspan="3">As proposed</td></tr>
<tr><td rowspan="7">Heating systems[d, e, j, k]</td><td colspan="4">For other than electric heating without a heat pump: as proposed.
Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC —Commercial Provisions.
Capacity: sized in accordance with Section N1103.7.</td><td colspan="3">As proposed</td></tr>
<tr><td colspan="4">Fuel Type/Capacity: Same as proposed design</td><td colspan="3">As proposed</td></tr>
<tr><td colspan="4">Product class: Same as proposed design</td><td colspan="3">As proposed</td></tr>
<tr><td colspan="4">Efficiencies:</td><td colspan="3">As proposed</td></tr>
<tr><td colspan="4">Heat pump: Complying with 10 CFR §430.32</td><td colspan="3">As proposed</td></tr>
<tr><td colspan="4">Non-electric furnaces: Complying with 10 CFR §430.32</td><td colspan="3">As proposed</td></tr>
<tr><td colspan="4">Non-electric boilers: Complying with 10 CFR §430.32</td><td colspan="3">As proposed</td></tr>
<tr><td rowspan="3">Cooling systems[d, f, k]</td><td colspan="4">As proposed.
Capacity: sized in accordance with Section N1103.7.</td><td colspan="3"></td></tr>
<tr><td colspan="4">Fuel Type: Electric
Capacity: Same as proposed design</td><td colspan="3">As proposed</td></tr>
<tr><td colspan="4">Efficiencies: Complying with 10 CFR §430.32</td><td colspan="3">As proposed</td></tr>
<tr><td rowspan="12">Service water heating[d, g, k]</td><td colspan="4" rowspan="7">As proposed.
Use, in units of gal/day = 25.5 + (8.5 × N_{br})
where: N_{br} = number of bedrooms.</td><td colspan="3">As proposed
Use, in units of gal/day = 25.5 + (8.5 × N_{br}) × (1 − $HWDS$)
where:
N_{br} = number of bedrooms.
$HWDS$ = factor for the compactness of the hot water distribution system.</td></tr>
<tr><td colspan="2">Compactness ratio[i] factor</td><td>HWDS</td></tr>
<tr><td>1 story</td><td>2 or more stories</td><td></td></tr>
<tr><td>> 60%</td><td>> 30%</td><td>0</td></tr>
<tr><td>> 30% to ≤ 60%</td><td>> 15% to ≤ 30%</td><td>0.05</td></tr>
<tr><td>> 15% to ≤ 30%</td><td>> 7.5% to ≤ 15%</td><td>0.10</td></tr>
<tr><td>< 15%</td><td>< 7.5%</td><td>0.15</td></tr>
<tr><td colspan="4">Fuel Type: Same as proposed design</td><td colspan="3">As proposed</td></tr>
<tr><td colspan="4">Rated Storage Volume: Same as proposed design</td><td colspan="3">As proposed</td></tr>
<tr><td colspan="4">Draw Pattern: Same as proposed design</td><td colspan="3">As proposed</td></tr>
<tr><td colspan="4">Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32</td><td colspan="3">As proposed</td></tr>
<tr><td colspan="4">Tank Temperature: 120° F (48.9° C)</td><td colspan="3">Same as standard reference design</td></tr>
<tr><td rowspan="4">Thermal distribution systems</td><td colspan="4">Duct insulation: in accordance with Section N1103.3.2.</td><td colspan="3">Duct insulation: as proposed</td></tr>
<tr><td colspan="4">Duct location:</td><td colspan="3" rowspan="3">Duct location: as proposed</td></tr>
<tr><td>Foundation type</td><td>Slab on grade</td><td>Unconditioned crawl space</td><td>Basement or conditioned crawl space</td></tr>
<tr><td>Duct location (supply and return)</td><td>One-story building:
100% in unconditioned attic

All other:
75% in unconditioned attic and 25% inside conditioned space</td><td>One-story building:
100% in unconditioned attic

All other:
75% in unconditioned attic and 25% inside conditioned space</td><td>50% inside conditioned space

50% unconditioned attic</td></tr>
</table>

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	Duct system leakage to outside: For duct systems serving > 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft2 (9.29 m2) of conditioned floor area. For duct systems serving ≤ 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).	Duct System Leakage to Outside: The measured total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate. **Exceptions:** 1. When duct system leakage to outside is tested in accordance ANSI/RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered. 2. When total duct system leakage is measured without the air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2(9.29 m^2) of conditioned floor area.
	For hydronic systems and ductless systems a thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies.	For hydronic systems and ductless systems, DSE shall be as specified in Table N1105.4.2(2).
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F.	Same as standard reference design.
Dehumidistat	Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None. Where the proposed design utilizes a mechanical ventilation system with latent heat recovery: Dehumidistat type: manual, setpoint = 60% relative humidity. Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.	Same as standard reference design.

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, °C = (°F – 32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design the following assumptions shall be made for both the proposed design and standard reference design.

Fuel Type: Same as the predominant heating fuel type

Rated Storage Volume: 40 Gallons

Draw Pattern: Medium

Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

AF $= A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and
where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

- Below-grade boundary wall is any thermal boundary wall in soil contact.

- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.

2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.

3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.

4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.

5. The basement or attic shall be counted as a story when it contains the water heater.

6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a proposed design with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the standard reference design.

k. For heating systems, cooling systems, or water heating systems not included in Table N1105.4.2(1), the standard reference design shall be the same as proposed design.

TABLE N1106.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
N1101.14	Certificate
Building Thermal Envelope	
N1102.1.1	Vapor retarder
N1102.2.4	Eave baffle
N1102.2.5.1	Access hatches and doors
N1102.2.9	Basement walls
N1102.2.9.1	Basement wall insulation installation
N1102.2.10.1	Slab-on-grade floor insulation installation
N1102.2.11.1	Crawl space wall insulation installation
N1102.5.1.1	Installation
N1102.5.1.2	Testing
N1102.5.2	Fireplaces
N1102.5.3	Fenestration air leakage
N1102.5.4	Rooms containing fuel burning appliances
N1102.5.5	Recessed lighting
N1102.5.6	Air sealed electrical and communication outlet boxes
N1106.3	*Building thermal envelope* Building thermal envelope
Mechanical	
N1103.1	Controls
N1103.2	Hot Water boiler temperature reset
N1103.3 except	Duct systems
N1103.4	Mechanical system piping insulation
N1103.5 except Section N1103.5.2	Service hot water systems
N1103.5.2	Hot water pipe insulation
N1103.6	Mechanical ventilation
N1103.7, except Section N1103.7.1	Equipment sizing and efficiency rating
N1103.8	Systems serving multiple dwelling units
N1103.9	Snow melt and ice system controls
N1103.11	Energy consumption of pools and spas
N1103.12	Portable spas

N1103.13	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
N1104.1	Lighting equipment
N1104.2	Interior lighting controls
N1104.5	Electric readiness
N1104.6	Renewable energy infrastructure
N1104.7	Electric Vehicle power transfer infrastructure

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

N1106.3 Building thermal envelope. The proposed total _building thermal envelope_~~building thermal envelope~~ UA, which is sum of *U*-factor times assembly area, shall be less than or equal to the _building thermal envelope_~~building thermal envelope~~ UA using the prescriptive *U*-factors from Table N1102.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and by 1.15 in Climates Zones 3 through 8, in accordance with Equation 11-7 Equation 11-7. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

(Equation 11-7)

$$\text{For Climate Zones 0-2: UA}_{\text{Proposed design}} \leq 1.08 \text{ x UA}_{\text{Prescriptive reference design}}$$

$$\text{For Climate Zones 3-8: UA}_{\text{Proposed design}} \leq 1.15\text{x UA}_{\text{Prescriptive reference design}}$$

N1106.7.2.1 Proposed compliance report for permit application. Compliance reports submitted with the application for a building permit shall include the following:

1. Building street address, or other *building site* identification.
2. Declaration of ERI on the title page and on the building plans.
3. The name of the individual performing the analysis and generating the compliance report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
6. A certificate indicating that the proposed design has an ERI less than or equal to the appropriate score indicated in Table N1106.5 when compared to the ERI reference design. The certificate shall document the building component energy specifications that are included in the calculation, including: component level insulation *R*-values or *U*-factors; assumed duct system and _building thermal envelope_ ~~building envelope~~ air leakage testing results; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
7. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

N1106.7.2.2 Confirmed compliance report for a certificate of occupancy. A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address or other *building site* identification.
2. Declaration of ERI on the title page and on the building plans.
3. The name of the individual performing the analysis and generating the report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.

6. A final confirmed certificate indicating that the confirmed rated design of the built home complies with Sections N1106.2 and N1106.4. The certificate shall report the energy features that were confirmed to be in the home, including: component-level insulation *R*-values or *U*-factors; results from any required duct system and *building thermal envelope* ~~building envelope~~ air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water-heating equipment installed. Where on-site renewable energy systems have been installed on or in the home, the certificate shall report the type and production size of the installed system.

N1108.2.1 Enhanced building thermal envelope options. The *building thermal envelope* shall meet the following:

1. Section N1108.2.1.1 or N1108.2.1.2
2. Section N1108.2.1.3

N1108.2.1.1 Enhanced building thermal envelope performance UA. The proposed total *building thermal envelope* ~~building thermal envelope~~ UA shall be calculated in accordance with Section N1102.1.5 and shall meet one of the following:

1. Not less than 2.5 percent of the total UA of the *building thermal envelope* ~~building thermal envelope~~.
2. Not less than 5 percent of the total UA of the *building thermal envelope* ~~building thermal envelope~~.
3. Not less than 7.5 percent of the total UA of the *building thermal envelope* ~~building thermal envelope~~.

N1108.2.4 More efficient duct thermal distribution system option. The thermal distribution system shall meet one of the following efficiencies:

1. 100 percent of ductless thermal distribution system or hydronic thermal distribution system located completely inside the *building thermal envelope* ~~building thermal envelope~~.

100 percent of duct thermal distribution system located in conditioned space as defined by Section N1103.3.3.

3. When ducts are located outside conditioned space, the total leakage of the ducts, measured in accordance with N1103.3.5, shall be in accordance with one of the following:

   3.1 Where air handler is installed at the time of testing, 2.0 cubic feet per minute (0.94 L/s) per 100 square feet (9.29 m^2) of conditioned floor area.

   3.2 Where air handler is not installed at the time of testing, 1.75 cubic feet per minute (0.83 L/s) per 100 square feet (9.29 m^2) of conditioned floor area.

4. Duct systems designed so the individual room airflow shall be within ±20 percent of the design/application requirements for the supply and return ducts. This shall be demonstrated by using a duct airflow balancing procedure as specified by ANSI/ACCA 5 QI or by other approved methods.

N1110.2.1 Building thermal envelope. New *building thermal envelope* ~~envelope~~ assemblies that are part of the *addition* shall comply with Sections N1102.1, N1102.2, N1102.4.1 through N1102.4.5, and N1102.5.

Exception: New _*building thermal envelope*_~~envelope~~ assemblies are exempt from the requirements of Section N1102.5.1.2.

N1111.1.1 Building _thermal_ envelope. *Alterations* of existing *building thermal envelope* assemblies shall comply with this section. ~~*New*~~ _New *building thermal envelope*_~~building thermal envelope~~ assemblies that are part of the *alteration* shall comply with Section N1102. In no case shall the R-value of insulation be reduced or the U-factor of a _*building thermal envelope*_~~building thermal envelope~~ assembly be increased as part of a _*building thermal envelope*_~~building thermal envelope~~ alteration.

Exception: The following *alterations* shall not be required to comply with the requirements for new construction provided that the energy use of the *building* is not increased:

1. Storm windows installed over existing fenestration.
2. *Roof recover*.
3. Surface-applied window film installed on existing single-pane fenestration assemblies to reduce solar heat gain provided that the code does not require the glazing or fenestration assembly to be replaced.
4. In no case shall the R-value of insulation be reduced or the U-factor of a _*building thermal envelope*_ ~~building thermal envelope~~ assembly be increased as part of a _*building thermal envelope*_ ~~building thermal envelope~~ alteration.

N1111.1.1.4 Floor alterations. Where an alteration to a floor or floor overhang exposes cavities or surfaces to which insulation can be applied and the floor or floor overhang is part of the _*building thermal envelope*_~~building thermal envelope~~, the floor or floor overhang shall be brought into compliance with Section N1102.1 or an approved design. This requirement shall apply to floor alterations where the floor cavities or surfaces are exposed and accessible prior to construction.

N1111.1.1.6 Air barrier. _*Building thermal envelope*_~~Building thermal envelope~~ assemblies altered in accordance with Section N1111.1.1 shall be provided with an air barrier in accordance with Section N1102.4. The air barrier shall not be required to be made continuous with unaltered portions of the _*building thermal envelope*_~~building thermal envelope~~. Testing requirements of Section N1102.4.1.2 shall not be required.

N1111.1.5 Additional Efficiency Packages. Alterations shall comply with Section N1114 where the alteration contains replacement of two or more of the following:

1. HVAC unitary systems or HVAC central heating or cooling equipment serving the work area of the alteration.
2. Water heating equipment serving the work area of the alteration.
3. 50 percent or more of the lighting fixtures in the work area of the alteration.
4. 50 percent or more of the area of interior surfaces of the _*building thermal envelope*_ ~~thermal envelope~~ in the work area of the alteration.
5. 50 percent or more the area of the building's exterior wall envelope.

Exceptions:

1. Alterations that are permitted with an addition complying with Section N1110.3.5.
2. Alterations that comply with Section N1105 or N1106.

N1114.1 General. Where required in Section N1110 or N1111, the building shall comply with one or more additional efficiency package options in accordance with the following:

1. Enhanced _*building thermal envelope*_ ~~envelope~~ performance in accordance with Section N1108.2.1.
2. More efficient HVAC equipment performance in accordance with Section N1108.2.2.
3. Reduced energy use in service water-heating in accordance with Section N1108.2.3.
4. More efficient duct thermal distribution system in accordance with Section N1108.2.4.
5. Improved air sealing and efficient ventilation system in accordance with Section N1108.2.5.

Reason: "Building thermal envelope" is a defined term in the IECC, but "building envelope" and "thermal envelope" are not defined. This comment attempts to standardize terminology throughout the residential provisions by replacing instances of "building envelope," "thermal envelope," and "envelope" with the defined term "building thermal envelope."

This replacement is made thirteen times for "building envelope," three times for "thermal envelope," and six times for "envelope" within both the IECC residential provisions and IRC Chapter 11 of the 1st Public Comment Draft. In addition, there are twenty-four cases in the IECC residential provisions and twenty-nine cases in IRC Chapter 11 where "building thermal envelope" is proposed to be italicized. It is understood that the decision to italicize rests with ICC staff, but identification of these instances is offered to assist staff and because they illustrate the potential for confusion that may arise on this topic when the defined term is not explicitly triggered via italicization.

If there are technically valid reasons to retain existing terminology in specific situations, please consider amending this comment for those sections, as necessary.

Companion comment CED1-92-22 offers similar changes for the commercial provisions to ensure consistency throughout the entire IECC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This comment is intended solely to clarify terminology without any technical impact. There should be no impact on cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal provides clarification and consistency in the use of defined terms.

Final Hearing Results

RED1-185-22	AS

RED1-186-22

Original Proposal

IECC: SECTION R102, R102.1.1, SECTION R402, R402.1.5, R402.2.1, R402.2.2, R402.2.5, R402.4.3, R402.4.4, SECTION R405, R405.2, SECTION R406, R406.3, SECTION R408, R408.2, TABLE R408.2, R408.2.1.1

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

SECTION R102
ALTERNATIVE MATERIALS, DESIGN AND METHODS OF CONSTRUCTION AND EQUIPMENT

Revise as follows:

R102.1.1 Above code programs. The *code official* or other authority having jurisdiction shall be permitted to deem a national, state or local energy-efficiency program to exceed the energy efficiency required by this code. *Buildings approved* in writing by such an energy-efficiency program shall be considered to be in compliance with this code where such buildings also meet the requirements identified in Table R405.2 and the proposed total *building thermal envelope* thermal conductance *TC*~~UA, which is the sum of U-factor times assembly area~~, shall be less than or equal to the total *building thermal envelope* thermal conductance TC ~~UA~~ using the prescriptive U-factors and F-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, 2, and by 1.15 in Climate Zones 3 through 8, in accordance with Equation 4-1. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

For Climate Zones 0-2: $TC\cancel{UA}_{Proposed\ design} \leq 1.08 \times TC\cancel{UA}_{Prescriptive\ reference\ design}$ **(Equation 4-1)**

For Climate Zones 3-8: $TC\cancel{UA}_{Proposed\ design} \leq 1.15 \times TC\cancel{UA}_{Prescriptive\ reference\ design}$ **(Equation 4-1)**

SECTION R402
BUILDING THERMAL ENVELOPE

Revise as follows:

R402.1.5 Component performance alternative. Where the proposed total *building thermal envelope* thermal conductance TC_p is less than or equal to the required total *building thermal envelope* thermal conductance TC_r using factors in Table R402.1.2, the *building* shall be considered to be in compliance with Table R402.1.2. The total thermal conductance TC shall be determined in accordance with Equation 4-1. Proposed *U*-factors and slab-on-grade *F*-factors shall be taken from ANSI/ASHRAE/IES Standard 90.1 Appendix A or determined using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. In addition to total thermal conductance TC compliance, the SHGC requirements of Table R402.1.2 and the maximum fenestration *U*-factors of Section R402.6 shall be met.

Equation 4-1

$$(Up\ A + Fp\ P) \leq (Ur\ A + Fr\ P)$$

$TC_p \leq TC_r$

where:

$TC_p = U_p A + F_p P$ $TC_r = U_r A + F_r P$ U_p A = the sum of proposed *U*-factors times the assembly areas in the proposed building.

F_p P = the sum of proposed *F*-factors times the slab-on-grade perimeter lengths in the proposed building.

U_r A = the sum of *U*-factors in Table R402.1.2 times the same assembly areas as in the proposed building.
F_r P = the sum of *F*-factors in Table R402.1.2 times the same slab-on-grade perimeter lengths as in the proposed building.

R402.2.1 Ceilings with attics. Where Section R402.1.3 requires R-49 insulation in the ceiling or attic, installing R-38 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. Where Section R402.1.3 requires R-60 insulation in the ceiling or attic, installing R-49 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for R-60 insulation wherever the full height o uncompressed R-49 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the insulation and fenestration criteria in Section R402.1.2 and the Component performance~~Total UA~~ alternative in Section R402.1.5.

R402.2.2 Ceilings without attics. Where Section R402.1.3 requires insulation *R*-values greater than R-30 in the interstitial space above a ceiling and below the structural roof deck, and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation *R*-value for such roof/ceiling assemblies shall be R-30. Insulation shall extend over the top of the wall plate to the outer edge of such plate and shall not be compressed. This reduction of insulation from the requirements of Section R402.1.3 shall be limited to 500 square feet (46 m^2) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the Component performance~~Total UA~~ alternative in Section R402.1.5.

R402.2.5 Access hatches and doors. Access hatches and doors from conditioned to unconditioned spaces such as attics and crawl spaces shall be insulated to the same *R*-value required by Table R402.1.3 for the wall or ceiling in which they are installed.

Exceptions:

1. Vertical doors providing access from conditioned spaces to unconditioned spaces that comply with the fenestration requirements of Table R402.1.3 based on the applicable climate zone specified in Chapter 3.
2. Horizontal pull-down, stair-type access hatches in ceiling assemblies that provide access from conditioned to unconditioned spaces in Climate Zones 0 through 4 shall not be required to comply with the insulation level of the surrounding surfaces provided the hatch meets all of the following:
   - 2.1. The average *U*-factor of the hatch shall be less than or equal to U-0.10 or have an average insulation*R*-value of R-10 or greater.
   - 2.2. Not less than 75 percent of the panel area shall have an insulation*R*-value of R-13 or greater.
   - 2.3. The net area of the framed opening shall be less than or equal to 13.5 square feet (1.25 m^2).
   - 2.4. The perimeter of the hatch edge shall be weatherstripped.

The reduction shall not apply to the Component performance~~total UA~~ alternative in Section R402.1.5.

R402.4.3 Glazed fenestration exemption. Not greater than 15 square feet (1.4 m^2) of glazed fenestration per *dwelling unit* shall be exempt from the *U*-factor and SHGC requirements in Section R402.1.2. This exemption shall not apply to theComponent performance~~Total UA~~ alternative in Section R402.1.5.

R402.4.4 Opaque door exemption. One side-hinged opaque door assembly not greater than 24 square feet (2.22 m^2) in area shall be exempt from the *U*-factor requirement in Section R402.1.2. This exemption shall not apply to theComponent performance~~Total UA~~ alternative in Section R402.1.5.

SECTION R405
SIMULATED BUILDING PERFORMANCE

Revise as follows:

R405.2 Simulated performance compliance. Compliance based on total building performance requires that a*proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total *building thermal envelope* thermal conductance TC ~~UA, which is the sum of the U-factor times assembly area~~, shall be less than or equal to the *building thermal envelope* thermal conductance TC ~~UA~~ using the prescriptive U-factors and F-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and 1.15 in Climate Zones 3 through 8 in accordance with Equation 4-2 and R402.1.5. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

   For Climate Zones 0-2: TC ~~UA~~Proposed Design ≤ 1.08 x TC ~~UA~~Prescriptive reference design **(Equation 4-2)**

   For Climate Zones 3-8: TC ~~UA~~Proposed Design ≤ 1.15 x TC ~~UA~~Prescriptive reference design **(Equation 4-2)**

3. For buildings without a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 85 percent of the annual energy cost of the *standard reference design*. For buildings with a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 80 percent of the annual energy cost of the standard reference design. For dwelling units with greater than 5,000 square feet (465 m^2) of living space floor area located above grade plane, the annual energy cost of the proposed design shall be reduced by an additional 5 percent of annual energy cost of the standard reference design. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

   Exceptions:

   1. The energy use based on source energy expressed in Btu or Btu per square foot of*conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multipliers for all energy sources shall be obtained from ASHRAE Standard 105 (Tables K2, K4, or K8) or from another data source approved by the *code official*.
   2. The energy use based on site energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost for an all-electric building with on-site renewable energy installed.

SECTION R406
ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

Revise as follows:

R406.3 Building thermal envelope. The proposed total *building thermal envelope* thermal conductance TC~~UA, which is sum of *U*-factor times assembly area,~~ shall be less than or equal to the *building thermal envelope* thermal conductance TC ~~UA~~ using the prescriptive *U*-factors and F-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and by 1.15 in Climates Zones 3 through 8, in accordance with Equation 4-3 and R402.1.5. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

For Climate Zones 0-2: TC~~UA~~Proposed design ≤ 1.08 x TC~~UA~~Prescriptive reference design **(Equation 4-3)**

For Climate Zones 3-8: TC~~UA~~Proposed design ≤ 1.15 x TC~~UA~~Prescriptive reference design **(Equation 4-3)**

SECTION R408
ADDITIONAL EFFICIENCY REQUIREMENTS

R408.2 Additional energy efficiency credit requirements . Two of the additional measures shall be selected from Table R408.2 that meet or exceed a total of ten credits. Five additional credits shall be selected for dwelling units with greater than 5,000 square feet (465 m) of living space floor area located above grade plane. Each measure selected shall meet the relevant subsections of Section R408 and receive credit as specified in Table R408.2 for the specific Climate Zone. Interpolation of credits between measures shall not be permitted.

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Portions of table not shown remain unchanged.

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 4C	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total TC UA	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total TC UA	0	1	1	2	2	3	3	3	3
R408.2.1.1(3)	>7.5% reduction in total TC UA	0	1	2	2	2	3	3	4	4

R408.2.1.1 Enhanced envelope performance ~~UA~~. The proposed total *building thermal envelope* thermal conductance TC~~UA~~ shall be calculated in accordance with Section R402.1.5 and shall meet one of the following:

1. Not less than 2.5 percent of the total TC ~~UA~~ of the *building thermal envelope*.
2. Not less than 5 percent of the total TC ~~UA~~ of the *building thermal envelope*.
3. Not less than 7.5 percent of the total TC ~~UA~~ of the *building thermal envelope*.

Reason: The Committee approved REPI-26, a DOE proposal, to replace 'total UA' alternative with 'Component performance' alternative but other sections still rely on and reference “UA”. This public comment updates uses of “UA” with “TC” for thermal conductance, the term being used in R402.1.5.

Other solutions to address this problem will likely be submitted and all these public comments should be assigned to an Envelope SC working group to identify the best solution.

Bibliography: None

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

None

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Makes needed editorial changes capturing instances where the term UA should have been corrected without introducing unintended consequences.

Final Hearing Results

RED1-186-22 AM

RED1-189-22

Original Proposal

IRCECC: SECTION 202

Proponents: Christopher McWhite, Town of Smithfield, Region VI (cmcwhite@me.com)

2024 ENERGY Chapter11

Revise 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~~measured on a scale from 0 to 1, where a value of 1 indicates perfect emission.

Reason: Unless there is an industry term that supports this, the inclusion of the language “black body” is inherently tone deaf and completely out of place in any ICC published Code with respect to black humans.

Bibliography: I am a career, 22 year Building Code Official who has served communities in five states from the Midwest, to the South, and now in New England. Through The Rhode Island Building Code Standards Committee, I am accepted as a certified Building Official; *R.I.G.L. Ch. 23-27.3 §107.5*. Through The International Code Council, I am exam certified as a Certified Building Official, Housing Code Official, Combination Residential Building Inspector, and a Residential and Commercial Plans Examiner. Through the State of Massachusetts I am a certified/licensed Inspector of Buildings/Building Commissioner. Currently I am working as the Department Head Building and Zoning Official in the Town of Smithfield Rhode Island. Here we are committed to our communities’ development through partnerships with local and statewide organizations, institutions, and people who are dedicated and/or focused on the process of maintaining existing buildings and constructing new edifices with the goal of making an ever safer built community. I am committed to pursuing improved life safety in residential and commercial structures and the judicious enforcement of current building code and its referenced standards through effective leadership both within the builders and design community and with the professional staff I have the honor to lead. My personal goal is the building of a team of amicable, fair, ethical, and consistently equitable Officials utilizing State and Local building regulations while also judiciously incorporating relevant 28 CFR, ADA requirements. My role is also to communicate these goals with political bodies, large stakeholder investors in high profile projects, local community projects, and simple renovations with homeowners, without parity. I am also a decades-long member of the International Code Council, the non-profit agency that develops and publishes the building Codes. I’ve twice served as a selected committee member for code development on the national level and I am currently serving as an elected, Governing Board Member with one ICC Membership Council while chairing a subcommittee in another.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There is no cost associated with this proposed change

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies the term consistent with the ways in which it is used throughout the code and other standards.

Final Hearing Results

RED1-189-22 AM

RED1-191-22 Part I

Original Proposal

IECC: SECTION 202

Proponents: Christopher McWhite, Town of Smithfield, Region VI (cmcwhite@me.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

EXTERIOR WALL ENVELOPE. A system or assembly of exterior wall components, including exterior wall finish materials, that provides protection of the building structural or non-structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment.

Reason: The exclusion of non-structural exterior wall elements could unintentionally exclude such installations as curtain walls and other non-load bearing exterior building elements that are intended to provide a delineation from unconditioned versus conditioned space.

Bibliography: I am a career, 22 year Building Code Official who has served communities in five states from the Midwest, to the South, and now in New England. Through The Rhode Island Building Code Standards Committee, I am accepted as a certified Building Official; *R.I.G.L. Ch. 23-27.3 §107.5*. Through The International Code Council, I am exam certified as a Certified Building Official, Housing Code Official, Combination Residential Building Inspector, and a Residential and Commercial Plans Examiner. Through the State of Massachusetts I am a certified/licensed Inspector of Buildings/Building Commissioner. Currently I am working as the Department Head Building and Zoning Official in the Town of Smithfield Rhode Island. Here we are committed to our communities' development through partnerships with local and statewide organizations, institutions, and people who are dedicated and/or focused on the process of maintaining existing buildings and constructing new edifices with the goal of making an ever safer built community. I am committed to pursuing improved life safety in residential and commercial structures and the judicious enforcement of current building code and its referenced standards through effective leadership both within the builders and design community and with the professional staff I have the honor to lead. My personal goal is the building of a team of amicable, fair, ethical, and consistently equitable Officials utilizing State and Local building regulations while also judiciously incorporating relevant 28 CFR, ADA requirements. My role is also to communicate these goals with political bodies, large stakeholder investors in high profile projects, local community projects, and simple renovations with homeowners, without parity. I am also a decades-long member of the International Code Council, the non-profit agency that develops and publishes the building Codes. I've twice served as a selected committee member for code development on the national level and I am currently serving as an elected, Governing Board Member with one ICC Membership Council while chairing a subcommittee in another.

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

The cost will increase because the inclusion of non-structural building elements will require the installation of materials intended to provide thermal resistance or thermal transmittance.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The exterior wall envelope does protect non-structural elements.

Final Hearing Results

RED1-191-22 Part I AM

RED1-191-22 Part II

Original Proposal

IRCECC: SECTION 202

Proponents: Christopher McWhite, Town of Smithfield, Region VI (cmcwhite@me.com)

2024 ENERGY Chapter11

Revise as follows:

EXTERIOR WALL ENVELOPE. A system or assembly of exterior wall components, including exterior wall finish materials, that provides protection of the building structural or non-structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment.

Reason: The exclusion of non-structural exterior wall elements could unintentionally exclude such installations as curtain walls and other non-load bearing exterior building elements that are intended to provide a delineation from unconditioned versus conditioned space.

Bibliography: I am a career, 22 year Building Code Official who has served communities in five states from the Midwest, to the South, and now in New England. Through The Rhode Island Building Code Standards Committee, I am accepted as a certified Building Official; *R.I.G.L. Ch. 23-27.3 §107.5*. Through The International Code Council, I am exam certified as a Certified Building Official, Housing Code Official, Combination Residential Building Inspector, and a Residential and Commercial Plans Examiner. Through the State of Massachusetts I am a certified/licensed Inspector of Buildings/Building Commissioner. Currently I am working as the Department Head Building and Zoning Official in the Town of Smithfield Rhode Island. Here we are committed to our communities' development through partnerships with local and statewide organizations, institutions, and people who are dedicated and/or focused on the process of maintaining existing buildings and constructing new edifices with the goal of making an ever safer built community. I am committed to pursuing improved life safety in residential and commercial structures and the judicious enforcement of current building code and its referenced standards through effective leadership both within the builders and design community and with the professional staff I have the honor to lead. My personal goal is the building of a team of amicable, fair, ethical, and consistently equitable Officials utilizing State and Local building regulations while also judiciously incorporating relevant 28 CFR, ADA requirements. My role is also to communicate these goals with political bodies, large stakeholder investors in high profile projects, local community projects, and simple renovations with homeowners, without parity. I am also a decades-long member of the International Code Council, the non-profit agency that develops and publishes the building Codes. I've twice served as a selected committee member for code development on the national level and I am currently serving as an elected, Governing Board Member with one ICC Membership Council while chairing a subcommittee in another.

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

There cost will increase because the inclusion of non-structural building elements will require the installation of materials intended to provide thermal resistance or thermal transmittance.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The exterior wall envelope does protect non-structural elements.

Final Hearing Results

RED1-191-22 Part II AM

RED1-194-22

Original Proposal

IECC: R303.1.5 (New), R303.1.1, R303.2.2
Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [RE Project]

Add new text as follows:

R303.1.5 Air spaces.. Where the *R-value* of an *enclosed reflective air space* or enclosed non-reflective air space is used for compliance with this standard, the air space shall be enclosed in a cavity bounded on all sides by building components and constructed to minimize airflow into and out of the enclosed air space. Airflow shall be deemed minimized where one of the following conditions occur:

1. The enclosed air space is unventilated.
2. The enclosed air space is bounded on one or more sides by an anchored masonry veneer, constructed in accordance with Chapter 7 of the *International Residential Code*, and vented by veneer weep holes located only at the bottom portionof the air space and spaced not less than 15 inches (381 mm) on center with the top of the cavity air space closed.

Exception: For ventilated cavities, the effect of the ventilation 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 airflow entering the bottom and exiting the top of the air space at an air movement rate of not less than 70 mm/second.

Revise as follows:

R303.1.1 Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope* insulation that is 12 inches (305 mm) or greater in width. Alternatively, the insulation installers shall provide a certification that indicates the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown-in or sprayed fiberglass and cellulose insulation, the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be indicated on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and the *R*-value of the installed thickness shall be indicated on the certification. For reflective insulation, the number of reflective sheet(s), the number and thickness of the enclosed reflective air space(s) and the R-value for the installed assembly determined in accordance with Section R303.1.5, shall be listed on the certification. For insulated siding, the*R*-value shall be on a label on the product's package and shall be indicated on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

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

R303.2.2 Radiant barrier. Where installed, *radiant barriers* shall comply with the requirements of ASTM C1313/C1313Mand shall be installed in accordance with ASTM C1743.

Reason: Air space R-values can vary by as much as a factor of 8 depending on various conditions of use (see ASHRAE 90.1 Appendix A). This proposal provides needed requirements to ensure air space R-values are properly specified and applied for both reflective and non-reflective air spaces.

Foam sheathing products with foil facers, various types of structural sheathing products with reflective facers, batt insulation products with reflective facers, and reflective insulation sheet goods (including radiant barriers) rely on an air space to achieve an R-value or thermal performance benefits that can vary significantly based on installation conditions, climate, air-space orientation and heat flow direction at different seasons of the year, and other factors. The FSC membership is among manufacturers and code users that rely on appropriate characterization of air spaces to provide added thermal performance under appropriate conditions of use. It is important that the R-value performance of such air spaces are consistently and properly characterized for code compliance purposes, just as is the case for the variety of insulation materials that rely on material based R-values alone and do not rely on combination with a reflective or non-reflective air space. It is the intent of this proposal to address air space R-values in a manner that is consistent with the determination of R-values for other materials and in a way that transparently addresses the unique considerations that are important to air space R-values.The charging language of the first paragraph of the new proposed Section R303.1.5, including items 1 and 2, are consistent with provisions for air spaces found in Section C402.2.7 of the IECC commercial provisions. It also makes use of the newly added definition "enclosed reflective air space" to ensure that it as well as other air spaces that are not reflective are properly constructed to attain (or nearly attain) the idealized R-values that are typically assigned to such air spaces. The exception provided at the end of the proposed new Section R303.1.5 provides flexibility to address ventilated air spaces (not meeting the requirements for an enclosed, unventilated air space) and also is part of the IECC commercial provisions in Section C402.2.7.

The 2nd paragraph gives needed direction on how to determine R-values for compliant air spaces. The FTC R-value rule is referenced as it is for insulation products in Section R303.1.4 because it does address reflective insulation and associated enclosed air spaces. However, the FTC R-value rule does not address horizontal air spaces such as found in floor or roof systems which have R-values that vary seasonally based on direction of heat flow and the magnitude of this effect on air space R-value depends on the climate zone. Therefore, reference to ASHRAE 90.1 Appendix A is provided which does address proper climate-based seasonal weighting to arrive at a single R-value for a given climate that is necessary to determine compliance with the R-value or U-factor requirements of the IECC standard. It also addresses R-value determination for non-reflective air spaces which also are not addressed in the FTC R-value Rule but which are commonly used to support compliance with the IECC. Finally, there is no means of assigning an R-value to radiant barrier applications unless they are installed together with and facing an enclosed reflective air space also meeting the air space construction requirements in R303.1.5.

To complement the above, Section R303.1.1 is revised to require that reflective insulation and associated enclosed reflective air spaces comply with the proposed new Section R303.1.5. Finally, Section R303.2.2 for radiant barriers is revised to a reference standard that addresses installation which is the purpose of Section R303.2. The currently referenced ASTM standard only addresses material properties, not installation.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is a clarification that doesn’t change appropriate methods for determining and applying air space R-values which the IECC-R provisions have been silent on. It relies on practices and references that are commonly used for this purpose. There may be a cost increase associated with air spaces that have been applied and characterized in a manner inconsistent with accepted practice.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Adds language to ensure air space R-values are properly specified and applied for both reflective and non-reflective air spaces.

Final Hearing Results

RED1-194-22	AM

RED1-196-22

Original Proposal

IECC: R402.1

Proponents: Daniel Carroll, New York State Department of State, Division of Building Standards & Codes (daniel.carroll@dos.ny.gov); Hendrik Shank, New York State/Department of State, New York State, Department of State (hendrikus.shank@dos.ny.gov)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.1 General. The *building thermal envelope* shall comply with the requirements of ~~Sections R402.1.1 through R402.1.5.~~ one of the following:

1. Sections R402.1.1 through R402.1.4, or
2. Sections R402.1.1 and R402.1.5

Exceptions:

1. The following low-energy *buildings*, or portions thereof, separated from the remainder of the building by *building thermal envelope* assemblies complying with this section shall be exempt from the *building thermal envelope* provisions of Section R402.
   - 1.1. Those with a peak design rate of energy usage less than 3.4 Btu/h × f^{2}t (10.7 W/m^2) or 1.0 watt/ft^2 of floor area for space-conditioning purposes.
   - 1.2. Those that do not contain *conditioned space*.
2. Log homes designed in accordance with ICC 400.

Reason: This modification clarifies that there are two options that can be used to demonstrate compliance with the Residential prescriptive building thermal envelope Provisions of the 2024 IECC. Essentially, the vapor retarder Provision identified in Section R402.1.1 is always applicable and the user may utilize the U-factor, f-factor, and R-value provisions identified in Sections R402.1.2 through R402.1.4 as one option, and the component performance alternative identified in Section R402.1.5 as another option.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change proposal is editorial so there is no cost impact associated with it.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Provides clarity to the intent and proper application of the section.

Final Hearing Results

RED1-196-22	AS

RED1-199-22

Original Proposal

IECC: TABLE R402.1.2, TABLE R402.1.3; IRCECC: TABLE N1102.1.2, TABLE N1102.1.3

Proponents: Jennifer Hatfield, J. Hatfield & Associates, Fenestration & Glazing Industry Alliance (formerly AAMA) (jen@jhatfieldandassociates.com)

2024 International Energy Conservation Code [RE Project]

TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

CLIMATE ZONE	0	1	2	3	4 except Marine	5 and Marine 4	6	7 and 8
FENESTRATION U-FACTOR	0.50	0.50	0.40	0.30	0.30	0.28[e]	0.28[e]	0.27[e]
SKYLIGHT[d] *U*-FACTOR	0.60	0.60	0.60	0.53	0.53	0.50	0.50	0.50
GLAZED FENESTRATION SHGC[d]	0.25	0.25	0.25	0.25	0.40	NR	NR	NR
CEILING *U*-FACTOR[f]	0.035	0.035	0.030	0.030	0.026	0.026	0.026	0.026
WOOD FRAME WALL *U*-FACTOR	0.084	0.084	0.084	0.060	0.045	0.045	0.045	0.045
MASS WALL U-FACTOR[b]	0.197	0.197	0.165	0.098	0.098	0.082	0.060	0.057
FLOOR *U*-FACTOR	0.064	0.064	0.064	0.047	0.047	0.033	0.033	0.028
BASEMENT WALL *U*-FACTOR	0.360	0.360	0.360	0.091[c]	0.059	0.050	0.050	0.050
UNHEATED SLAB F-FACTOR	0.73	0.73	0.73	0.54	0.54	0.54	0.48	0.48
HEATED SLAB F-FACTOR[g]	1.03	1.03	1.03	0.77	0.68	0.68	0.68	0.68
CRAWL SPACE *U*-FACTOR	0.477	0.477	0.477	0.136	0.065	0.055	0.055	0.055

For SI: 1 foot = 304.8 mm.

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

b. Mass walls shall be in accordance with Section R402.2.6. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In Warm Humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.

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

   Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.28.

e. A maximum *U*-factor of 0.30 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

   1. Above 4,000 feet in elevation above sea level, or
   2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

f. Roofs with insulation entirely above deck shall comply with Section C402.2.1 and the Group R U-factors of Table C402.1.2.

g. F-factors for heated slabs correspond to the configuration described by footnote (d) of Table R402.1.3

Revise as follows:

TABLE R402.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	0	1	2	3	4 except Marine	5 and Marine 4	6	7 and 8
FENESTRATION U-FACTOR[b, i]	0.50	0.50	0.40	0.30	0.30	0.28 ~~h~~	0.28 ~~h~~	0.27 ~~h~~
SKYLIGHT ~~b~~ U-FACTOR	0.60	0.60	0.60	0.53	0.53	0.50	0.50	0.50
GLAZED FENESTRATION SHGC[b, e]	0.25	0.25	0.25	0.25	0.40	NR	NR	NR
CEILING R-VALUE ~~i~~	30	30	38	38	49	49	49	49
WOOD FRAME WALL R-VALUE[g]	13 or 0&10ci	13 or 0&10ci	13 or 0&10ci	20 or 13&5ci or 0&15ci	30 or 20&5ci or 13&10ci or 0&20ci	30 or 20&5ci or 13&10ci or 0&20ci	30 or 20&5ci or 13&10ci or 0&20ci	30 or 20&5ci or 13&10ci or 0&20ci
MASS WALL R-VALUE ~~h~~	3/4	3/4	4/6	8/13	8/13	13/17	15/20	19/21
FLOOR R-VALUE[h, j]	13 or 7+5ci or 10ci	13 or 7+5ci or 10ci	13 or 7+5ci or 10ci	19 or 13+5ci or 15ci	19 or 13+5ci or 15ci	30 or 19+7.5ci or 20ci	30 or 19+7.5ci or 20ci	38 or 19+10ci or 25ci
BASEMENT[c, g] WALL R-VALUE	0	0	0	5ci or 13[f]	10ci or 13	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci	15ci or 19 or 13& 5ci
SLAB[d] R-VALUE & DEPTH	0	0	0	10ci, 2 ft	10ci, 4 ft	10ci, 4 ft	10ci, 4 ft	10ci, 4 ft
CRAWL SPACE[c, g] WALL R-VALUE	0	0	0	5ci or 13[f]	10ci or 13	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

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

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

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.28.

c. “5ci or 13” means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13&5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

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

e. Basement wall insulation is not required in Warm Humid locations as defined by Figure R301.1 and Table R301.1.

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

g. Mass walls shall be in accordance with Section R402.2.6. The second *R*-value applies where more than half of the insulation is on the interior of the mass wall.

h. A maximum *U*-factor of 0.30 ~~2~~ shall apply in Marine Climate Zone 4 and Climate Zones 5 ~~3~~ through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation, or

2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

i. Roofs with insulation entirely above deck shall comply with Section C402.2.1 and the Group R R-values of Table C402.1.2.

j. "30 or 19+7.5ci or 20ci" means R30 cavity insulation alone or R19 cavity insulation with R7.5 continuous insulation or R20 continuous insulation alone.

2024 ENERGY Chapter11

TABLE N1102.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

CLIMATE ZONE	**0**	**1**	**2**	**3**	**4 except Marine**	**5 and Marine 4**	**6**	**7 and 8**
FENESTRATION *U*-FACTOR[f]	0.50	0.50	0.40	0.30	0.30	0.28[e]	0.28[e]	0.27[e]
SKYLIGHT *U*-FACTOR	0.60	0.60	0.60	0.53	0.53	0.50	0.50	0.50
GLAZED FENESTRATION SHGC[g]	0.25	0.25	0.25	0.25	0.40	NR	NR	NR
CEILING *U*-FACTOR	0.035	0.035	0.030	0.030	0.026	0.026	0.026	0.026
WOOD FRAME WALL *U*-FACTOR	0.084	0.084	0.084	0.060	0.045	0.045	0.045	0.045
MASS WALL *U*-FACTOR[b]	0.197	0.197	0.165	0.098	0.098	0.082	0.060	0.057
FLOOR *U*-FACTOR	0.064	0.064	0.064	0.047	0.047	0.033	0.033	0.028
BASEMENT WALL *U*-FACTOR	0.360	0.360	0.360	0.091[c]	0.059	0.050	0.050	0.050
UNHEATED SLAB F-FACTOR	0.73	0.73	0.73	0.54	0.54	0.54	0.48	0.48
HEATED SLAB F-FACTOR[g]	1.03	1.03	1.03	0.77	0.68	0.68	0.68	0.68
CRAWL SPACE WALL *U*-FACTOR	0.477	0.477	0.477	0.136	0.065	0.055	0.055	0.055

For SI: 1 foot = 304.8 mm.

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

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In Warm Humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.

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

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.28.

e. A maximum *U*-factor of 0.30 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation above sea level, or

2. In windborne debris regions where protection of openings is required by Section R301.2.1.2.

f. Roofs with insulation entirely above deck shall comply with Section C402.2.1 and the Group R U-factors ofTable C402.1.2.

g. F-factors for heated slabs correspond to the configuration described by footnote (d) of Table R402.1.3.

Revise as follows:

TABLE N1102.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	**0**	**1**	**2**	**3**	**4 except Marine**	**5 and Marine 4**	**6**	**7 and 8**
FENESTRATION *U*-FACTOR[b, i]	0.50	0.50	0.40	0.30	0.30	0.28 [n]	0.28 [n]	0.27 [n]

CLIMATE ZONE	0	1	2	3	4 except Marine	5 and Marine 4	6	7 and 8
SKYLIGHT[b] *U*-FACTOR	0.60	0.60	0.60	0.53	0.53	0.50	0.50	0.50
GLAZED FENESTRATION SHGC[b, e]	0.25	0.25	0.25	0.25	0.40	NR	NR	NR
CEILING *R*-VALUE[l]	30	30	38	38	49	49	49	49
WOOD FRAME WALL *R*-VALUE[g]	13 or 0&10ci	13 or 0&10ci	13 or 0&10ci	20 or 13&5ci or 0&15ci	30 or 20&5ci or 13&10ci or 0&20ci	30 or 20&5ci or 13&10ci or 0&20ci	30 or 20&5ci or 13&10ci or 0&20ci	30 or 20&5ci or 13&10ci or 0&20ci
MASS WALL *R*-VALUE[h]	3/4	3/4	4/6	8/13	8/13	13/17	15/20	19/21
FLOOR *R*-VALUE[l]	13 or 7+5ci or 10ci	13 or 7+5ci or 10ci	13 or 7+5ci or 10ci	19 or 13+5ci or 15ci	19 or 13+5ci or 15ci	30 or 19+7.5ci or 20ci	30 or 19+7.5ci or 20ci	38 38 or 19+10ci or 25ci
BASEMENT[c, g] WALL *R*-VALUE	0	0	0	5ci or 13[f]	10ci or 13	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci
SLAB[d] R-VALUE & DEPTH	0	0	0	10ci, 2 ft	10ci, 4 ft	10ci, 4 ft	10ci, 4 ft	10ci, 4 ft
CRAWL SPACE[c, g] WALL R-VALUE	0	0	0	5ci or 13[f]	10ci or 13	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required. ci = continuous insulation.

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

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

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.28.

c. **"5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13&5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.**

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

e. **Basement wall insulation shall not be required in Warm Humid locations as defined by Figure N1101.7 and Table N1101.7.**

f. **The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, "13&5" means R-13 cavity insulation plus R-5 continuous insulation.**

g. **Mass walls shall be in accordance with Section N1102.2.6. The second *R*-value applies where more than half of the insulation is on the interior of the mass wall.**

h. **A maximum *U*-factor of 0.30 ~~2~~ shall apply in Marine Climate Zone 4 and Climate Zones 5 ~~3~~ through 8 to vertical fenestration products installed in buildings located either:**

1. **Above 4,000 feet in elevation, or**

2. **In windborne debris regions where protection of openings is required by Section R301.2.1.2.**

i. Roofs with insulation entirely above deck shall comply with Section C402.2.1 and the Group R R-values of Table C402.1.2.

j. "30 or 19+7.5ci or 20ci" means R30 cavity insulation alone or R19 cavity insulation with R7.5 continuous insulation or R20 continuous insulation alone.

Reason: This public comment is errata as it simply addresses what we believe was an error in Public Comment Draft #1. It simply aligns with the consensus proposal, REPI-28, that was adopted during the first round by making edits to the following footnotes:

- Table R402.1.3, footnote h – the consensus agreement that passed changed this from 0.32 to 0.30 and it should be for CZs Marine 4 and 5-8 (matching the same change to Table R402.1.2, footnote e).
- This same error is in Table N1102.1.3, footnote h of the IRC, Chapter 11 document and the fix aligns with Table N1102.1.2, footnote e.

The proposal includes both Tables to show how this errata provides for consistency between table footnotes.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Simply fixing what we believe to be a publishing error in PC Draft #1.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Correcting an errata in the code, just a matter of breaking out its own footnote.

Final Hearing Results

RED1-199-22	AS

RED1-204-22

Original Proposal

IECC: TABLE R402.1.2; IECC: TABLE R402.1.3

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

Portions of table not shown remain unchanged.

CLIMATE ZONE	0	1	2	3	4 except Marine	5 and Marine 4	6	7 and 8
VERTICAL FENESTRATION U-FACTOR	0.50	0.50	0.40	0.30	0.30	0.28[e]	0.28[e]	0.27[e]
SKYLIGHT[d] *U*-FACTOR	0.60	0.60	0.60	0.53	0.53	0.50	0.50	0.50
GLAZED VERTICAL FENESTRATION SHGC[d]	0.25	0.25	0.25	0.25	0.40	NR	NR	NR
SKYLIGHT SHGC	0.28	0.28	0.28	0.28	0.40	NR	NR	NR

For SI: 1 foot = 304.8 mm.

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

b. Mass walls shall be in accordance with Section R402.2.6. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In Warm Humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.

d. ~~The fenestration *U*-factor columnrow excludes skylights other than skylights in Climate Zones 0 through 3 that have a SHGC of 0.28 or less. The SHGC column row applies to all glazed fenestration~~.

   ~~**Exception:** In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.28.~~

e. A maximum *U*-factor of 0.30 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

   1. Above 4,000 feet in elevation above sea level, or
   2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

f. Roofs with insulation entirely above deck shall comply with Section C402.2.1 and the Group R U-factors of Table C402.1.2.

g. F-factors for heated slabs correspond to the configuration described by footnote (d) of Table R402.1.3

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE R402.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

Portions of table not shown remain unchanged.

CLIMATE ZONE	0	1	2	3	4 except Marine	5 and Marine 4	6	7 and 8
VERTICAL FENESTRATION U-FACTOR	0.50	0.50	0.40	0.30	0.30	0.28[e]	0.28[e]	0.27[e]
SKYLIGHT~~[b]~~ U-FACTOR	0.60	0.60	0.60	0.53	0.53	0.50	0.50	0.50
GLAZED VERTICAL FENESTRATION SHGC~~[b]~~	0.25	0.25	0.25	0.25	0.40	NR	NR	NR
SKYLIGHT SHGC	0.28	0.28	0.28	0.28	0.40	NR	NR	NR

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

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

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

~~**Exception:** In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.~~

c. “5ci or 13” means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13&5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

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

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

f. Basement wall insulation is not required in Warm Humid locations as defined by Figure R301.1 and Table R301.1.

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

h. Mass walls shall be in accordance with Section R402.2.6. The second *R*-value applies where more than half of the insulation is on the interior of the mass wall.

i. A maximum *U*-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

Reason: Footnotes should not contain requirements, they should be explanatory. Since there should be no requirements in footnotes there should be no exceptions. There are no columns for fenestration u-factors or SHGC; there are rows.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No change in requirements.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Editorial clarification of the requirements.

Final Hearing Results

RED1-204-22	AM

RED1-208-22

Original Proposal

IECC: R402.1.5, R405.2, R405.4.2, TABLE R405.4.2(1), R406.3; IECC: R402.2.10

Proponents: Maston Stafford, US-EcoLogic, Inc., US-EcoLogic, Inc. (maston.stafford@texenergy.org); Aaron Gary, Tempo, Inc., Tempo, Inc. (aaron.gary@texenergy.org); Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.1.5 Component performance alternative. Where the proposed total *building thermal envelope* thermal conductance TC is less than or equal to the required total *building thermal envelope* thermal conductance TC using factors in Table R402.1.2 the *building* shall be considered to be in compliance with Table R402.1.2. The total thermal conductance shall be determined in accordance with Equation 4-1. Proposed *U*-factors and slab-on-grade *F*-factors shall be taken from ANSI/ASHRAE/IES Standard 90.1 Appendix A or determined using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. In addition to total thermal conductance TC compliance, the SHGC requirements of Table R402.1.2 and the maximum fenestration *U*-factors of Section R402.6 shall be met.

Equation 4-1

$$(\mathrm{Up\ A} + \mathrm{Fp\ P}) \leq (\mathrm{Ur\ A} + \mathrm{Fr\ P})$$

Up A = the sum of proposed *U*-factors times the assembly areas in the proposed building.
Fp P = the sum of proposed *F*-factors times the slab-on-grade perimeter lengths in the proposed building.
Ur A = the sum of *U*-factors in Table R402.1.2 times the same assembly areas as in the proposed building.
Fr P = the sum of *F*-factors in Table R402.1.2 times the same slab-on-grade perimeter lengths as in the proposed building.

R405.2 Simulated performance compliance. Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total *building thermal envelope* thermal conductance TC ~~UA, which is the sum of the U-factor times assembly area~~, shall be less than or equal to the required total *building thermal envelope* thermal conductance TC ~~UA~~ using the prescriptive *U*-factors and *F*-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and 1.15 in Climate Zones 3 through 8 in accordance with Equation 4-2 and Section R402.1.5. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

   For Climate Zones 0-2: TC ~~UA~~ Proposed Design ≤ 1.08 × TC ~~UA~~ Prescriptive reference design **(Equation 4-2)**
   For Climate Zones 3-8: TC ~~UA~~ Proposed Design ≤ 1.15 × TC ~~UA~~ Prescriptive reference design

3. For buildings without a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 85 percent of the annual energy cost of the *standard reference design*. For buildings with a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 80 percent of the annual energy cost of the standard reference design. For dwelling units with greater than 5,000 square feet (465 m^2) of living space floor area located above grade plane, the annual energy cost of the proposed design shall be reduced by an additional 5 percent of annual energy cost of the standard reference design. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

   Exceptions:

   1. The energy use based on source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multipliers for all energy sources shall be obtained from ASHRAE Standard 105 (Tables K2, K4, or K8) or from another data source approved by the *code official*.
   2. The energy use based on site energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost for an all-electric building with on-site renewable energy installed.

R405.4.2 Residence specifications. The *standard reference design* and *proposed design* shall be configured and analyzed as specified by Table R405.4.2(1). Table R405.4.2(1) shall include, by reference, all notes contained in Table R402.1.~~3~~2. Proposed *U*-factors and slab-on-grade *F*-factors shall be taken from ANSI/ASHRAE/IES Standard 90.1 Appendix A or determined using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials.

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Foundations	Type: same as proposed.	As proposed
	Foundation wall area above and below grade and soil characteristics and slab-on-grade exposed perimeter lengths: same as proposed.	As proposed
	Foundation wall *U*-factor and slab-on-grade *F*-factor: as specified in Table R402.1.2.~~l~~	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, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

~~l. A maximum *F*-factor of 0.73 shall apply in jurisdictions designated by the *code official* as having a very heavy termite infestation.~~

R406.3 Building thermal envelope. The proposed total *building thermal envelope* thermal conductance TC~~UA, which is sum of *U*-factor times assembly area,~~ shall be less than or equal to the required total *building thermal envelope* thermal conductance TC~~UA~~ using the prescriptive *U*-factors and *F*-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and by 1.15 in Climates Zones 3 through 8, in accordance with Equation 4-3 and Section R402.1.5. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

For Climate Zones 0-2: TC~~UA~~ Proposed design ≤ 1.08 × TC~~UA~~ Prescriptive reference design **(Equation 4-3)**

For Climate Zones 3-8: TC~~UA~~ Proposed design ≤ 1.15 × TC~~UA~~ Prescriptive reference design

2024 International Energy Conservation Code [CE Project]

Revise as follows:

R402.2.10 Slab-on-grade floors. Slab-on-grade floors, in contact with the ground, with a floor surface within 24 inches (600 mm) above or below grade shall be insulated in accordance with Table R402.1.3.

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

Reason: Section R402.1.5 has changed from the UA alternative to a component performance alternative which includes the*F*-factor of a slab-on-grade foundation. This change to the prescriptive compliance path should also be included to sections R405 and R406 envelope requirements. With the inclusion of *F*-factors to slab-on-grade foundations in Table R402.1.2, then the foundation section of Table R405.4.2(1) needs to include these changes for the standard reference design. An interpretation could be made that because Table R405.4.2(1) does not specify slab-edge insulation for slab-on-grade foundation types, then the standard reference design will equal the proposed design slab-edge insulation or lack thereof. Hypothetically a building using the Simulated Building Performance compliance path in climate zones 3 through 8 built without slab-edge insulation would never have to compensate for the increased energy costs by lowering the U-factor of other assemblies because the simulation software would run both the proposed design and the standard reference design with no slab-edge insulation. Making this change to Table R405.4.2(1) and the changes we have made to Equation 4-2 of Section R405.2, this hypothetical becomes impossible.

A footnote was added to Table R405.4.2(1) to coordinate with existing Section R402.2.10 addressing slab-edge insulation in areas with very heavy termite infestation.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These suggested changes only incorporate changes made in section R402.1.5 to other sections. There is no cost impact.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies R405 to be consistent with edits to R402.1.5 that were approved in the last round of comments.

Final Hearing Results

RED1-208-22	AM

RED1-210-22

Original Proposal

IECC: R402.2.10

Proponents: Shane Hoeper, City of Dubuque, myself (shoeper@cityofdubuque.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.2.10 Slab-on-grade floors. Slab-on-grade floors~~, in contact with the ground~~, with a floor surface within 24 inches (600 mm) above or below grade shall be insulated in accordance with Table R402.1.3.

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

Reason: Slab on grade is by definition "in contact with the ground". The phrase is unnecessary.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Grammar correction only.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Removes unnecessary language

Final Hearing Results

RED1-210-22	AS

RED1-211-22

Original Proposal

IECC: R402.2.11.1

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.2.11.1 Crawl space wall insulation installation~~s~~. Where installed, c~~C~~rawl space wall insulation ~~shall comply with the following~~:

~~1. Where exterior crawl space wall insulation is installed, it~~shall be secured ~~permanently attached~~ to the wall and extend downward from the sill plate to not less than the top ~~base~~ of the foundation wall footing.

~~2.~~ **Exception:** Where ~~interior~~ the crawl space wall insulation is installed on the interior side of the wall and the crawl space floor is more than 24 inches below the exterior grade, the crawl space wall insulation ~~it~~ shall be permitted to ~~permanently attached to the foundation wall and~~ extend downward from the sill plate at the top of the foundation wall to not less than the interior floor of the crawl space.

Exposed earth in crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the International Building Code or *International Residential Code*, as applicable. Joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up stem walls and shall be attached to the stem walls.

Reason: This proposal is a clean-up of formatting and clarification of crawl space wall insulation installation requirements. These revisions also align better with the basis of the R-value requirements for crawl space walls. It also removes the word "permanently attached" and replaces it with "secured" to avoid situations where insulation is installed to be removable, such as done in accordance with some local requirements to allow for termite inspections.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is a clarification and does not change requirements in a way that should have any negative impact on construction cost. In fact, it may allow some flexibility through the clarifications that could reduce construction cost such as by the exception provided or by way of requiring insulation to be "secured" rather than "permanently attached".

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Since crawl space insulation can be traded, "where required" is a good addition and the language proposed is helpful for code officials. Also agreement that in some jurisdictions it may need to be removed for inspection

Final Hearing Results

RED1-211-22	AS

RED1-212-22

Original Proposal

IECC: R402.2.3, R402.2.3.1

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.2.3 Attic knee wall. <u>Wood attic knee</u> ~~Attic knee~~wall assemblies that separate conditioned space from unconditioned attic spaces shall <u>comply with Table R402.1.3 for wood frame walls.</u> ~~meet the same insulation requirements as above-grade walls.~~ <u>Steel attic knee wall assemblies shall comply with Section R402.2.7.</u> Such knee walls shall have an air barrier between conditioned an<u>d</u> unconditioned space.

R402.2.3.1 ~~Truss~~ <u>Roof truss</u> framing separating conditioned and unconditioned space. Where <u>wood</u> vertical roof truss framing members are used to separate conditioned space and unconditioned space, they shall ~~meet the same insulation requirements as the~~ <u>comply with Table R402.1.3 for wood frame walls</u> ~~above-grade walls~~. <u>Steel frame vertical roof truss framing members used to separate conditioned space and unconditioned space shall comply with Section R402.2.7.</u>

Reason: These sections are imprecise and do not differentiate between wood and steel framing. The title of R402.2.3.1 is changed to differentiate between roof trusses and floor trusses.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Mainly an editorial change.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Appropriate and will add clarity.

Final Hearing Results

RED1-212-22	AS

RED1-217-22

Original Proposal

IECC: R402.2.9.1

Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.2.9.1 Basement wall insulation installation. Where *basement walls* are insulated, the insulation shall be installed from the top of the *basement wall* down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less, or in accordance with the *proposed design* or the *rated design*, as applicable.

Reason: The proposal clarifies the relationship between the prescriptive path and both performance paths. The performance paths are intended to provide design flexibility in achieving target energy performance. Only installation provisions should be listed in this table because the amount of insulation should be tradable. The insulation height on basement walls should be tradable as well.

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

The added design flexibility may lead to cost improved cost-effectiveness.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies the relationship between the prescriptive path and both performance paths regarding basement walls.
Reason for the modification:

- Reconciles with errata for Tables R405.2 and R406.2.
- It is proposed to italicize the term “proposed design” at the request of the subcommittee because it’s a defined term. However, the term “proposed design” is not always italicized throughout the code and a coordination effort may be needed in the future.
- The term “proposed design” is used in a similar manner in Section R402.2.10.1 Slab-on-grade.

Final Hearing Results

RED1-217-22	AM

RED1-218-22

Original Proposal

IECC: R402.3

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.3 Radiant barriers. Where installed~~ to reduce thermal radiation~~, radiant barriers shall be installed in accordance with ASTM C1743.

Reason: The reason to install a radiant barrier is commentary and should not be in a requirement.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Essentially editorial.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This is an editorial update to remove unnecessary language.

Final Hearing Results

RED1-218-22	AS

RED1-222-22

Original Proposal

IECC: R402.5.1.2, R402.5.1.4

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.5.1.2 Air leakage Testing. The *building* or each *dwelling unit* in the buildingshall be tested for air leakage. ~~The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 4.0 air changes per hour or 0.22 cfm/f^{2}t (1.1 L/s x m^2) of building or dwelling unit enclosure area.~~ Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, ASTM E1827 or ASTM E3158 and reported at a pressure differential of 0.2 inch water gauge (50 Pa). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the*building thermal envelope* have been sealed.
During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exceptions:

~~1. When testing individual dwelling units, an air leakage rate not exceeding 0.27 cubic feet per minute per square foot [1.35 L/s x m^2)] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:~~

~~1.1 Attached single and multiple family building dwelling units.~~

~~1.2 Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.~~

1. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.5.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.13 and R402.4.5, as applicable.
2. Where tested in accordance with R402.5.1.2.1 4, testing of each *dwelling unit* is not required.

~~During testing:~~

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

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

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

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

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

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

~~Mechanical ventilation shall be provided in accordance with Section M1505 of the~~ ~~*International Residential Code*~~ ~~or Section 403.3.2 of the~~ ~~*International Mechanical Code*, as applicable, or with other~~ ~~*approved*~~ ~~means of ventilation~~.

~~R402.5.1.4~~R402.5.1.2.1 Dwelling unit sampling. For buildings with eight or more dwelling units~~,the greater of~~ seven or 20 percent of the dwelling units, whichever is greater, ~~in the building~~ shall be tested. Tested units shall include a top floor unit, a ground floor unit, a middle floor unit, and the dwelling unit with the largest dwelling unit enclosure area. Where the air leakage rate of a tested unit is greater than the maximum permitted ~~air leakage~~ rate, corrective actions shall be taken m~~ade to the unit~~ and the unit re-tested until it passes. For each tested dwelling unit with an ~~that has a greater~~ air leakage rate greater than the maximum permitted ~~air leakage~~ rate, ~~an additional~~ three additional units, including the corrected unit, shall be tested. Where buildings have fewer than eight dwelling units, each dwelling unit shall be tested.

Reason: This Public Comment does the following:

- Improves the organization of Section R402.5.1.2 by separating testing procedures from testing thresholds and re-ordering the test steps and exceptions
- Clarifies the testing thresholds by compliance path
- Establishes a cfm/ft2 metric alternative to ACH50 when choosing the Prescriptive Compliance Option.
- Clarifies the whole-building test threshold vs the dwelling unit test threshold.
- Corrects the spelling of "appliances" in Table R405.2 and adds the reference to the new Performance air leakage rate section

Bibliography: None

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

None

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Most of the content of the proposal had already been approved by prior action. The modifications improve the language and add clarity.

Final Hearing Results

RED1-222-22	AM

RED1-224-22 Part I

Original Proposal

IECC: R402.5.1, R402.5.1.2, R402.5.1.3 (New), R402.5.1.3, R402.5.1.4 (New); IECC: TABLE R405.2, TABLE R406.2

Proponents: Theresa Weston, The Holt Weston Consultancy, ABAA (Air Barrier Association of America) (holtweston88@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.5.1 Building thermal envelope. The *building thermal envelope* shall comply with Sections R402.5.1.1 through R402.5.1.3. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.5.1.2 Air Leakage Testing. The *building* or each *dwelling unit* in the buildingshall be tested for air leakage. ~~The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 4.0 air changes per hour or 0.22 cfm/ft ^{2} (1.1 L/s x m ^{2}) of building or dwelling unit enclosure area.~~ Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, ASTM E1827 or ASTM E3158 and reported at a pressure differential of 0.2 inch water gauge (50 Pa). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the*building thermal envelope* have been sealed.

Exceptions:

~~1. When testing individual dwelling units, an air leakage rate not exceeding 0.27 cubic feet per minute per square foot [1.35 L/s x m ^{2})] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:~~

~~1.1 Attached single and multiple family building dwelling units.~~

~~1.2 Buildings or dwelling units that are 1,500 square feet (139.4 m ^{2}) or smaller.~~

~~2.~~ 1. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.5.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.13 and R402.4.5, as applicable.

~~3.~~ 2. Where tested in accordance with R402.5.1.4, testing of each dwelling unit is not required.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Mechanical ventilation shall be provided in accordance with Section M1505 of the*International Residential Code* or Section 403.3.2 of the

International Mechanical Code, as applicable, or with other*approved* means of ventilation.

Delete without substitution:

~~**R402.5.1.3 Prescriptive air leakage rate.** When complying with Section R401.2.1, the building or each dwelling unit in the building shall have an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 0, 1 and 2, 3.0 air changes per hour in Climate Zones 3 through 5, and 2.5 air changes per hour in Climate Zones 6 through 8, when tested in accordance with Section R402.5.1.2.~~

Add new text as follows:

R402.5.1.4 Dwelling unit sampling. For buildings with eight or more dwelling units, the greater of seven or 20 percent of the dwelling units in the building shall be tested. Tested units shall include a top floor unit, a ground floor unit, a middle floor unit, and the dwelling unit with the largest dwelling unit enclosure area. Where the air leakage rate of a tested unit is greater than the maximum permitted air leakage rate, corrective actions shall be made to the unit and the unit re-tested. For each tested unit that has a greater air leakage rate than the maximum permitted air leakage rate, an additional three units, including the corrected unit, shall be tested. Where buildings have fewer than eight dwelling units, each dwelling unit shall be tested.

R402.5.1.3 Maximum air leakage rate. Where tested in accordance with Section R402.5.1.2, the air leakage rate for*buildings* or *dwelling units* shall be as follows:

1. Where complying with Section R401.2.1, the *building* or *dwelling units* in the building shall have an air leakage rate not greater than 4.0 air changes per hour in Climate Zones 0, 1 and 2, 3.0 air changes per hour in Climate Zones 3 through 5, and 2.5 air changes per hour in Climate Zones 6 through 8.
2. Where complying with Section R401.2.2 or R401.2.3, the building or dwelling units in the building shall have an air leakage rate not greater than 4.0 air changes per hour, or 0.22 cfm/ft^2 (1.1 L/s x m^2) of the building thermal envelope area or dwelling unit enclosure area, as applicable.

Exceptions:

1. Where *dwelling units* are attached or located in an R-2 occupancy, and are tested without simultaneously testing adjacent *dwelling units*, the air leakage rate is permitted to be not greater than 0.27 cfm/ft2 (1.35 L/s x m2) of the dwelling unit enclosure area. Where adjacent dwelling units are simultaneously tested in accordance with ASTM E779, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 (1.35 L/s x m^2) of the *dwelling unit enclosure area* that separates *conditioned space* from the exterior.
2. Where *buildings* have 1,500 square feet (139.4 m^2) or less of *conditioned floor area*, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 (1.35 L/s x m^2).

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency

R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.4	Eave baffle
R402.2.5.1	Access hatches and doors
R402.2.11.1	Crawl space wall insulation installations
R402.5.1.1	Installation
R402.5.1.2	Air leakage testing ~~Testing~~
R402.5.1.3	Maximum air leakage rate
R402.6	Maximum fenestration *U*-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.11	Energy consumption of pools and spas
R403.12	Portable spas
R403.13	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2.1	Interior lighting controls

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.4	Eave baffle
R402.2.5.1	Access hatches and doors

R402.2.11.1	Crawl space wall insulation installation
R402.5.1.1	Installation
R402.5.1.2	Air leakage testing Testing
R402.5.1.3	Maximum air leakage rate
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.11	Energy consumption of pools and spas
R403.12	Portable spas
R403.13	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2.1	Interior lighting controls
R406.3	Building thermal envelope

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

Reason: This proposals seeks a more logical organization of the code. It only updates the organization of the code and does not change technical requirements. More specifically, it separates the mandatory maximum air leakage rate (required across all compliance pathways) from the test method section by moving the existing language into a separate section identified as mandatory. This is intended to improve the code readability and the ease of understanding the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal does not change requirements but only reorganizes the code for readability and clarity.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Improves the clarity of the code by clearly separating test protocols from maximum air leakage rate criteria.

Final Hearing Results

RED1-224-22 Part I AM

RED1-224-22 Part II

Original Proposal

IRCECC: N1102.5.1, N1102.5.1.2, N1102.5.1.3 (New), N1102.5.1.3, N1102.5.1.4 (New), TABLE N1105.2, TABLE N1106.2
Proponents: Theresa Weston, The Holt Weston Consultancy, ABAA (Air Barrier Association of America) (holtweston88@gmail.com)

2024 ENERGY Chapter11

Revise as follows:

N1102.5.1 Building thermal envelope. The *building thermal envelope* shall comply with Sections N1102.5.1.1 through N1102.5.1.3. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

N1102.5.1.2 Air leakage Testing ~~and maximum air leakage rate~~. The *building* or each *dwelling unit* in the building shall be tested for air leakage. ~~The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 4.0 air changes per hour or 0.22 cfm/ft^2 (1.1 L/s x m^2) of building or dwelling unit enclosure area.~~ Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, ASTM E1827 or ASTM E3158 and reported at a pressure differential of 0.2 inch water gauge (50 Pa). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

Exceptions:

~~1. When testing individual dwelling units, an air leakage rate not exceeding 0.27 cubic feet per minute per square foot [1.35 L/s x m^2] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch water gauge (50 Pa), shall be permitted in all climate zones for:~~

~~1.1 Attached single and multiple family building dwelling units.~~

~~1.2 Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.~~

~~2.~~ 1. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table N1102.5.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other conditioned spaces in accordance with Sections N1102.2.13 and N1102.4.5, as applicable.

~~3.~~ 2. Where tested in accordance with N1102.5.1.2, testing of each dwelling unit is not required.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Mechanical *ventilation* shall be provided in accordance with Section M1505 of this code or Section 403.3.2 of the *International Mechanical*

Code, as applicable, or with other*approved* means of *ventilation*.

Delete without substitution:

~~**N1102.5.1.3 Prescriptive air leakage rate.** Where complying with Section N1101.13.1, the building or each *dwelling unit* in the building shall have an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 0, 1 and 2, 3.0 air changes per hour in Climate Zones 3 through 5, and 2.5 air changes per hour in Climate Zones 6 through 8, when tested in accordance with Section N1102.5.1.2.~~

Add new text as follows:

N1102.5.1.4 Dwelling unit sampling. For buildings with eight or more dwelling units, the greater of seven or 20 percent of the dwelling units in the building shall be tested. Tested units shall include a top floor unit, a ground floor unit, a middle floor unit, and the dwelling unit with the largest dwelling unit enclosure area. Where the air leakage rate of a tested unit is greater than the maximum permitted air leakage rate, corrective actions shall be made to the unit and the unit re-tested. For each tested unit that has a greater air leakage rate than the maximum permitted air leakage rate, an additional three units, including the corrected unit, shall be tested. Where buildings have fewer than eight dwelling units, each dwelling unit shall be tested.

N1102.5.1.3 Maximum air leakage rate. Where tested in accordance with Section N1102.5.1.2, the air leakage rate for *buildings* or *dwelling units* shall be as follows:

1. Where complying with Section N1101.2.1, the building or dwelling units in the building shall have an air leakage rate not greater than 4.0 air changes per hour in Climate Zones 0, 1 and 2, 3.0 air changes per hour in Climate Zones 3 through 5, and 2.5 air changes per hour in Climate Zones 6 through 8.
2. Where complying with Section N1101.2.2 or N1101.2.3, the building or dwelling units in the building shall have an air leakage rate not greater than 4.0 air changes per hour, or 0.22 cfm/ft^2 (1.1 L/s x m^2) of the building thermal envelope area or dwelling unit enclosure area, as applicable.

Exceptions:

1. Where dwelling units are attached or located in an R-2 occupancy, and are tested without simultaneously testing adjacent dwelling units, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 (1.35 L/s x m^2) of the dwelling unit enclosure area. Where adjacent dwelling units are simultaneously tested in accordance with ASTM E779, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 (1.35 L/s x m^2) of the dwelling unit enclosure area that separates conditioned space from the exterior.
2. Where buildings have 1,500 square feet (139.4 m^2) or less of conditioned floor area, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 (1.35 L/s x m^2).

Revise as follows:

TABLE N1105.2 REQUIREMENTS FOR SIMULATED BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
N1101.14	Certificate
Building Thermal Envelope	
N1102.1.1	Vapor retarder
N1102.2.3	Attic knee or pony wall
N1102.2.4	Eave baffle
N1102.2.5.1	Access hatches and doors

N1102.2.9	Basement walls
N1102.2.9.1	Basement wall insulation installation
N1102.2.10.1	Slab-on-grade floor insulation installation
N1102.2.11.1	Crawl space wall insulation installation
N1102.5.1.1	Installation
N1102.5.1.2	~~Testing~~Air leakage testing
N1102.5.1.3	Maximum air leakage rate
N1102.5.2	Fireplaces
N1102.5.3	Fenestration air leakage
N1102.5.4	Rooms containing fuel burning appliances
N1102.5.5	Recessed lighting
N1102.5.6	Air Sealed electrical and communication outlet boxes
N1102.6	Maximum fenestration *U*-factor and SHGC
Mechanical	
N1103.1	Controls
N1103.2	Hot Water boiler temperature reset
N1103.3,	Duct systems
N1103.4	Mechanical system piping insulation
N1103.5 except Section N1103.5.2	Service hot water systems
N1103.5.2	Hot water pipe insulation
N1103.6	Mechanical ventilation
N1103.7, except Section N1103.7.1	Equipment sizing and efficiency rating
N1103.8	Systems serving multiple dwelling units
N1103.9	Snow melt and ice system controls
N1103.11	Energy consumption of pools and spas
N1103.12	Portable spas
N1103.13	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
N1104.1	Lighting equipment
N1104.2	Interior lighting controls
N1104.5	Electric readiness
N1104.6	Renewable energy infrastructure
N1104.7	Electric vehicle power transfer infrastructure

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

TABLE N1106.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
N1101.14	Certificate
Building Thermal Envelope	
N1102.1.1	Vapor retarder
N1102.2.4	Eave baffle
N1102.2.5.1	Access hatches and doors
N1102.2.9	Basement walls
N1102.2.9.1	Basement wall insulation installation
N1102.2.10.1	Slab-on-grade floor insulation installation
N1102.2.11.1	Crawl space wall insulation installation
N1102.5.1.1	Installation
N1102.5.1.2	~~Testing~~Air leakage testing
N1102.5.1.3	Maximum air leakage rate
N1102.5.2	Fireplaces
N1102.5.3	Fenestration air leakage
N1102.5.4	Rooms containing fuel burning appliances
N1102.5.5	Recessed lighting
N1102.5.6	Air sealed electrical and communication outlet boxes
N1106.3	Building thermal envelope
Mechanical	
N1103.1	Controls
N1103.2	Hot Water boiler temperature reset
N1103.3 except	Duct systems
N1103.4	Mechanical system piping insulation
N1103.5 except Section N1103.5.2	Service hot water systems
N1103.5.2	Hot water pipe insulation
N1103.6	Mechanical ventilation
N1103.7, except Section N1103.7.1	Equipment sizing and efficiency rating
N1103.8	Systems serving multiple dwelling units
N1103.9	Snow melt and ice system controls
N1103.11	Energy consumption of pools and spas

N1103.12	Portable spas
N1103.13	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
N1104.1	Lighting equipment
N1104.2	Interior lighting controls
N1104.5	Electric readiness
N1104.6	Renewable energy infrastructure
N1104.7	Electric Vehicle power transfer infrastructure

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

Reason: This proposals seeks a more logical organization of the code. It only updates the organization of the code and does not change technical requirements. More specifically, it separates the mandatory maximum air leakage rate (required across all compliance pathways) from the test method section by moving the existing language into a separate section identified as mandatory. This is intended to improve the code readability and the ease of understanding the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not change requirements but only reorganizes the code for readability and clarity.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Improves the clarity of the code by clearly separating test protocols from maximum air leakage rate criteria.

Final Hearing Results

RED1-224-22 Part II AM

RED1-226-22

Original Proposal

IECC: TABLE R402.5.1.1

Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R402.5.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION

Portions of table not shown remain unchanged.

COMPONENT	AIR BARRIER CRITERIA
Ceiling/attic	An sealed air barrier shall be installed in any dropped ceiling or soffit to separate it from unconditioned space. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be air sealed with gasketing materials that allow for repeated entrance over time.

Reason: This proposal removes the redundant term "sealed." It is already required that breaks and joints in the air barrier are sealed. The term “sealed air barrier” can be interpreted as a new term different from “air barrier” with sealed joints. Therefore, it will lead to issues in the field with interpretation of the code. It’s not the air barrier that gets sealed, it’s the joints that get sealed.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change is editorial and will not effect the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Helps clarify the code by reducing potential for misinterpretation.

Final Hearing Results

RED1-226-22	AS

RED1-229-22

Original Proposal

IECC: TABLE R402.5.1.1

Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R402.5.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

Portions of table not shown remain unchanged.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Common walls or double walls separating attached single-family dwellings or townhouses	Air sealing materials recognized in a listed fire-resistance rated common wall or double wall design and installed in accordance with the listing, or air sealing materials recognized in an approved design, shall be used. Common walls or double walls shall be considered an exterior wall for the purposes of air barrier and air sealing application of this Table. An interior air barrier shall be provided. Air sealing at the intersections with building thermal envelope shall be provided. Where installed in a fire-resistance rated wall assembly, air sealing materials shall comply with one of the following: 1. be in accordance with an *approved* design for the fire resistance-rated assembly. 2. be supported by *approved* data that shows the assembly as installed complies with the required fire-resistance rating	Insulation materials recognized in the *approved* listed common wall or double-wall design and installed in accordance with the listing, or insulation materials recognized in the *approved* design~~,~~ shall be permitted to be used.

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

b. Insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: The proposal resolves several issues with the current language:

1. The revised language clearly identifies that the provisions are intended to apply to townhomes. The terms "double wall" and "common wall" were originally adopted from IRC Section R302.2 Townhomes. However, both terms can apply to other uses such exterior double walls.

2. The revised language requires that an air barrier be provided without limiting the designer's choice on the type of fire-rated assembly or imposing overly prescriptive provisions.

3. The revised language requires that the boundary of the fire rated assembly be sealed to the exterior wall (air barrier materials installed on the outside of the assembly do not impact the fire rating).

4. The revised language removes the highly problematic language that the common wall shall be considered an exterior wall. These walls are not exterior walls. The energy code cannot require that the shaft liner panels be sealed at the H-channel. There are no listed assemblies that allow that. In addition, Section R402.5 Air Leakage or Table R402.5.1.1 do not use the term "exterior wall" in this manner elsewhere. This language is replaced by the sentence requiring that the air barrier be provided at these wall assemblies.

5. The proposal also adds a compliance option for using are sealing materials that are approved for use in similar fire rated systems. The installation of air sealing is limited only to the perimeter of the assembly and intersections with other assemblies.

6. The revised language also clarifies that it is not a requirement to insulate common walls. These walls do not represent exterior building boundary. The current language may lead the code user to an interpretation that common walls must be insulated to the same level as

exterior walls.

During testimony it was stated that these provisions can be met by installation of proprietary foam products in the gap between the liner panels and framing. However, the same gap can be filled with strips of the same liner panels and complemented with other air sealing strategies. In addition, the area separation wall system is not the only strategy for achieving the required fire rating. The current language limits other wall options.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed language is intended to provide clarity and allow options for achieving air sealing of fire rated assemblies. It may or may not impact cost.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Resolves potential conflict in draft 1 language for fire-resistance rated wall assemblies and provides more clarity.

Final Hearing Results

RED1-229-22	AM

RED1-230-22

Original Proposal

IECC: TABLE R402.5.1.1 (New)

Proponents: Robert Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R402.5.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a].

COMPONENT	AIR BARRIER AND AIR SEALING CRITERIA	INSULATION INSTALLATION CRITERIA
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed,and air sealed to maintain its continuity at any exposed edges of insulation the insulated floor cavity. Floor framing members that are part of the building thermal envelope shall be air sealed to maintain a continuous air barrier. Air permeable floor cavity insulation shall be enclosed	Floor framing cavity insulation shall be installed in accordance with the requirements of Section R402.2.8. to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floor framing members.

Reason: Table R402.4.1.1 has continued to evolve to recognize other component installation requirements that have been defined in Sections R402.2.1 through R402.2.13. Floor insulation installation requirements specifically, in Section R402.2.7 of the 2021 IECC, have changed and the Component section of Floors in Table R402.4.1.1 has not changed in the same way causing inconsistency between the two sections of code.

The proposal has been simplified in the public comment and uses now common language in the table to refer the user to Section R402.2.7 as a reference.

Component Criteria: No Changes proposed.

Air barrier and air sealing criteria section:

- Floor cavities are wall cavities laid down, therefore, air permeable insulation installed inside the cavity also needs to be enclosed by the air barrier assembly. As the IECC now allows three insulation techniques for insulating floors as seen in Section R402.2.7 it becomes more important to ensure that the rim joist of the insulated floor not only get insulated but is airtight because the insulation is no longer required to be installed adjacent to the subfloor decking. The proposed language brings this to light for builders and trades that are executing the code requirements.

Insulation Installation Criteria:

- The insulation installation criteria outlined in Section R402.2.7 clearly describes how insulation in floor systems must be installed. There is no need to further explain it in this table,

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed language does not increase the cost of construction but rather offers clarity of existing requirements for inspection and installation of insulation.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Addressing previous comments made in RED1-18 and referring back to table we had approved in REDC1-11.

Final Hearing Results	
RED1-230-22	AM

RED1-231-22

Original Proposal

IECC: TABLE R402.5.1.1

Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R402.5.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA
Electrical,communication, and other equipment boxes, housings, and enclosures	Boxes, housing, and enclosures that penetrate the air barrier shall be caulked, taped, gasketed, or otherwise sealed to the air barrier element being penetrated. All concealed openings into the box, housing, or enclosure shall be sealed. The continuity of the air barrier shall be maintained around boxes, housings, and enclosures that penetrate the air barrier. Alternatively, air-sealed boxes shall be installed in accordance with R402.5.6.

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

b. Insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: This proposal removes duplicative and unnecessary language. The requirements for air barrier around boxes, housings and enclosures is already addressed by the first sentence in this cell, which states that boxes, housing and enclosures shall be sealed to the air barrier. This requirement will ensure the continuity of the air barrier. The third sentence is recommended for deletion because it effectively re-states the same requirement and does not provide new information. Duplicative requirements can lead to issues in the field with interpreting the intent of the code and should be removed.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change is editorial and will have no effect on the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal removes redundant language.

Final Hearing Results

RED1-231-22 AS

RED1-233-22

Original Proposal

IECC: TABLE R402.5.1.1

Proponents: Shannon Corcoran, American Gas Association, American Gas Association

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R402.5.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	A sealed air barrier shall be installed in any dropped ceiling or soffit to separate it from unconditioned space. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be air sealed with gasketing materials that allow for repeated entrance over time.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier. Access hatches and doors shall be installed and insulated in accordance with Section R402.2.5 Eave Baffles shall be installed in accordance with Section R402.2.4
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, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	Framing cavities around windows, skylights and doors shall be completely filled with insulation or insulated per window manufacturer's instructions.
Rim joists	Rim joists shall include an air barrier. The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement, crawl space, and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.11. Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.11. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.9.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.11.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.8.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.5.5.	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Showers, tubs, and fireplaces adjacent to the building thermal envelope	<u>An</u> air barrier shall separate <u>insulation in</u> the <u>*building thermal envelope*</u> from the shower<u>,</u> tub<u>,</u> ~~and~~ <u>or fireplace assemblies</u>.	Exterior <u>framed</u> walls adjacent to showers<u>,</u> tubs <u>and fireplaces</u> shall be insulated.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Electrical,communication, and other equipment boxes, housings, and enclosures	Boxes, housing, and enclosures that penetrate the air barrier shall be caulked, taped, gasketed, or otherwise sealed to the air barrier element being penetrated. All concealed openings into the box, housing, or enclosure shall be sealed. The continuity of the air barrier shall be maintained around boxes, housings, and enclosures that penetrate the air barrier. Alternatively, air-sealed boxes shall be installed in accordance with R402.5.6.	Boxes, housing, and enclosures shall be burried in or surrounded by insulation.
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	HVAC supply and return register boots located in the building's thermal envelope shall be buried and surrounded by insulation.
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—
Common walls or double walls	Air sealing materials recognized in a listed fire-resistance rated common wall or double wall design and installed in accordance with the listing, or air sealing materials recognized in an approved design, shall be used. Common walls or double walls shall be considered an exterior wall for the purposes of air barrier and air sealing application of this Table.	Insulation materials recognized in the listed common wall or double-wall design and installed in accordance with the listing, or insulation materials recognized in the approved design, shall be used.

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

b. Insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: As currently written, the tub and fireplace assemblies are one item. I believe the intent is to provide a barrier for any one of those installations.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This as an editorial change that should not affect the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal removes redundant language.

Final Hearing Results

RED1-233-22 AS

RED1-235-22

Original Proposal

IECC: TABLE R402.5.1.1 (New)

Proponents: Robert Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2024 International Energy Conservation Code [RE Project]

Add new text as follows:

TABLE R402.5.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a].

Component	Air Barrier, Air Sealing Criteria	Insulation Installation Criteria
Knee wall	Knee walls shall have an air barrier between conditioned and unconditioned space	Insulation installed in a knee wall assembly shall be installed in accordance with Section R402.2.A3ir-permeable insulation shall be enclosed inside an air barrier assembly. -

Reason: Attic knee walls, in the field, are a unique assembly that have been overlooked by the IECC up until the 2024 IECC code development cycle when Section R402.2.3 Attic Knee Wall as well as a definition for knee wall, has been incorporated into the body of the code.

Now that knee walls are defined and Section R402.2.3 has been established it is important to incorporate Knee walls into Table R402.4.1.1 in the same way that other distinct assembly components have been incorporated.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Since Knee walls are now defined in the IECC and have been called out specifically and separately in Section R402.2.3 adding additional Air barrier, Air Sealing, and insulation installation requirements and clarification will not increase the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Conditioned spaces need air barriers on both sides of the wall

Final Hearing Results

RED1-235-22 AM

RED1-237-22

Original Proposal

IECC: R402.5.1.2

Proponents: Hendrik Shank, New York State/Department of State, New York State, Department of State (hendrikus.shank@dos.ny.gov); Daniel Carroll, New York State Department of State, Division of Building Standards & Codes (daniel.carroll@dos.ny.gov)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.5.1.2 Testing. The *building* or each *dwelling unit* in the buildingshall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 4.0 air changes per hour or 0.22 cfm/f^{2}t (1.1 L/s x m^2) of building or ~~dwelling unit enclosure area~~*dwelling unit enclosure area*. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, ASTM E1827 or ASTM E3158 and reported at a pressure differential of 0.2 inch water gauge (50 Pa). Where required by the *code official*, testing shall be conducted by an*approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the*building thermal envelope* have been sealed.

Exceptions:

1. When testing individual ~~dwelling units~~ *dwelling units*, an air leakage rate not exceeding 0.27 cubic feet per minute per square foot [1.35 L/s x m^2)] of the ~~dwelling unit enclosure area~~ *dwelling unit enclosure area*, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch ~~w.g.~~ water gauge (50 Pa), shall be permitted in all ~~climate zones~~ *climate zones* for:

   1.1 Attached single and multiple family building dwelling units.

   1.2 Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.

2. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.5.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.13 and R402.4.5, as applicable.
3. Where tested in accordance with R402.5.1.4, testing of each dwelling unit is not required.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Mechanical ventilation shall be provided in accordance with Section M1505 of the*International Residential Code* or Section 403.3.2 of the

International Mechanical Code, as applicable, or with other*approved* means of ventilation.

Reason: The intention of the editorial code change relating to water gauge is to keep the units consistent with other units in this code section and the units used in the fenestration air leakage provisions identified in Section R402.5.3 of the Draft 2024 IECC. The purpose of changing “dwelling unit enclosure area” to italic font is to inform the user that “dwelling unit enclosure area” is a defined term in Chapter 2.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change proposal is editorial so there is no cost impact associated with it.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Editorial modifications consistent with the intent of the applicable section and terminology.

Final Hearing Results

RED1-237-22 AS

RED1-243-22 Part I

Original Proposal

IECC: R402.5.4

Proponents: Theresa Weston, The Holt Weston Consultancy, ABAA (Air Barrier Association of America) (holtweston88@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

~~**R402.5.4**~~ **R402.1.6 Rooms containing fuel-burning appliances.** In Climate Zones 3 through 8, where open combustion air ducts provide combustion air to open combustion fuel-burning appliances, the appliances and combustion air opening shall be located outside the *building thermal envelope* or enclosed in a room that is isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.3, where the walls, floors and ceilings shall meet a minimum of the *basement wall R*-value requirement. The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through *conditioned space* to an *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. Fireplaces and stoves complying with Section R402.5.2 and Section R1006 of the International Residential Code.

Reason: This moves the section on "Rooms containing fuel-burning appliances" to a more appropriate place in the code. Currently, it is buried in the air leakage section, but contains more general requirements rather than only air leakage requirements.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal only reorganizes the code and makes no changes in requirements.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal moves the fuel-burning appliance section to a more appropriate section.

Final Hearing Results

RED1-243-22 Part I	AS

RED1-243-22 Part II

Original Proposal

IRCECC: N1102.5.4

Proponents: Theresa Weston, The Holt Weston Consultancy, ABAA (Air Barrier Association of America) (holtweston88@gmail.com)

2024 ENERGY Chapter11

Revise as follows:

~~N1102.5.4~~ N1102.1.6 Rooms containing fuel-burning appliances. In Climate Zones 3 through 8, where opencombustion airducts provide combustion air to open combustion fuel-burning appliances, the appliances and combustion air opening shall be located outside the *building thermal envelope* or enclosed in a room that is isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table N1102.1.3, where the walls, floors and ceilings shall meet a minimum of 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 N1103. The combustion air duct shall be insulated where it passes through *conditioned space* to 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. Fireplaces and stoves complying with Sections N1102.5.2 and R1006.

Reason: This moves the section on "Rooms containing fuel-burning appliances" to a more appropriate place in the code. Currently, it is buried in the air leakage section, but contains more general requirements rather than only air leakage requirements.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal only reorganizes the code and makes no changes in requirements.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Proposal moves the fuel-burning appliance section to a more appropriate section.

Final Hearing Results

RED1-243-22 Part II	AS

RED1-249-22

Original Proposal

IECC: SECTION R202, SECTION 202, SECTION R405, R405.1, R405.2, R405.3, R405.3.1, R405.3.2, R405.3.2.1, R405.3.2.2, R405.4, R405.4.1, R405.4.2, TABLE R405.4.2(1), R405.5.1

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

SECTION R202
GENERAL DEFINITIONS

Revise as follows:

PROPOSED DESIGN. A description of the proposed *dwelling unit* ~~*building*~~used to estimate annual energy use for determining compliance based on simulated building performance.

SECTION R405
SIMULATED BUILDING PERFORMANCE

Revise as follows:

R405.1 Scope. This section establishes criteria for compliance using simulated building performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water-heating energy only. Such analysis shall be limited to *dwelling units*. Spaces other than *dwelling units* in Group R-2, R-3, or R-4 buildings shall comply with Sections R402 through R404.

R405.2 Simulated performance compliance. Compliance based on simulated~~total~~ building performance requires that abuilding~~*proposed design*~~ ~~meets all of~~comply with the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total building thermal envelope UA, which is the sum of the U-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1, and 2, and 1.15 in Climate Zones 3 through 8 in accordance with Equation 4-2. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

(Equation 4-2)

$$\text{For Climate Zones 0-2: } UA_{\text{Proposed design}} \leq 1.08 \text{ x } UA_{\text{Prescriptive reference design}}$$

$$\text{For Climate Zones 3-8: } UA_{\text{Proposed design}} \leq 1.15\text{x } UA_{\text{Prescriptive reference design}}$$

3. For each dwelling unit ~~buildings~~ without a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 85 percent of the annual energy cost of the *standard reference design*. For each dwelling unit ~~buildings~~ with a fuel burning appliance for space heating or water heating, the annual energy cost of the dwelling unit ~~proposed design~~ that is less than or equal to 80 percent of the annual energy cost of the standard reference design. For each dwelling unit ~~s~~ with greater than 5,000 square feet (465 m^2) of living space floor area located above grade plane, the annual energy cost of the dwelling unit~~proposed design~~ shall be reduced by an additional 5 percent of annual energy cost of the *standard reference design*. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

   Exceptions:

   1. The energy use based on source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multipliers for all energy sources shall be obtained from ASHRAE Standard 105 (Tables K2, K4, or K8) or from another data source approved by the *code official*.
   2. The energy use based on site energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost for an all-electric dwelling unit ~~building~~ with on-site renewable energy installed.

R405.3 Documentation. Documentation of the software used for the proposed design, as-built dwelling unit, and the parameters for the *standard reference design*~~baseline *building*~~ shall be in accordance with Sections R405.3.1 through R405.3.2.2.

R405.3.1 Compliance software tools. Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the *code official.*

Revise as follows:

R405.3.2 Compliance report. Compliance software tools shall generate a report that documents that the *proposed design* and as-built *dwelling unit* complies with Section R405.2~~3~~. A compliance report on the *proposed design* shall be submitted with the application for the building permit. Upon completion of the building, a confirmed compliance report based on the confirmed condition of the building shall be submitted to the *c ode official* before a certificate of occupancy is issued. Compliance reports shall include information in accordance with Sections R405.3.2.1 and R405.3.2.2.

R405.3.2.1 Compliance report for permit application. A compliance report submitted with the application for building permit shall include the following:

1. Building street address, or other *building site* identification.
2. The name of the individual performing the analysis and generating the compliance report.
3. The name and version of the compliance software tool.
4. Documentation of all inputs entered into the software used to produce the results for the *standard reference design* and~~/or~~ the proposed design ~~rated home~~.
5. A certificate indicating that the *proposed design* complies with Section R405.2 ~~3~~. The certificate shall document the building components' energy specifications that are included in the calculation including: component-level insulation *R*-values or *U*-factors; duct system and building envelope air leakage testing assumptions; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation and service water-heating equipment to be installed. ~~If~~ Where on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
6. Where a site-specific report is not generated, the *proposed design* shall be based on the worst-case orientation and configuration of the rated dwelling unit ~~home~~.

R405.3.2.2 Compliance report for certificate of occupancy. A compliance report submitted for obtaining the certificate of occupancy shall include the following:

1. Building street address, or other *building site* identification.
2. Declaration of the simulated building performance path on the title page of the energy report and the title page of the building plans.
3. A statement, bearing the name of the individual performing the analysis and generating the report, indicating that the as-built building complies with Section R405.2 ~~3~~.
4. The name and version of the compliance software tool.
5. A site-specific energy analysis report that is in compliance with Section R405.4 ~~3~~ ,where all inputs for the *proposed design* have been replaced in the simulation with confirmed energy features of the as-built *dwelling unit*.
6. A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the as-built building ~~confirmed rated design of the built home~~ complies with Section R405. 2 ~~3~~. The certificate shall report the energy features that were confirmed to be in the building ~~home~~, including component-level insulation *R*-values or *U*-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation and service water-heating equipment installed.
7. When on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.

R405.4 Calculation procedure. Calculations ~~of the proposed design~~ shall be in accordance with Sections R405.4.1 and R405.4.2.

R405.4.1 General. Except as specified by this section, the *standard reference design*, ~~and~~ *proposed design*, and as-built *dwelling unit* shall be configured and analyzed using identical methods and techniques.

R405.4.2 Residence specifications. The *standard reference design*, ~~and~~ *proposed design*, and as-built *dwelling unit* shall be configured and analyzed as specified by Table R405.4.2(1). Table R405.4.2(1) shall include, by reference, all notes contained in Table R402.1.3.

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 4.0 air changes per hour. Climate Zones 3 , 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour.	The measured air leakage exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M where: B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air leakage exchange rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Heat recovery or energy recovery shall be modeled for mechanical ventilation where required by Section R403.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section R403.6.1.	The measured mechanical ventilation rate[b], Q, shall be in addition to the measured air leakage rate and shall be as proposed.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN	
Thermal distribution systems	Duct system leakage to outside: For duct systems serving > 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft2 (9.29 m2) of conditioned floor area. For duct systems serving ≤ 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).	Duct System Leakage to Outside: The measured total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate. **Exceptions:** 1. When duct system leakage to outside is tested in accordance ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered. 2. When total duct system leakage is measured without the air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.	

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, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design ~~home~~ without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design the following assumptions shall be made for both the proposed design and standard reference design.

Fuel Type: Same as the predominant heating fuel type

Rated Storage Volume: 40 Gallons

Draw Pattern: Medium

Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

AF $= A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and
where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the “hot water rectangle”) divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a proposed design with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the standard reference design.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the standard reference design shall be the same as proposed design.

R405.5.1 Minimum capabilities. Calculation procedures used to comply with this section shall be software tools capable of calculating the annual energy consumption of all building elements that differ between the *standard reference design* and the *proposed design* and shall include the following capabilities:

1. Computer generation of the *standard reference design* using only the input for the *proposed design.* The calculation procedure shall not allow the user to directly modify the building component characteristics of the *standard reference design.*
2. Calculation of whole-dwelling unit ~~building~~ (as a single *zone*) sizing for the heating and cooling equipment in the *standard reference design* residence in accordance with Section R403.7.
3. Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
4. Printed *code official* inspection checklist listing each of the *proposed design* component characteristics from Table R405.4.2(1) determined by the analysis to provide compliance, along with their respective performance ratings such as *R*-value, *U*-factor, SHGC, HSPF2, AFUE, SEER2 and UEF.

Reason: This public comment is submitted to accomplish the following:

1. Clarify that for Group R-2 buildings, simulations are performed on the dwelling unit, not the whole building. Common spaces, such as lobbies, stairwells, corridors and amenity spaces shall follow requirements in R401 through R404.
2. For Group R-2, rather than require repetitive modeling of dwelling units with identical features, specifies a list of unit types that must be simulated.
3. Makes more explicit the process prior to CO (i.e., proposed design MUST be updated with as-built information) and creates a footnote to clarify that assumptions for tested results may be used at Proposed Design for the sake of the permit application.
4. Corrected some incorrect section references
5. Updates references to SEER, EF and HSPF to more current ratings

Bibliography: None

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
N/A

Public Hearing Results

Committee Action **As Modified**

Committee Reason: clarifying edits but could not reach consensus on the proposed edits related to sampling and a new footnote clarifying that measured values should replace assumed values in the simulations prior to CO. The motion was therefore modified to remove the text introducing sampling and the new footnote.

Final Hearing Results

RED1-249-22 AM

RED1-250-22

Original Proposal

IECC: TABLE R405.2, TABLE R406.2; IECC: R402.2.10, R402.2.10.1, R402.2.10.2 (New), R402.2.11, R402.2.11.2 (New)

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR SIMULATED BUILDING PERFORMANCE

Portions of table not shown remain unchanged.

SECTION[a]	TITLE
Building Thermal Envelope	
R402.2.9	Basement walls
R402.2.9.1	Basement wall insulation installation
R402.2.10.1	Slab-on-grade floors floor insulation installation
R402.2.11.1	Crawl space wall insulation installations

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

Portions of table not shown remain unchanged.

SECTION[a]	TITLE
Building Thermal Envelope	
R402.2.9	Basement walls
R402.2.9.1	Basement wall insulation installation
R402.2.10.1	Slab-on-grade floors floor insulation installation
R402.2.11.1	Crawl space wall insulation installation

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

2024 International Energy Conservation Code [CE Project]

Revise as follows:

R402.2.10 Slab-on-grade floors. Slab-on-grade floors, in contact with the ground, with a floor surface within 24 inches (600 mm) above or below grade shall be insulated in accordance with either Section R402.2.10.1 or R402.2.10.2.

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

R402.2.10.1 Slab-on-grade floor insulation installation. For buildings complying with Section R401.2.1,~~Where installed~~, the slab edge continuous insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the vertical distance provided in Table R402.1.3 but need not exceed the footing depth in accordance with

Section R403.1.4 of the *International Residential Code*. ~~Alternatively, a proposed design for slab insulation R-value and installation shall comply with Table R402.1.2, Section R402.1.5, or Section R405.~~ Where a proposed design includes insulation extending away from the building, it shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall. ~~Where installed, full~~ Full slab insulation shall be continuous under the entire area of the slab-on-grade floor, except at structural column locations and service penetrations. Slab edge insulation required at the heated slab perimeter shall not be required to extend below the bottom of the heated slab and shall be continuous with the full slab insulation.

Add new text as follows:

R402.2.10.2 Alternative slab-on-grade insulation configurations.. For *buildings* complying with Sections R405 or R406, slab-on-grade insulation shall be installed in accordance with the *proposed design* or *rated design*. The proposed or rated design shall use an alternative insulation configuration and associated F-factor complying with Appendix A of ASHRAE 90.1 or, where adopted, Appendix RF of this code. Where used to comply with Section R401.2.1, the F-factor shall be equal to or less than the F-factor required by Table R402.1.2 for a heated or unheated slab, as applicable.

Revise as follows:

R402.2.11 Crawl space walls. Crawl space walls shall be insulated in accordance with one of the following: ~~Table R402.1.3.~~

Exception: Crawl space walls associated with a crawl space that is vented to the outdoors and the floor overhead is insulated in accordance with Table R402.1.3 and Section R402.2.8.

Add new text as follows:

R402.2.11.2 Alternative crawl space wall insulation configurations.. For *buildings* complying with Sections R405 or R406 crawl space wall insulation shall be installed in accordance with the *proposed design* or *rated design*. The proposed or rated design shall use an alternative insulation configuration and associated U-factor or C-factor complying with Appendix A of ASHRAE 90.1 or, where adopted, Appendix RF of this code. Where used to comply with Section R401.2.1, the U-factor or C-factor shall be equal to or less than the U-factor required by Table R402.1.2 for crawlspace walls.

Reason: Each of the sections proposed to be deleted from Tables R405.2 and R406.2 are prescriptive installation requirements that mandate a certain area of insulation be installed (under a full slab per footnote d to Table R402.1.3; top of the basement wall to 10 ft below grade or to the basement floor; crawlspace insulation from sill to base of foundation or to interior floor of crawlspace).

Mandating installation of specific areas - volumes - of insulation defeats the purpose of the performance paths, which are intended to permit the flexibility of trading some amount or area of insulation for other energy saving measures like additional insulation in some other area of the building.

There is no reason that an owner/designer/contractor should not be able to trade away 1/2 of the insulation on a basement wall. Ditto for underslab insulation and crawlspace wall insulation provided the any loss of energy efficiency is fully mitigated by other efficiency measures .

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

The proposal protects trade-off flexibility which permits owners to find the most cost effective approach to energy code compliance.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The Committee supported the modified proposal because it clarifies application of performance path requirements for slab and crawl space insulation.

Final Hearing Results	
RED1-250-22	AM

RED1-251-22

Original Proposal

IECC: SECTION R405, TABLE R405.4.2(1)

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

SECTION R405 SIMULATED BUILDING PERFORMANCE

Revise as follows:

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN	
Air exchange rate	For detached one-family dwellings, t~~T~~he air leakage rate at a pressure of 0.2 inch water gauge ~~w.g.~~ (50 Pa) shall be Climate Zones 0 through 2: 4.0~~5.0~~ air changes per hour. Climate Zones 3 , 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour. For detached one-family dwellings that are 1,500 ft^2 (139.4 m^2) or smaller and attached *dwelling units*, the air leakage rate at a pressure of 0.2 inch water gauge (50 Pa) shall be 0.27 cfm/ft^2 of the *dwelling unit enclosure area.*	The measured air leakage~~exchange~~ rate.[a]	
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M where: B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air leakage~~exchange~~ rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms. ~~The mechanical ventilation system type shall be the same as in the proposed design. Heat recovery or energy recovery shall be modeled for mechanical ventilation where required by Section R403.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section R403.6.1.~~	The measured mechanical ventilation rate[b], Q, shall be in addition to the measured air leakage rate ~~and shall be as proposed~~.	
Mechanical ventilation	The mechanical ventilation system type shall be the same as in the proposed design. Heat recovery or energy recovery shall be modeled for mechanical ventilation where required by Section R403.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section R403.6.1. Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (8.76 × B × M)/ef where: B and M are determined in accordance with the Air Exchange Rate row of this table. e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of B × M. *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	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, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. ~~Where required by the code official, testing shall be conducted by an approved party~~.Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design the following assumptions shall be made for both the proposed design and standard reference design.

   Fuel Type: Same as the predominant heating fuel type

   Rated Storage Volume: 40 Gallons

   Draw Pattern: Medium

   Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

$AF = A_S \times FA \times F$

where:

AF = Total glazing area

A_S = Standard reference design total glazing area
FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F= (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.

2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.

3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.

4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.

5. The basement or attic shall be counted as a story when it contains the water heater.

6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a proposed design with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the standard reference design.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the standard reference design shall be the same as proposed design.

Reason: Based on another public comment to add a 0.25 cfm50/ft2 metric for the air leakage threshold for attached units and smaller homes when using the Prescriptive Compliance option, this public comment adds those same metrics/thresholds to the Standard

Reference Design (SRD).

Additionally, given that air “exchange” rate is the combination of air “leakage” and mechanical ventilation, some revisions are made to phrasing to maintain that intent.

Also, the text related the ERV and HRVs in the SRD is better placed in the row called “Mechanical Ventilation” rather than “Air exchange rate”, so this PC proposes to move it.

Also, footnote a contains text redundant to R402.5.1.2, so is struck in this PC.

Finally, an Errata was submitted clarifying that the Committee previously voted to approve REPI-63, therefore the 5.0 ACH50 is revised to 4.0 ACH50, as approved previously by the Committee.

Bibliography: None

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

None

Public Hearing Results

Committee Action **As Modified**

Committee Reason: [The Committee voted in favor of the proposal which moves ventilation text into the mechanical ventilation row in Table R405.4.2(1) and adds the Prescriptive CFM50/ft2 air leakage values in the Standard Reference Design for the types of dwelling units that are permitted to use that metric. The modification at the Sub-Committee corrected the 0.25 to read 0.27, and the additional modification that was approved was editorial, to use air leakage phrasing consistent with action taken by the Consensus Committee on RED1-224.]

Final Hearing Results

RED1-251-22	AM

RED1-252-22

Original Proposal

IECC: TABLE R405.4.2(1); IRCECC: TABLE N1105.4.2(1)

Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	Solar reflectance~~absorptance~~ = 0.25~~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: as specified in Table R402.1.2, with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Roofs	Type: composition shingle on wood sheathing.	As proposed
	Gross area: same as proposed.	As proposed
	Solar reflectance~~absorptance~~ = 0.25~~0.75~~.	As proposed
	Emittance = 0.90.	As proposed
Attics	Type: vented with an aperture of 1 ft^2 per 300 ft^2 of 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 as specified in Table R402.1.2.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Vertical fenestration other than opaque doors	Total area[h] = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. (b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: 0.92 – (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 – (0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2:5.0 air changes per hour. Climate Zones 3 , 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M where: B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air exchange rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Heat recovery or energy recovery shall be modeled for mechanical ventilationwhere required by Section R403.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section R403.6.1.	The mechanical ventilation rate[b], Q, shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (8.76 × B × M)/ef where: B and M are determined in accordance with the Air Exchange Rate row of this table. e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate ofB × M. *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed
Internal gains	IGain, in units of Btu/day per dwelling unit, shall equal 17,900 + 23.8 ×*CFA* + 4,104 × N_{br} where: *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	Same as standard reference design.
Internal mass	Internal mass for furniture and contents: 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.3, located on the interior side of the walls.	As proposed
	For other walls, ceilings, floors, and interior walls: wood frame construction.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Heating systems[d, e, j, k]	For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC–Commercial Provisions. Capacity: sized in accordance with Section R403.7.	
	Fuel Type/Capacity: Same as proposed design	As proposed
	Product class: Same as proposed design	As proposed
	Efficiencies:	As proposed
	Heat pump: Complying with 10 CFR §430.32	As proposed
	Non-electric furnaces: Complying with 10 CFR §430.32	As proposed
	Non-electric boilers: Complying with 10 CFR §430.32	As proposed
Cooling systems[d, f, k]	As proposed. Capacity: sized in accordance with Section R403.7.	
	Fuel Type: Electric Capacity: Same as proposed design	As proposed
	Efficiencies: Complying with 10 CFR §430.32	As proposed
Service water heating[d, g, k]	As proposed. Use, in units of gal/day = 25.5 + (8.5 × N_{br}) where: N_{br} = number of bedrooms.	As proposed Use, in units of gal/day = 25.5 + (8.5 × N_{br}) × (1 − *HWDS*) where: N_{br} = number of bedrooms. *HWDS* = factor for the compactness of the hot water distribution system.

Compactness ratio[i] factor		HWDS
1 story	2 or more stories	
> 60%	> 30%	0
> 30% to ≤ 60%	> 15% to ≤ 30%	0.05
> 15% to ≤ 30%	> 7.5% to ≤ 15%	0.10
< 15%	< 7.5%	0.15

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	Fuel Type: Same as proposed design	As proposed
	Rated Storage Volume: Same as proposed design	As proposed
	Draw Pattern: Same as proposed design	As proposed
	Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32	As proposed
	Tank Temperature: 120° F (48.9° C)	Same as standard reference design
Thermal distribution systems	Duct location:	Duct location: as proposed.

Foundation Type	Slab on grade	Unconditioned crawl space	Basement or conditioned crawl space
Duct location (supply and return)	One-story building: 100% in unconditioned attic All other: 75% in unconditioned	attic and 25% inside conditioned space	One-story building: 100% in unconditioned crawlspace All other: 75% in unconditioned crawlspace and 25% inside conditioned space

5	i	d	ed space	
0 % i n s	d e c o n	i t i o n	50% unconditioned attic	
	Duct insulation: in accordance with Section R403.3.1.			Duct insulation: as proposed.

<table>
<tr><th>BUILDING COMPONENT</th><th>STANDARD REFERENCE DESIGN</th><th>PROPOSED DESIGN</th></tr>
<tr><td rowspan="2"></td><td>Duct system leakage to outside:
For duct systems serving > 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft2 (9.29 m2) of conditioned floor area.
For duct systems serving ≤ 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).</td><td>Duct System Leakage to Outside: The measure total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate.
Exceptions:
1. When duct system leakage to outside is tested in accordance ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered.
2. When total duct system leakage is measured without the air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.</td></tr>
<tr><td>For hydronic systems and ductless systems a thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies.</td><td>For hydronic systems and ductless systems, DSE shall be as specified in Table R405.4.2(2).</td></tr>
<tr><td>Thermostat</td><td>Type: Manual, cooling temperature setpoint = 75°F;
Heating temperature setpoint = 72°F.</td><td>Same as standard reference design.</td></tr>
<tr><td>Dehumidistat</td><td>Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None.
Where the proposed design utilizes a mechanical ventilation system with latent heat recovery:
Dehumidistat type: manual, setpoint = 60% relative humidity.
Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.</td><td>Same as standard reference design.</td></tr>
</table>

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design the following assumptions shall be made for both the proposed design and standard reference design.

Fuel Type: Same as the predominant heating fuel type

Rated Storage Volume: 40 Gallons

Draw Pattern: Medium

Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

AF $= A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and
where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.

2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.

3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.

4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.

5. The basement or attic shall be counted as a story when it contains the water heater.

6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a proposed design with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the standard reference design.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the standard reference design shall be the same as proposed design.

2024 ENERGY Chapter11

Revise as follows:

TABLE N1105.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table N1102.1.2.	As proposed
	Solar reflectanceabsorptance = 0.250.75.	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: as specified in Table N1102.1.2, with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	U-factor: as specified in Table N1102.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table N1102.1.2.	As proposed
Roofs	Type: composition shingle on wood sheathing.	As proposed
	Gross area: same as proposed.	As proposed
	Solar reflectance~~absorptance~~ = 0.25~~0.75~~.	As proposed
	Emittance = 0.90.	As proposed
Attics	Type: vented with an aperture of 1 ft^2 per 300 ft^2 of 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 as specified in Table N1102.1.2.	As proposed
Vertical fenestration other than opaque doors	Total area[h] = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. (b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table N1102.1.2.	As proposed
	SHGC: as specified in Table N1102.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: 0.92 – (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 – (0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: air changes per hour. Climate Zones 3, 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater thanB x M where:B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air exchange rate is ≥ 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms.The mechanical ventilation system type shall be the same as in the proposed design. Heat recovery or energy recovery shall be modeled assumed for mechanical ventilation where required by Section N1103.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section N1103.6.1..	The mechanical ventilation rate[b] ,Q, shall be in addition to the air leakage rate and shall be as proposed.

<table>
<tr><th>BUILDING COMPONENT</th><th>STANDARD REFERENCE DESIGN</th><th>PROPOSED DESIGN</th></tr>
<tr><td>Mechanical ventilation</td><td>Where mechanical ventilation is not specified in the proposed design: None
Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (8.76 x B x M)/ef
where:
e_f = the minimum fan efficacy, as specified in Table N1103.6.2, corresponding to the system type at a flow rate of B x M
CFA = conditioned floor area, ft^2.
N_{br} = number of bedrooms.</td><td>As proposed</td></tr>
<tr><td>Internal gains</td><td>IGain, in units of Btu/day per dwelling unit, shall equal $17,900 + 23.8 \times CFA + 4,104 \times N_{br}$
where:
CFA = conditioned floor area, ft^2.
N_{br} = number of bedrooms.</td><td>Same as standard reference design.</td></tr>
<tr><td>Internal mass</td><td>Internal mass for furniture and contents: 8 pounds per square foot of floor area.</td><td>Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.</td></tr>
<tr><td rowspan="3">Structural mass</td><td>For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.</td><td>As proposed</td></tr>
<tr><td>For masonry basement walls: as proposed, but with insulation as specified in Table N1102.1.3, located on the interior side of the walls.</td><td>As proposed</td></tr>
<tr><td>For other walls, ceilings, floors, and interior walls: wood frame construction.</td><td>As proposed</td></tr>
<tr><td rowspan="7">Heating systems[d, e, j, k]</td><td>For other than electric heating without a heat pump: as proposed.
Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC–Commercial Provisions.
Capacity: sized in accordance with Section N1103.7.</td><td>As proposed</td></tr>
<tr><td>Fuel Type/Capacity: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Product class: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Efficiencies:</td><td>As proposed</td></tr>
<tr><td>Heat pump: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td>Non-electric furnaces: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td>Non-electric boilers: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td rowspan="3">Cooling systems[d, f, k]</td><td>As proposed.
Capacity: sized in accordance with Section N1103.7.</td><td></td></tr>
<tr><td>Fuel Type: Electric
Capacity: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Efficiencies: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td>Service water heating[d, g, k]</td><td>As proposed.
Use, in units of gal/day = $25.5 + (8.5 \times N_{br})$
where: N_{br} = number of bedrooms.</td><td>As proposed
Use, in units of gal/day = $25.5 + (8.5 \times N_{br}) \times (1 - HWDS)$
where:
N_{br} = number of bedrooms.
$HWDS$ = factor for the compactness of the hot water distribution system.
<table>
<tr><th colspan="2">Compactness ratio[i] factor</th><th>HWDS</th></tr>
<tr><td>1 story</td><td>2 or more stories</td><td></td></tr>
<tr><td>> 60%</td><td>> 30%</td><td>0</td></tr>
<tr><td>> 30% to ≤ 60%</td><td>> 15% to ≤ 30%</td><td>0.05</td></tr>
<tr><td>> 15% to ≤ 30%</td><td>> 7.5% to ≤ 15%</td><td>0.10</td></tr>
<tr><td>< 15%</td><td>< 7.5%</td><td>0.15</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>BUILDING COMPONENT</th><th colspan="4">STANDARD REFERENCE DESIGN</th><th>PROPOSED DESIGN</th></tr>
<tr><td rowspan="5"></td><td colspan="4">Fuel Type: Same as proposed design</td><td>As proposed</td></tr>
<tr><td colspan="4">Rated Storage Volume: Same as proposed design</td><td>As proposed</td></tr>
<tr><td colspan="4">Draw Pattern: Same as proposed design</td><td>As proposed</td></tr>
<tr><td colspan="4">Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td colspan="4">Tank Temperature: 120° F (48.9° C)</td><td>Same as standard reference design</td></tr>
<tr><td rowspan="6">Thermal distribution systems</td><td colspan="4">Duct insulation: in accordance with Section N1103.3.2.</td><td>Duct insulation: as proposed</td></tr>
<tr><td colspan="4">Duct location:</td><td rowspan="3">Duct location: as proposed</td></tr>
<tr><td>Foundation type</td><td>Slab on grade</td><td>Unconditioned crawl space</td><td>Basement or conditioned crawl space</td></tr>
<tr><td>Duct location (supply and return)</td><td>One-story building:
100% in unconditioned attic

All other:
75% in unconditioned attic and 25% inside conditioned space</td><td>One-story building:
100% in unconditioned attic

All other:
75% in unconditioned attic and 25% inside conditioned space</td><td>50% inside conditioned space

50% unconditioned attic</td></tr>
<tr><td colspan="4">Duct system leakage to outside: For duct systems serving > 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft2 (9.29 m2) of conditioned floor area.
For duct systems serving ≤ 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).</td><td>Duct System Leakage to Outside: The measured total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate.
Exceptions:
1. When duct system leakage to outside is tested in accordance ANSI/RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered.
2. When total duct system leakage is measured without the air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2(9.29 m^2) of conditioned floor area.</td></tr>
<tr><td colspan="4">For hydronic systems and ductless systems athermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies.</td><td>For hydronic systems and ductless systems, DSE shall beas specified in Table N1105.4.2(2).</td></tr>
<tr><td>Thermostat</td><td colspan="4">Type: Manual, cooling temperature setpoint = 75°F;
Heating temperature setpoint = 72°F.</td><td>Same as standard reference design.</td></tr>
<tr><td>Dehumidistat</td><td colspan="4">Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None. Where the proposed design utilizes a mechanical ventilation system with latent heat recovery:
Dehumidistat type: manual, setpoint = 60% relative humidity.
Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.</td><td>Same as standard reference design.</td></tr>
</table>

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, °C = (°F – 32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design the following assumptions shall be made for both the proposed design and standard reference design.

Fuel Type: Same as the predominant heating fuel type

Rated Storage Volume: 40 Gallons

Draw Pattern: Medium

Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

AF = $A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and
where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the “hot water rectangle”) divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.

2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.

3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.

4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.

5. The basement or attic shall be counted as a story when it contains the water heater.

6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a proposed design with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the standard reference design.

k. For heating systems, cooling systems, or water heating systems not included in Table N1105.4.2(1), the standard reference design shall be the same as proposed design.

Reason: Within the IECC residential provisions and IRC Chapter 11 of the 1st Public Comment Draft, there are only two instances where "solar absorptance" is used. In contrast, there are multiple uses of "solar reflectance" in IECC Section R408.2.1.3 and IRC Section N1108.2.1.3. This comment changes those two instances of "solar absorptance," and the associated values, to make all uses consistent throughout the residential provisions. The intended result is less confusion in understanding roof radiative property requirements in different portions of the IECC and IRC.

CED1-197-22 proposes the same changes in the commercial provisions.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The changes proposed in this comment align language across sections of the code without making technical modifications. Therefore, there is no impact on cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Aligns terms with those used in the body of the residential code; also consistent with action take for the commercial code

Final Hearing Results

RED1-252-22	AS

RED1-253-22

Original Proposal

IECC: R407.2; IECC: TABLE C402.4 (New)

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R407.2 Tropical climate region. Compliance with this section requires the following:

1. Not more than one-half of the *occupied* space is air conditioned.
2. The *occupied* space is not heated.
3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for service water heating.
4. Glazing in *conditioned spaces* has a *solar heat gain coefficient* (SHGC) of less than or equal to 0.40, or has an overhang with a projection factor equal to or greater than 0.30.
5. Permanently installed lighting is in accordance with Section R404.
6. The ~~exterior roof surface complies with one of the options in Table C402.3 of the~~ ~~*International Energy Conservation Code–*~~ ~~Commercial Provisions or the~~ <u>exterior roof surface complies with one of the options in Table R407.1 or the</u> roof or ceiling has insulation with an *R-value* of R-15 or greater. Where attics are present, attics above the insulation are vented and attics below the insulation are unvented.
7. Roof surfaces have a slope of not less than $^1/_4$ unit vertical in 12 units horizontal (21-percent slope). The finished roof does not have water accumulation areas.
8. Operable fenestration provides a ventilation area of not less than 14 percent of the floor area in each room. Alternatively, equivalent ventilation is provided by a ventilation fan.
9. Bedrooms with *exterior walls* facing two different directions have operable fenestration on exterior walls facing two directions.
10. Interior doors to bedrooms are capable of being secured in the open position.
11. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom.

2024 International Energy Conservation Code [CE Project]

Add new text as follows:

<u>**TABLE R407.1 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS[a]**</u>

<u>Three-year-aged solar reflectance[b] of 0.55 and 3-year aged thermal emittance[c] of 0.75</u>
<u>Three-year-aged solar reflectance index[d] of 64</u>

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for either solar reflectance or thermal emittance shall be assigned both a 3-year-aged solar reflectance in accordance with Section C402.4.1 and a 3-year-aged thermal emittance of 0.90.

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Aged thermal emittance tested in accordance with ASTM C1371 or ASTM E408 or CRRC-S100.

d. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × f^{2}t × °F (12 W/m^{2} × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance.

Reason: Section R101.5 clearly requires that residential buildings comply with the IECC-R rather than the IECC- commercial provisions. The original proponent of this section should do the work of incorporating the actual requirements for the benefit of the code user instead of referencing a code that may not be adopted.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
There will be no cost impact if the original proponent does the work of incorporating the provisions they wish to see applied.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Removes the reference to the IECC-C and brings in the table.

Final Hearing Results

RED1-253-22	AM

RED1-254-22

Original Proposal

IECC: TABLE R408.2, R408.2.1.2, TABLE R408.2.1.2

Proponents: Dynice Broadnax, ICC, SELF (cdpsadynice@iccsafe.org); Jennifer Hatfield, J. Hatfield & Associates, Fenestration & Glazing Industry Alliance (formerly AAMA) (jen@jhatfieldandassociates.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4 except Marine	Climate Zone 4 Marine	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total UA	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total UA	0	1	1	2	2	3	3	3	3
R408.2.1.1(3)	>7.5% reduction in total UA	0	1	2	2	2	3	3	4	4
~~R408.2.1.2(1)~~	~~0.22 U-factor windows~~	~~1~~	~~2~~	~~2~~	~~3~~	~~3~~	~~4~~	~~4~~	~~4~~	~~5~~
R408.2.1.2(2)	U-factor and SHGC for~~windows~~ vertical fenestration per Table R408.2.1	1	1	1	~~0~~ 2	~~0~~ 1	~~0~~ 1	~~0~~ 1	1	2
R408.2.1.3	Cool Roof	TBD	TBD	TBD	TBD	TBD	0	0	0	0
R408.2.2(1)	High performance cooling system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(2)	High performance cooling system option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(3)	High performance gas furnace option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(4)	High performance gas furnace option 2	0	0	0	0	0	TBD	TBD	TBD	0
R408.2.2(5)	High performance gas furnace and cooling system option 2	TBD	TBD	TBD	TBD	TBD	0	0	0	TBD
R408.2.2(6)	High performance gas furnace and heat pump system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(7)	High performance gas furnace option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(8)	High performance heat pump system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(9)	High performance heat pump system option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(10)	High performance heat pump system option 3	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(11)	Ground source heat pump	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(12)	Ductless - Single zone	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(13)	Ductless - Multizone (Non-ducted indoor unit)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(14)	Ductless - Multizone (Ducted or Mixed)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(1)	Gas-fired storage water heaters	7	6	5	3	3	2	2	3	1
R408.2.3(2)	Gas-fired instantaneous water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(3)	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

R408.2.3(4)	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(5)	Solar hot water heating system	4	5	6	6	6	6	5	5	4
R408.2.3(6)	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.4(1)	More efficient distribution system	4	6	7	10	10	12	13	15	16
R408.2.4(2)	100% of ducts in conditioned space	4	6	8	12	12	15	17	19	20
R408.2.4(3)	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.5(1)	2 ACH50 air leakage rate with ERV or HRV installed	1	4	5	10	10	13	15	8	8
R408.2.5(2)	2 ACH50 air leakage rate with balanced ventilation	2	3	2	4	4	5	6	6	6
R408.2.5(3)	1.5 ACH50 air leakage rated with ERV or HRV installed	2	4	6	12	12	15	18	11	11
R408.2.5(4)	1 ACH50 air leakage rate with ERV or HRV installed	2	5	6	14	14	17	21	14	14
R408.2.6	Energy efficient appliances	9	8	8	7	7	5	5	5	4
R408.2.7	Renewable energy measures	17	16	17	11	11	9	8	7	4
R408.2.9	Demand responsive thermostat	1	1	1	1	1	1	1	1	1

R408.2.1.2 Improved fenestration. The area weighted average U-factor and SHGC of all vertical~~Vertical~~ fenestration ~~shall meet one of the following:~~shall be equal to or less than values specified in Table R408.2.1.2

~~1. U-factor equal to or less than 0.22~~

~~2. U-factor and SHGC shall be equal to or less than that values specified in Table R408.2.1.2~~

TABLE R408.2.1.2 IMPROVED FENESTRATION

Climate Zone	Fenestration U-factor	Fenestration SHGC
0	0.32	0.23
1	0.32	0.23
2	0.30	0.23
3	0.250.28	0.250.23
4 except 4 Marine	NA 0.25	NA 0.40
5 and 4 Marine	NA 0.25	NA NR
6	NA 0.25	NA NR
7 and 8	0.25	NA NR

Reason: A number of changes are necessary in section R408 for fenestration in order to make the section more usable, improve the accuracy of credits allocated, and improve clarity and consistency.

- Climate Zone 4 has been modified to exclude Zone 4 Marine and Zone 4C changed to 4 Marine on order to make it consistent with the prescriptive tables.
- The 0.22 U-Factor measure has been removed. This is done because the associated points are only accurate with a 15% windows to floor area ratio that was used for the analysis. There are already multiple options to change the thermal performance of the building envelope which is a more accurate alternative that accounts for window area and better represents the savings associated with improving the building envelope.
- Section R408.2.1.2 has been rewritten for clarity and to insure that window U-factor and SHGC weighted averages are permitted to

achieve the Improved Fenestration target values.

- Table R408.2.1.2 has been modified to include values for climate zones 4-6. It is believed that the overall energy savings is sufficient to earn 1 or 2 credits (needs to be verified by PNNL).
- NAs have been changed to NRs to be consistent with the terminology in the prescriptive tables.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No change in cost.

Public Hearing Results

Committee Action	**As Modified**

Committee Reason: A number of changes are necessary in section R408 for fenestration in order to make the section more usable, improve the accuracy of credits allocated, and improve clarity and consistency.

Final Hearing Results

RED1-254-22	AM

RED1-255-22

Original Proposal

IECC: R408.2.1.3, TABLE R408.2; IRCECC: N1108.2.1.3, TABLE N1108.2

Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R408.2.1.3 Roof reflectance. Roofs shall comply with one or more of the options in Table R408.2.1.3.The following roofs and portions of roofs are excluded from the roof reflectance credit: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 or landscaped roofs.1.4. Above-roof decks or walkways.1.5. Skylights.1.6. HVAC systems and components, and other opaque objects mounted above the roof.2. Portions of the roof shaded during the peak sun angle on the summer solstice by permanent features of the building or by permanent features of adjacent buildings.3. Portions of roofs that are ballasted with a minimum stone ballast of 17 pounds per square foot (74 kg/m2) or 23 psf (117 kg/m2) pavers.4. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this section.

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 4C	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total UA	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total UA	0	1	1	2	2	3	3	3	3
R408.2.1.1(3)	>7.5% reduction in total UA	0	1	2	2	2	3	3	4	4
R408.2.1.2(1)	0.22 U-factor windows	1	2	2	3	3	4	4	4	5
R408.2.1.2(2)	U-factor and SHGC for windows per Table R408.2.1	1	1	1	0	0	0	0	1	2
R408.2.1.3	Cool RoofRoof reflectance (roof is part of the *building thermal envelope* and directly above cooled, conditioned space)	TBD	TBD	TBD	TBD	TBD	0	0	0	0
R408.2.1.3	Roof reflectance (roof is above an unconditioned space that contains a duct system)	TBD	TBD	TBD	TBD	TBD	0	0	0	0
R408.2.2(1)	High performance cooling system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(2)	High performance cooling system option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(3)	High performance gas furnace option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(4)	High performance gas furnace option 2	0	0	0	0	0	TBD	TBD	TBD	0
R408.2.2(5)	High performance gas furnace and cooling system option 2	TBD	TBD	TBD	TBD	TBD	0	0	0	TBD
R408.2.2(6)	High performance gas furnace and heat pump system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(7)	High performance gas furnace option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(8)	High performance heat pump system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(9)	High performance heat pump system option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(10)	High performance heat pump system option 3	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

R408.2.2(11)	Ground source heat pump	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(12)	Ductless - Single zone	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(13)	Ductless - Multizone (Non-ducted indoor unit)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(14)	Ductless - Multizone (Ducted or Mixed)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(1)	Gas-fired storage water heaters	7	6	5	3	3	2	2	3	1
R408.2.3(2)	Gas-fired instantaneous water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(3)	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(4)	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(5)	Solar hot water heating system	4	5	6	6	6	6	5	5	4
R408.2.3(6)	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.4(1)	More efficient distribution system	4	6	7	10	10	12	13	15	16
R408.2.4(2)	100% of ducts in conditioned space	4	6	8	12	12	15	17	19	20
R408.2.4(3)	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.5(1)	2 ACH50 air leakage rate with ERV or HRV installed	1	4	5	10	10	13	15	8	8
R408.2.5(2)	2 ACH50 air leakage rate with balanced ventilation	2	3	2	4	4	5	6	6	6
R408.2.5(3)	1.5 ACH50 air leakage rated with ERV or HRV installed	2	4	6	12	12	15	18	11	11
R408.2.5(4)	1 ACH50 air leakage rate with ERV or HRV installed	2	5	6	14	14	17	21	14	14
R408.2.6	Energy efficient appliances	9	8	8	7	7	5	5	5	4
R408.2.7	Renewable energy measures	17	16	17	11	11	9	8	7	4
R408.2.9	Demand responsive thermostat	1	1	1	1	1	1	1	1	1

2024 ENERGY Chapter11

Revise as follows:

N1108.2.1.3 Roof reflectance. Roofs shall comply with one or more of the options in Table N1108.2.1.3.The following roofs and portions of roofs are excluded from the roof reflectance credit: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 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 of this section.

TABLE N1108.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 4C	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8		
N1108.2.1.1(1)	≥2.5% Reduction in total UA	0	0	0	1	1	1	1	1	1
N1108.2.1.1(2)	≥5% reduction in total UA	0	1	1	2	2	3	3	3	3
N1108.2.1.1(3)	>7.5% reduction in total UA	0	1	2	2	2	3	3	4	4
N1108.2.1.2(1)	0.22 U-factor windows	1	2	2	3	3	4	4	4	5

N1108.2.1.2(2)	U-factor and SHGC for windows per Table R408.2.1	1	1	1	0	0	0	0	1	2
N1108.2.1.3	~~Cool Roof~~ Roof reflectance (roof is part of the *building thermal envelope* and directly above cooled, conditioned space)	TBD	TBD	TBD	TBD	TBD	0	0	0	0
N1108.2.1.3	Roof reflectance (roof is above an unconditioned space that contains a duct system)	TBD	TBD	TBD	TBD	TBD	0	0	0	0
N1108.2.2(1)	High performance cooling system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.2(2)	High performance cooling system option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.2(3)	High performance gas furnace option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.2(4)	High performance gas furnace and cooling system option 1	0	0	0	0	0	TBD	TBD	TBD	0
N1108.2.2(5)	High performance gas furnace and cooling system option 2	TBD	TBD	TBD	TBD	TBD	0	0	0	TBD
N1108.2.2(6)	High performance gas furnace and heat pump system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.2(7)	High performance gas furnace option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.2(8)	High performance heat pump system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.2(9)	High performance heat pump system option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.2(10)	High performance heat pump system option 3	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.2(11)	Ground source heat pump	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.2(12)	Ductless - Single zone	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.2(13)	Ductless - Multizone (Non-ducted indoor unit)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.2(14)	Ductless - Multizone (Ducted or Mixed)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.3(1)	Gas-fired storage water heaters	7	6	5	3	3	2	2	3	1
N1108.2.3(2)	Gas-fired instantaneous water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.3(3)	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.3(4)	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
N1108.2.3(5)	Solar hot water heating system	4	5	6	6	6	6	5	5	4
N1108.2.3(6)	Compact hot water distribution	2	2	2	2	2	2	2	2	2
N1108.2.4(1)	More efficient distribution system	4	6	7	10	10	12	13	15	16
N1108.2.4(2)	100% of ducts in conditioned space	4	6	8	12	12	15	17	19	20
N1108.2.4(3)	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
N1108.2.5(1)	2 ACH50 air leakage rate with ERV or HRV installed	1	4	5	10	10	13	15	8	8
N1108.2.5(2)	2 ACH50 air leakage rate with balanced ventilation	2	3	2	4	4	5	6	6	6
N1108.2.5(3)	1.5 ACH50 air leakage rated with ERV or HRV installed	2	4	6	12	12	15	18	11	11
N1108.2.5(4)	1 ACH50 air leakage rate with ERV or HRV installed	2	5	6	14	14	17	21	14	14
N1108.2.6	Energy efficient appliances	9	8	8	7	7	5	5	5	4
N1108.2.7	Renewable energy measures	17	16	17	11	11	9	8	7	4
N1108.2.9	Demand reponsive thermostat	1	1	1	1	1	1	1	1	1

Reason: Placing "cool roofs" in the additional efficiency requirements section permits design professionals to utilize reflective roofs to achieve an energy efficiency improvement when appropriate based on project specifics. However, as presently configured, selection of the cool roof credit may allow fulfillment of credit requirements without the intended improvement in energy efficiency. This comment modifies this section to ensure that, when a cool roof is selected, it can be expected to improve energy efficiency.

R408.2.1.3 (N1108.2.1.3). Under certain circumstances, installation of a reflective roof will not yield an improvement in energy efficiency. These limitations are already present in the IECC commercial provisions (C402.4 of the 1st Public Comment Draft). This comment incorporates those existing limits into the residential provisions. Doing so will prevent someone from asserting energy efficiency improvement via installation of a reflective roof when, for example, the roof is located beneath a photovoltaic array.

Table R408.2 (N1108.2). Replace the existing "cool roof" row in the table with two rows that recognize that energy efficiency improvement from a reflective roof is contingent on other conditions. One row acknowledges that energy efficiency gains may be available in certain climate zones when a reflective roof is part of the *building thermal envelope* and is above cooled, conditioned space. The other row recognizes the potential energy efficiency benefit in certain climate zones when a reflective roof is installed above an unconditioned space that contains ducts that are insufficiently insulated. By establishing separate rows in the table that recognize the interdependency of reflective roofing and other building elements, this comment supports analysis that assigns appropriate credits based on building construction details.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This comment clarifies the situations in which a reflective roof may offer energy efficiency benefits. This comment is not expected to affect cost of construction because it only adds guidance to ensure selection of an additional energy efficiency credit that saves energy.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: improves the accuracy of this credit.

Final Hearing Results

RED1-255-22 AM

RED1-256-22

Original Proposal

IECC: R408.2.1.3; IRCECC: N1108.2.1.3

Proponents: Glen Clapper, National Roofing Contractors Association, National Roofing Contractors Association (gclapper@nrca.net)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R408.2.1.3 Roof reflectance. Roofs in Climate Zones 0-4 and 4C shall comply with one or more of the options in Table R408.2.1.3.

2024 ENERGY Chapter11

Revise as follows:

N1108.2.1.3 Roof reflectance. Roofs in Climate Zone 0-4 and 4C shall comply with one or more of the options in Table N1108.2.1.3.

Reason: This public comment code change proposal further clarifies that the roof reflectance criteria options are only required in these specific climate zones based upon the "TBD" credits in Table R408.2 (N1108.2).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This public comment code change proposal will neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Clarified the application of the provision.

Final Hearing Results

RED1-256-22	AS

RED1-257-22

Original Proposal

IECC: TABLE R408.2.1.3, R408.2.1.3.1; IRCECC: TABLE N1108.2.1.3, N1108.2.1.3.1; IECC: ASTM Chapter 06 (New)
Proponents: Aaron Phillips, Asphalt Roofing Manufacturers Association, Asphalt Roofing Manufacturers Association (aphillips@asphaltroofing.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R408.2.1.3 MINIMUM ROOF REFLECTANCE[a]

ROOF SLOPE	THREE-YEAR AGED SOLAR REFLECTANCE INDEX[b]
Low-slope	75[b, c]
Steep-slope	16

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for solar reflectance shall be assigned a 3-year-aged solar reflectance in accordance with Section R408.2.1.3.1.

b. ~~Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100~~.

b. ~~c.~~ Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × ft^2 × °F (12 W/m^2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectancetested in accordance withASTM C1549, ASTM E903, ASTM E1918, or CRRC S100and thermal emittance tested in accordance with ASTM C1371, ASTM E408, or CRRC S100.

R408.2.1.3.1 Aged solar reflectance. Where an aged solar reflectance ~~required by Section R402.6~~ is not available, it shall be determined in accordance with Equation 4-4

(Equation 4-4)

$$R_{aged} = [0.2+0.7(R_{initial}-0.2)]$$

R_{aged} = The aged solar reflectance
$R_{initial}$ = The initial solar reflectance determined in accordance withASTM C1549, ASTM E903, ASTM E1918, orCRRC-S100

2024 ENERGY Chapter11

Revise as follows:

TABLE N1108.2.1.3 MINIMUM ROOF REFLECTANCE[a]

ROOF SLOPE	THREE-YEAR AGED SOLAR REFLECTANCE INDEX[b]
Low-slope	75[b,c]
Steep-slope	16

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for solar reflectance shall be assigned a 3-year aged solar reflectance in accordance with Section N1108.2.1.3.1.

b. ~~Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100~~.

b. ~~c.~~ Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h x ft^2 x ºF (12 W/m^2 x K). Calculation of aged SRI shall be based on aged tested values of ~~Aged~~ solar reflectance tested in accordance with ASTM C1549, ASTM E903 , ~~or~~ ASTM E1918 or CRRC-S100 and thermal emittance tested in accordance with ASTM C1371, ASTM E408, or CRRC S100.

N1108.2.1.3.1 Aged solar reflectance. Where an aged solar reflectance ~~required by Section N1102.6~~ is not available, it shall be determined in accordance with Equation 11-8.

(Equation 11-8)

$$R_{aged} = [0.2+0.7(R_{initial}-0.2)]$$

R_{aged} = The aged solar reflectance
$R_{initial}$ = The initial solar reflectance determined in accordance with ASTM C1549, ASTM E903, ASTM E1918, or CRRC-S100

2024 International Energy Conservation Code [RE Project]

Add new standard(s) as follows:

ASTM

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

C1371-15(2022)	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
E408-13(2019)	Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques

Reason: This comment cleans up the roof reflectance provisions in Section R408 and Section N1108. Modifications are summarized as follows:

- Remove footnote b and place the necessary information into the final footnote, which is re-identified from "c" to "b".
- Delete footnote references "b" and "c" in the second row of Tables R408.2.1.3 and N1108.2.1.3.
- Add additional acceptable test methods C1371 and E408 for thermal emittance in the final footnote of Tables R408.2.1.3 and N1108.2.1.3. This coordinates with options present in the Commercial 1st Public Comment Draft.
- Align content of the final footnote of Table N1108.2.1.3 with the content of the Table R408.2.1.3 footnote. For some reason, these do not match in the 1st Public Comment Draft.
- Add alternative solar reflectance test methods in the "$R_{initial}$" term description to coordinate with options already offered in footnotes to the Tables.
- Remove from R408.2.1.3.1 the reference to section R402.6, which is no longer accurate.
- Remove from N1108.2.1.3.1 the reference to section N1102.6, which is no longer accurate.
- Add ASTM C1371 and ASTM E408 as new standards within Chapter 6 of the residential provisions. They are already present in Chapter 6 of the commercial provisions.
- To coordinate with this comment, add ASTM C1371, ASTM C1549, ASTM E408, ASTM E903, ASTM E1918, and ASTM E1980 to Chapter 44 of the IRC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This comment primarily makes improvements for clarity, which should have no impact on cost of construction. The addition of more options for measuring radiative properties provides greater flexibility but is not expected to lead to a change in cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Clarifies footnotes and aligns IECC-R provision with IRC Ch11 provision.

Final Hearing Results

RED1-257-22	AS

RED1-260-22

Original Proposal

IECC: R503.1.1

Proponents: Hendrik Shank, New York State/Department of State, New York State, Department of State (hendrikus.shank@dos.ny.gov); Daniel Carroll, New York State Department of State, Division of Building Standards & Codes (daniel.carroll@dos.ny.gov)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R503.1.1 Building thermal envelope. Alterations of existing building thermal envelope assemblies shall comply with this section. New Building building thermal envelope assemblies that are part of the *alteration* shall comply with Section R402. In no case shall the R-value of insulation be reduced or the U-factor of a building thermal envelope assembly be increased as part of a building thermal envelope alteration.

Exception: The following alterations shall not be required to comply with the requirements for new construction provided that the energy use of the ~~building~~*building* is not increased:

1. Storm windows installed over existing fenestration.
2. ~~Roof recover~~ *Roof recover*.
3. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided that the code does not require the glazing or fenestration assembly to be replaced.
4. An existing building undergoing alterations that is demonstrated to be in compliance with Section R405 or Section R406

Reason: The purpose of this code change proposal is to change the title of the code section from “building envelope” to the defined term in Chapter 2, “building thermal envelope”, and to italicize the defined terms “building” and “roof recover” in the same code section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change proposal is editorial so there is no cost impact associated with it.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: Editorial modification to italicize terms where the use is consistent with definitions.

Final Hearing Results

RED1-260-22	AS

RED1-261-22

Original Proposal

IECC: APPENDIX RF, RF 101 (New), RF101

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [RE Project]

APPENDIX RF
ALTERNATIVE BUILDING THERMAL ENVELOPE INSULATION R-VALUE OPTIONS

Add new text as follows:

RF 101 GENERAL. \ **RF101.1 General.** This appendix shall be used as a basis to determine alternative building assembly and insulation component R-value solutions that comply with the maximum U-factors and F-factors in Table R402.1.2 of this standard. Alternative building assembly insulation solutions determined in accordance with this appendix also shall comply with the requirements of Section R702.7 of the *International Residential Code*.

Revise as follows:

~~RF101~~ RF102
ABOVE-GRADE WALL ASSEMBLIES

Reason: Appendix RF is missing a general section establishing the scope and purpose of the appendix and also related general requirements important to proper application of the appendix in coordination with the IECC standard and also related IRC building code provisions, such as R702.7 for water vapor control (which may constrain appropriate insulation solutions used to comply with the IECC or vice versa).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The added general section does not change requirements in Appendix RF and clarifies how to properly apply the requirements of the Appendix in coordination with the IECC provisions and the building code. This will not impact cost of construction but will help ensure it is compliant with the intended application of Appendix RF.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal adds a general section which is consistent with other appendices in the code.

Final Hearing Results

RED1-261-22	AS

RED1-263-22

Original Proposal

IECC: SECTION 202 (New), TABLE R408.2, R408.2.10 (New), R502.2.5, R503.1.5, R506.1
Proponents: Sean Denniston, New Buildings Institute, New Buildings Institute (sean@newbuildings.org)

2024 International Energy Conservation Code [RE Project]

Add new definition as follows:

SUBSTANTIAL IMPROVEMENT. Any repair, reconstruction, rehabilitation, alteration, addition or other improvement of a building or structure, the cost of which equals or is more than 50 percent of the market value of the structure before the improvement. Where the structure has sustained substantial damage, as defined in the International Building Code, any repairs are considered substantial improvement regardless of the actual repair work performed. Substantial improvement does not include the following:
1. Improvement of a building required to correct health, sanitary or safety code violations ordered by the building official.
2. Alteration of a historic building where the alteration will not affect the designation as a historic building.

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 4C	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.1.1(1)	≥2.5% Reduction in total UA	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total UA	0	1	1	2	2	3	3	3	3
R408.2.1.1(3)	>7.5% reduction in total UA	0	1	2	2	2	3	3	4	4
R408.2.1.2(1)	0.22 U-factor windows	1	2	2	3	3	4	4	4	5
R408.2.1.2(2)	U-factor and SHGC for windows per Table R408.2.1	1	1	1	0	0	0	0	1	2
R408.2.1.3	Cool Roof	TBD	TBD	TBD	TBD	TBD	0	0	0	0
R408.2.2(1)	High performance cooling system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(2)	High performance cooling system option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(3)	High performance gas furnace option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(4)	High performance gas furnace option 2	0	0	0	0	0	TBD	TBD	TBD	0
R408.2.2(5)	High performance gas furnace and cooling system option 2	TBD	TBD	TBD	TBD	TBD	0	0	0	TBD
R408.2.2(6)	High performance gas furnace and heat pump system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(7)	High performance gas furnace option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(8)	High performance heat pump system option 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(9)	High performance heat pump system option 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(10)	High performance heat pump system option 3	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(11)	Ground source heat pump	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(12)	Ductless - Single zone	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

R408.2.2(13)	Ductless - Multizone (Non-ducted indoor unit)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(14)	Ductless - Multizone (Ducted or Mixed)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(1)	Gas-fired storage water heaters	7	6	5	3	3	2	2	3	1
R408.2.3(2)	Gas-fired instantaneous water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(3)	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(4)	Electric water heaters	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.3(5)	Solar hot water heating system	4	5	6	6	6	6	5	5	4
R408.2.3(6)	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.4(1)	More efficient distribution system	4	6	7	10	10	12	13	15	16
R408.2.4(2)	100% of ducts in conditioned space	4	6	8	12	12	15	17	19	20
R408.2.4(3)	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.5(1)	2 ACH50 air leakage rate with ERV or HRV installed	1	4	5	10	10	13	15	8	8
R408.2.5(2)	2 ACH50 air leakage rate with balanced ventilation	2	3	2	4	4	5	6	6	6
R408.2.5(3)	1.5 ACH50 air leakage rated with ERV or HRV installed	2	4	6	12	12	15	18	11	11
R408.2.5(4)	1 ACH50 air leakage rate with ERV or HRV installed	2	5	6	14	14	17	21	14	14
R408.2.6	Energy efficient appliances	9	8	8	7	7	5	5	5	4
R408.2.7	Renewable energy measures	17	16	17	11	11	9	8	7	4
R408.2.9	Demand responsive thermostat	1	1	1	1	1	1	1	1	1
R408.2.10	Higher efficacy lighting	1	1	1	1	1	1	1	1	1

Add new text as follows:

R408.2.10 Higher efficacy lighting. All spaces shall be provided with hard wired lighting with a lamp efficacy of 90 lm/W or a luminaire efficacy of 55 lm/W.

Exception: Closets and other storage spaces.

Revise as follows:

R502.2.5 Additional Efficiency credit requirements for additions~~Packages~~. *Additions* shall ~~comply with Section R506~~comply with sufficient measures from Table R408.2 to achieve not less than 5 credits. *Alterations* to the existing building that are not part of the *addition*, but permitted with the *addition*, shall be permitted to be used to achieve this requirement.

Exceptions:

1. *Additions* that increase the building's total conditioned floor area by less than 25 percent.
2. *Additions* that do not include the addition or replacement of equipment covered in Sections R403.5 or R403.7.
3. Additions that do not ~~contain~~ increase conditioned space.
4. Where the *addition* alone or the existing building and *addition* together comply with Section R405 or R406.

R503.1.5 Additional Efficiency credit requirements for substantial improvements~~Packages~~. ~~Alterations shall comply with Section R506 where the alteration contains replacement of two or more of the following:~~ *Substantial improvements* shall comply with sufficient measures from Table R408.2 to achieve not less than 3 credits.

1. ~~HVAC unitary systems or HVAC central heating or cooling equipment serving the *work area* of the *alteration*.~~
2. ~~Water heating equipment serving the *work area* of the *alteration*.~~
3. ~~50 percent or more of the lighting fixtures in the *work area* of the *alteration*.~~
4. ~~50 percent or more of the area of interior surfaces of the thermal envelope in the *work area* of the *alteration*.~~
5. ~~50 percent or more the area of the building's *exterior wall envelope*.~~

Exceptions:

1. *Alterations* that are permitted with an *addition* complying with Section ~~R502.3.5~~ R502.2.5.
2. *Alterations* that comply with Section R405 or R406.
3. *Substantial improvements* that do not include the addition or replacement of equipment covered in either Section R403.5 or Section R403.7.

~~**R506.1 General.** Where required in Section R502 or R503, the building shall comply with one or more additional efficiency package options in accordance with the following:~~

1. ~~Enhanced envelope performance in accordance with Section R408.2.1.~~
2. ~~More efficient HVAC equipment performance in accordance with Section R408.2.2.~~
3. ~~Reduced energy use in service water-heating in accordance with Section R408.2.3.~~
4. ~~More efficient duct thermal distribution system in accordance with Section R408.2.4.~~
5. ~~Improved air sealing and efficient ventilation system in accordance with Section R408.2.5.~~

Reason: This public comment does two things: it correlates the language with changes that were approved for Section R408 and it clarifies the language.

Alignment

The approved language in R503.1.5 was constructed to work with the 2021 version of Section R408, but Section R408 was ultimately modified for the public comment draft in ways that made it incompatible with this language. This public comment adapts the language to make it compatible with the new credit approach in R408. Since there are no more packages and R408 incorporates a target table, the new Section R506 is not necessary and has been struck. The additions and alterations sections just reference that table directly.

- **Target Setting:** The public comment sets the targets at 5 credits (about 50% of the target for new buildings) for subject additions and 1 credit for subject alterations. The new table approach is more flexible but provides less credit for existing systems that meet the "substantial alteration" definition.
- **Additional Credit Option:** The credit table has no credit options for lighting. Since the definition of "substantial alteration" includes alterations to the lighting, the lack of a lighting option is problematic. Therefore, this PC adds an additional credit option for lighting that sets an efficacy requirement higher than the requirements in the main body of the code. It also requires that spaces have hard-wired lighting that meets the requirement to ensure that there are actually savings.

Language clarifications

During the committee hearing process for this language and related language in the commercial section, this new code section received substantial support, but there were some concerns, particularly the clarity of the language, the alteration threshold for the requirement and the compliance criteria.

- **Clarity of the Language:** The original language was structured so that only "substantial" alterations would be subject to the requirements. This was done by creating an exception that effectively defined an alteration that was not substantial and exempted those alterations. During the committee process, concerns were raised about how this was a confusing way to structure the requirement even if the language itself was reasonably clear. In order to increase clarity, the language was reconfigured so that the threshold would not be defined through the exception. This public comment defines a new term: "substantial energy alteration" and only makes this specific kind of alteration subject to the requirements. The definition of the term is largely the same as the exception, except expressed in terms of what it is instead of what it isn't. This is clearer since alterations that are not substantial energy alterations will not even need to look at the section. This term was chosen because it follows an approach to substantial alterations that is already in the code. The International Existing Building Code (IEBC) has a definition for "substantial structural alteration" that sets a threshold for alterations to the structure that are considered substantial enough for special requirements. This definition does the same thing, it creates a threshold for alterations to the energy systems that are substantial enough for special requirements. This definition is mirrored in a public comment for the commercial section.

- **Threshold:** The other concern raised was that the original language defined the substantial alteration as one that impact more that 50% of the systems serving the alteration area. Concerns were raised that the area of an alteration is difficult to define. Concerns were also raised that even if the alteration area is defined, it could be easy for substantial alterations to a limited part of the building to meet the threshold but hard for them to achieve points, particularly areas of the building served by central systems. To address this issue, this public comment changes the threshold for the alteration from just the alteration area to the entire building. While there is some loss in stringency, this will be much easier to understand, much clearer to enforce, and much easier to comply with.
- **Compliance Criteria:** The third concern was related to clarity about what portion of the building would have to comply with the credit criteria to achieve the credit. It was not entirely clear whether the entire building would have to comply with the credit criteria or only the alteration. This was of special concern for multi-tenant buildings where portions of the building that are not part of the alteration may be inaccessible. The public comment adds language to make it clear that only the alteration needs to comply with the credits. But it also includes language to ensure that only portions of the alteration that cross that 50% impact threshold are able to be used.

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

The PC results in slightly less stringency than the language in the public comment draft.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal improves code by including flexibility of the additional energy efficiency table.

Final Hearing Results

RED1-263-22	AM

RED1-264-22

Original Proposal

IECC: SECTION 202, SECTION 202 (New), R501.2, R501.4, R501.5, R501.6, R501.7, R503.1.1.2, R503.1.1.3, R503.1.1.5, R505.1, R505.1.1

Proponents: Patricia Chawla, Austin Energy, Austin Energy (patricia.chawla@austinenergy.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

ADDITION. An extension or increase in the ~~*conditioned space*~~ floor area, number of stories or height of a building or structure.

ALTERATION. Any ~~construction, retrofit or renovation to an existing structure other than repair or addition. Also, a change in a building, electrical, gas, mechanical or plumbing system that involved an extension, addition or change to the arrangement, type or purpose of the original installation~~ <u>construction or renovation to an *existing structure* other than a *repair* or *addition*</u>.

Add new definition as follows:

<u>**EXISTING BUILDING.** A building erected prior to the date of adoption of the appropriate code, or one for which a legal building permit has been issued.</u>

Revise as follows:

REPAIR. The reconstruction, <u>replacement</u> or renewal of any part of an existing *building* for the purpose of its maintenance or to correct damage.

R501.2 Compliance. *Additions*, *alterations*, *repairs* or changes of occupancy to, or relocation of, an existing *building*, *building* system or portion thereof shall comply with Section R502, R503, R504 or R505, respectively, in this code <u>and the provisions for alterations, repairs, additions, and changes of occupancy or relocation, respectively, in the ***International Residential Code***, ***International Building Code***, ***International Existing Building Code***, ***International Fire Code***, ***International Fuel Gas Code***, ***International Mechanical Code***, ***International Plumbing Code***, ***International Property Maintenance Code***, ***International Private Sewage Disposal Code*** and **NFPA 70 as applicable**</u>. Changes where unconditioned space is changed to *conditioned space* shall comply with Section ~~R502~~ <u>R501.6</u>.

~~**R501.4 Compliance.** *Alterations*, *repairs*, *additions* and changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for *alterations*, *repairs*, *additions* and changes of occupancy or relocation, respectively, in this code and the *International Residential Code*, *International Building Code*, *International Existing Building Code*, *International Fire Code*, *International Fuel Gas Code*, *International Mechanical Code*, *International Plumbing Code*, *International Property Maintenance Code*, *International Private Sewage Disposal Code* and NFPA 70.~~

~~**R501.5**~~<u>**R501.4**</u> **New and replacement materials.** Except as otherwise required or permitted by this code, materials permitted by the applicable code for new construction shall be used. Like materials shall be permitted for *repairs*, provided that hazards to life, health or property are not created. Hazardous materials shall not be used where the code for new construction would not allow their use in *buildings* of similar occupancy, purpose and location.

~~**R501.6**~~<u>**R501.5**</u> **Historic buildings.** Provisions of this code relating to the construction, *repair, alteration*, restoration and movement of structures, and *change of occupancy* shall not be mandatory for *historic buildings* provided that a report has been submitted to the code official and signed by the owner, 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 historic form, fabric or function of the *building*.

~~**R501.7**~~<u>**R501.6**</u> **Change in space conditioning.** Any unconditioned or low-energy space that is altered to become conditioned space shall be required to be brought into full compliance with ~~this code~~Section 502.

Exception: Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.2.

R503.1.1.2 Roof alterations. Roof insulation shall comply ~~complying~~ with Section R402.1 or an *approved* design ~~shall be provided~~ for the following roof alteration conditions as applicable:

1. An alteration to roof-ceiling construction where there is no insulation above conditioned space.
2. Roof replacements for roofs with insulation entirely above deck,

Exceptions: Where compliance with Section R402.1 cannot be met due to limiting conditions on an existing roof, the following shall be permitted to demonstrate compliance with the insulation requirements:

1. Construction documents that include a report by a registered design professional or other approved source documenting details of the limiting conditions affecting compliance with the insulation requirements.
2. Construction documents that include a roof design by a registered design professional or other approved source that minimize deviation from the insulation requirements.
3. Conversion of an unconditioned attic space into conditioned space, and
4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling construction to which insulation can be applied.

R503.1.1.3 Above-grade wall alterations. Above-grade wall alterations shall comply with the following requirements as applicable:

1. Where interior finishes are removed exposing wall cavities, the existing cavity shall be filled with existing or new insulation complying with Section R303.1.4;
2. Where exterior wall coverings and fenestration are removed and replaced for the full extent of any exterior wall assembly, continuous insulation shall be provided where required in accordance with Section R402.1 or an ~~approved~~ *approved* design;
3. Where Items 1 and 2 apply, the entire wall assembly shall be insulated in accordance with Section R402.1; and,
4. Where new interior finishes or exterior wall coverings are applied to the full extent of any exterior wall assembly of mass construction, insulation shall be provided where required in accordance with Section R402.1 or an approved design.

Where any of the above requirements are applicable, the above-grade wall alteration shall comply with the insulation and water vapor retarder requirements of Section R702.7 of the International Residential Code. Where the exterior wall coverings are removed and replaced, the above-grade wall alteration shall comply with the water and wind resistance requirements of Section R703.1.1 of the International Residential Code.

R503.1.1.5 Below-grade wall alterations. Where a ~~blow~~below-grade space is changed to conditioned space, the below-grade walls shall be insulated where required in accordance with Section R402.1. Where the below-grade space is conditioned space and a below-grade wall is altered by removing or adding interior finishes, it shall be insulated where required in accordance with Section R402.1.

R505.1 General. Any space that is converted to a dwelling unit or portion thereof from another use or occupancy shall comply with this ~~code~~chapter.

Exception: Where the simulated building performance option in Section R405 is used to comply with this section, the annual energy cost of the *proposed design* is permitted to be 110 percent of the annual energy cost allowed by Section R405.2.

R505.1.1 Unconditioned space. Any unconditioned or low-energy space that is altered to become a *conditioned space* shall comply with Section ~~R502~~R501.6.

Reason: A working group of few (mostly committee) members was formed during public comment period #2 to specifically look at Chapter 5 [RE]. The proposed changes in this modification seek to clarify the existing chapter 5 language and the new chapter 5 language from public comment draft #1. No substantial changes have been made.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed code changes will not increase nor decrease the cost of construction since they are changes to clarify the code language. The proposed new definitions are in the International Existing Building Code. Amendments to existing definitions bring the definitions in alignment with the International Existing Building Code.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal coordinates and improves code by combining two sections with the same name and similar requirements. Adding a new definition for existing building.

Final Hearing Results

RED1-264-22	AM

RED1-268-22

Original Proposal

IECC: SECTION 202, R503.1.1, R503.1.1.1, R503.1.1.2, R503.1.1.3, R503.1.1.4, R503.1.1.5, R503.1.1.6, TABLE R402.1.2, TABLE R402.1.3

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz); Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

APPROVED SOURCE. An independent person, firm or corporation, approved by the code official, who is competent and experienced in the application of engineering principles to materials, methods or system analyses.

R503.1.1 Building thermal envelope. Alterations of existing *building thermal envelope* assemblies shall comply with this section. New ~~Building~~ *building thermal envelope* assemblies that are part of the *alteration* shall comply with Section R402. ~~In no case shall~~ tThe *R-value* of insulation shall not be reduced, nor~~or~~ the *U-factor* of a *building thermal envelope* assembly ~~be~~ increased as part of a *building thermal envelope* alteration except where the building after the alteration complies with Section R405 or R406.

Exception: The following alterations shall not be required to comply with the requirements for new construction provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Roof recover.
3. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided that the code does not require the glazing or fenestration assembly to be replaced.
4. *Roof replacement* where roof assembly insulation is integral to or located below the structural roof deck. ~~An existing building undergoing alterations that is demonstrated to be in compliance with Section R405 or Section R406~~

R503.1.1.1 Fenestration alterations. Where new fenestration area is added to an existing building, the new fenestration shall comply with Section R402.3. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for *U*-factor and SHGC as specified in Table R402.1.3. Where more than one replacement fenestration unit is to be installed, an area-weighted average of the *U*-factor, SHGC or both of all replacement fenestration units shall be an alternative that can be used to show compliance.

Revise as follows:

R503.1.1.2 Roof, ceiling, and attic alterations. ~~Roof insulation~~ Insulationshall comply ~~complying~~ with Section R402.1. Alternatively, where limiting conditions prevent compliance with Section R402.1, ~~or~~ an *approved* design that minimizes deviation from Section R402.1shall be providedfor the following alterations:~~roof alteration conditions as applicable~~:

1. An alteration to roof-ceiling construction other than *reroofing* where existing ~~there is no~~ insulation located belwo the *roof* deck or on an attic floor above conditioned space does not comply with Table R402.1.3.
2. *Roof replacements* or a roof ~~for roofs with~~ *alteration* that includes removing and replacing the *roof covering* where the roof assembly includes insulation entirely above the roof deck. Where limiting conditions require use of an*approved* design to minimize deviation from Section R402.1 for a Group R-2 building, a registered design professional or other approved source shall provide *construction documents* that identify the limiting conditions and the means to address them.
3. Conversion of an unconditioned attic space into conditioned space.

4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling.

~~**Exceptions:** Where compliance with Section R402.1 cannot be met due to limiting conditions on an existing roof, the following shall be permitted to demonstrate compliance with the insulation requirements:~~

~~1. Construction documents that include a report by a registered design professional or other approved source documenting details of the limiting conditions affecting compliance with the insulation requirements.~~

~~2. Construction documents that include a roof design by a registered design professional or other approved source that minimize deviation from the insulation requirements.~~

~~3. Conversion of an unconditioned attic space into conditioned space., and~~

~~4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling construction to which insulation can be applied~~.

R503.1.1.3 Above-grade wall alterations. Above-grade wall alterations shall comply with the following ~~requirements as applicable~~:

1. Where ~~interior finishes are removed exposing~~ wall cavities are exposed, the ~~existing cavity~~ cavities shall be filled with ~~existing or new~~ insulation complying with Section R303.1.4~~;~~ . New cavities created shall be insulated in accordance with Section R402.1 or an *approved* design that minimizes deviation from Section R402.1.
2. Where exterior wall coverings and fenestration areadded or ~~removed and~~ replaced for the full extent of any exterior~~wall assembly~~ facade of one or more elevations of the building, *continuous insulation* shall be provided where required in accordance with one of the following: ~~Section R402.1 or an approved design~~;2.1. An *R-value* of *continuous insulation* not less than that designated in Table R402.1.3;2.2. An *R-value* of *continuous insulation* not less than that required to comply with Table R402.1.2; or2.3. An approved design that minimizes deviation from Section R402.1.
3. Where Items 1 and 2 apply, the~~entire wall assembly shall be insulated~~ insulation shall be provided in accordance with Section R402.1; and,
4. Where new interior finishes or exterior wall coverings are applied to the full extent of any exterior wall assembly of mass construction, insulation shall be provided ~~where required~~ in accordance with Section R402.1 or an*approved* design.

Where any of the above requirements are applicable, the above-grade wall alteration shall comply with ~~ht e insulation and water vapor retarder requirements of~~ Sections R702.7 and R703.1.1 of the *International Residential Code*. ~~Where the exterior wall coverings are removed and replaced, the above-grade wall alteration shall comply with the water and wind resistance requirements of Section R703.1.1 of the International Residential Code.~~

R503.1.1.4 Floor alterations. Where cavities in a floor or floor overhang are exposed~~an alteration to a floor or floor overhang exposes cavities or surfaces to which insulation can be applied~~ and the floor or floor overhang is part of the*building thermal envelope*, the floor or floor overhang shall comply ~~be brought into compliance~~ with Section R402.1 or an *approved* design. ~~This requirement shall apply to floor alterations where the floor cavities or surfaces are exposed and accessible prior to construction.~~

R503.1.1.5 Below-grade wall alterations. Where unconditioned ~~a~~ below-grade space is changed to conditioned space, ~~the below-grade~~ *building thermal envelope* walls enclosing such space shall be insulated ~~where required~~ in accordance with Section R402.1. Where the below-grade space is conditioned space and where ~~a below-grade~~ *building thermal envelope* walls enclosing such space are ~~is~~ altered ~~by removing or adding interior finishes,~~ they ~~it~~ shall be insulated ~~where required~~ in accordance with Section R402.1.

R503.1.1.6 Air barrier. Altered ~~B~~*building thermal envelope* assemblies ~~altered in accordance with Section R503.1.1~~ shall be provided with an air barrier in accordance with Section R402.5. ~~The~~ Such air barrier ~~shall~~ need not be ~~required to be made~~ continuous with unaltered portions of the building thermal envelope. Testing requirements of Section R402.5.1.2 shall not be required.~~Content~~

TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

Portions of table not shown remain unchanged.

CLIMATE ZONE	0	1	2	3	4 except Marine	5 and Marine 4	6	7 and 8
Insulation entirely above roof deck	0.039	0.039	0.039	0.039	0.032	0.032	0.032	0.028

For SI: 1 foot = 304.8 mm.

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

b. Mass walls shall be in accordance with Section R402.2.6. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In Warm Humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.

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

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.28.

e. A maximum *U*-factor of 0.30 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation above sea level, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

f. ~~Roofs with insulation entirely above deck shall comply with Section C402.2.1 and the Group R U-factors of Table C402.1.2~~.

g. f. F-factors for heated slabs correspond to the configuration described by footnote (d) of Table R402.1.3

TABLE R402.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

Portions of table not shown remain unchanged.

CLIMATE ZONE	0	1	2	3	4 except Marine	5 and Marine 4	6	7 and 8
Insulation entirely above roof deck	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-35ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

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

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

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.28.

c. “5ci or 13” means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13&5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

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

e. Basement wall insulation is not required in Warm Humid locations as defined by Figure R301.1 and Table R301.1.

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

g. Mass walls shall be in accordance with Section R402.2.6. The second *R*-value applies where more than half of the insulation is on the interior of the mass wall.

h. A maximum *U*-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

i. ~~Roofs with insulation entirely above deck shall comply with Section C402.2.1 and the Group R R-values of Table C402.1.2~~.

j. i. "30 or 19+7.5ci or 20ci" means R30 cavity insulation alone or R19 cavity insulation with R7.5 continuous insulation or R20 continuous insulation alone.

Reason: This PC is submitted to coordinate with changes made by CEPI-221 to Section C503.1 of the commercial provisions based on additional input and review by the commercial subcommittee that occurred after the residential existing buildings and main committees had completed action on REPI-150. The two proposals intended to make the two codes consistent. So, this proposal is primarily one of editorial and formatting coordination between the IECC-C and IECC-R. It is not intended to make any technical requirement changes.

This PC also addresses a modification made to REPI-150 to provide direction for insulation entirely above the roof deck as it relates to roof replacement requirements. REPI-150 added a footnote 'f' to the U-factor and R-value tables to point to the commercial tables for Group R buildings for appropriate criteria since this specific roof condition (low slope roof with insulation entirely above deck) was not specifically addressed in the residential provisions. Rather than rely on a footnote pointing to IECC-C provisions for requirements, the relevant requirements are proposed to be brought directly into the R-value and U-factors tables of the IECC-R.

Finally, the following additional revisions were made to R503.1.1: (1) various editorial and formatting changes or corrections were made to simplify and improve clarity, (2) the "approved source" definition which was added by REPI-150 is now deleted preferring instead to use the term "approved third party" for consistency with this term's use in the air leakage and ERI provisions, (3) the additional approved third-party and construction document requirements which previously existed in an exception are made a part of the requirements for roof replacements with insulation entirely above deck and limited to Group R-2 buildings (e.g., apartments) which addresses the primary application and need for consistency with similar building types addressed in the IECC-C provisions. Roofs with above-deck insulation on other types of residential buildings (e.g., one- and two-family, townhouses, etc.) would comply with the charging language of Section R503.1.1.2 (allowing an approved design without additional requirement for a third party and construction documents).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal does not change requirements and focuses on editorial and formatting improvements to coordinate with similar provisions in the IECC-C. Therefore, there should be no cost impacts.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies several sections of the code, fits appropriately in the IECC standard.

Final Hearing Results

RED1-268-22	AM

RED1-271-22

Original Proposal

IECC: R503.1.1.3

Proponents: Daniel Carroll, New York State Department of State, Division of Building Standards & Codes (daniel.carroll@dos.ny.gov); Hendrik Shank, New York State/Department of State, New York State, Department of State (hendrikus.shank@dos.ny.gov)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R503.1.1.3 Above-grade wall alterations. Above-grade wall alterations shall comply with the following requirements as applicable:

1. Where interior finishes are removed exposing wall cavities, the existing cavity shall be filled with existing or new insulation complying with Section R303.1.4;
2. Where exterior wall coverings and fenestration are removed and replaced for the full extent of any exterior wall assembly, continuous insulation shall be provided where required in accordance with Section R402.1 or an approved design;
3. Where Items 1 and 2 apply, the entire wall assembly shall be insulated in accordance with Section R402.1; and,
4. Where new interior finishes or exterior wall coverings are applied to the full extent of any exterior wall assembly of mass construction, insulation shall be provided where required in accordance with Section R402.1 or an approved design.

Where any of the above requirements are applicable, the above-grade wall alteration shall comply with the insulation and water vapor retarder requirements of Section R702.7 of the International Residential Code or Section 1404.3 of the International Building Code, as applicable. Where the exterior wall coverings are removed and replaced, the above-grade wall alteration shall comply with the water and wind resistance requirements of Section R703.1.1 of the International Residential Code or 1402.2 of the International Building Code, as applicable.

Reason: Not all buildings regulated by the IECC-Residential Provisions are regulated by the IRC. This change avoids confusion or the misapplication of the IRC for R-2, R-3, and R-4 buildings three stories or less that are regulated by the IECC-Residential Provisions and the IBC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change is a clarification. There is no increase in cost, R-2, R-3 and R-4 buildings are required to comply with the IBC requirements not the IRC.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: these edits should have been in the Code already and so supports proposed language.

Final Hearing Results

RED1-271-22	AS

RED1-273-22

Original Proposal

IECC: R503.1.1.3
Proponents: Vladimir G. Kochkin, NAHB, NAHB (vkochkin@nahb.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R503.1.1.3 Above-grade wall alterations. Above-grade wall alterations shall comply with the following ~~requirement~~s as applicable:

1. Where interior finishes are removed ~~exposing~~ and wall cavities are exposed, the ~~existing cavity~~ exposed cavities shall be filled with existing or new insulation complying with Section R303.1.4and an interior vapor retarder shall be provided where required in accordance with Section R702.7 of the *International Residential Code* or Section 1404.3 of the *International Building Code*, as applicable~~;~~
2. Where exterior wall coverings and fenestration are removed and replaced for the full extent of any exterior wall assembly, continuous insulation shall be provided where required in accordance with Section R402.1 or the wall insulation shall be in accordance with an approved design that minimizes deviation from Section R402.1;Where specified, the continuous insulation requirement also shall comply with Section R702.7 of the *International Residential Code*. Replacement exterior wall coverings shall comply with the water resistance requirements of Section R703.1.1 of the *International Residential Code* or Section 1402.2 of the International Building Code, as applicable, and manufacturers' instructions.
3. ~~Where Items 1 and 2 apply, the entire wall assembly shall be insulated in accordance with Section R402.1; and~~,
4. 3. Where new interior finishes or exterior wall coverings are applied to the full extent of any exterior wall assembly of mass construction, insulation shall be provided where required in accordance with Section R402.1 or an approved design that minimizes deviation from Section R402.1.

~~Where any of the above requirements areimplemented applicable and resulted in a change of the vapor retarder classsification, the above-grade wall alteration shall comply with the insulation and water vapor retarder requirements of Section R702.7 of the International Residential Code. Where the exterior wall coverings are removed and replaced, the above-grade wall alteration shall comply with the water and wind resistance requirements of Section R703.1.1 of the International Residential Code .~~

Reason: This proposal addresses conflicts with the vapor retarder and wind resistance provisions.
The IRC provisions for vapor retarders do not allow prescriptive compliance for walls with "double" Class I vapor retarders.

The alteration does not need to comply with new vapor retarder requirements if vapor permeability characteristics did not change.

Section R702.7 does not contain insulation requirements.

The intent of this section is not to require replacement of the existing structural exterior sheathing when replacing the cladding.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This change may or may not impact the cost of alterations.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal provides flexibility for construction affecting existing structures - especially with regard to wall assemblies, exterior finishes, and not disturbing existing construction outside scope of work as well as providing for coordination with existing construction.

Final Hearing Results	
RED1-273-22	AM

RED1-277-22

Original Proposal

IECC: SECTION 202, R503.1.5

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [RE Project]

Delete without substitution:

~~**EXTERIOR WALL ENVELOPE.** A system or assembly of exterior wall components, including exterior wall finish materials, that provides protection of the building structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment.~~

Revise as follows:

R503.1.5 Additional Efficiency Packages. Alterations shall comply with Section R506 where the alteration contains replacement of two or more of the following:

1. HVAC unitary systems or HVAC central heating or cooling equipment serving the *work area* of the *alteration*.
2. Water heating equipment serving the *work area* of the *alteration*.
3. 50 percent or more of the lighting fixtures in the *work area* of the *alteration*.
4. 50 percent or more of the area of interior surfaces of the *building thermal envelope* ~~thermal envelope~~ in the *work area* of the *alteration*.
5. 50 percent or more the *exterior wall* area of the *building thermal envelope* ~~building's *exterior wall envelope*~~ , including vertical fenestration area.

Exceptions:

1. *Alterations* that are permitted with an *addition* complying with Section R502.3.5.
2. *Alterations* that comply with Section R405 or R406.

Reason: This PC is submitted to coordinate with a similar proposal (CED1-149-22) submitted to the IECC commercial committee. The newly added "exterior wall envelope" definition is used only once in the entire IECC residential provisions in the newly added Section R503.1.5, Item 5. The term is deleted and existing defined terms are used instead to revise Item 5 in Section R503.1.5 to retain its intent while not requiring a new term to be created and applied. The exception is also clarified to apply the percentage trigger on the basis of area, not length of walls, number of walls, or other possible metrics that are currently left open to interpretation. It is clarified that the exterior wall area used for this purpose should also include the area of vertical fenestration. Finally, the new "exterior wall envelope" definition overlaps with the defined term "exterior wall covering" as used in the IBC and IRC and this could create confusion in coordination between the I-codes. Deleting the term and using existing definitions resolves this concern as well. However, if the intent was that "exterior wall envelope" was intended to be applied the same as "exterior wall covering", then use of the latter defined term in the building codes should be considered instead.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The intent of this proposal is to provide a clean-up of terminology and not to change requirements. However, the clarification could result in a relaxation of the trigger for additional efficiency (and possible cost reduction for some alteration projects) by clarifying that vertical fenestration is to be included in the exterior wall area for purposes of the 50% of exterior wall trigger.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Deletes an unneeded definition. If full committee passes RED1-263-22 any coordination issues can be cleaned up in the development round.

Final Hearing Results

RED1-277-22	AS

RED1-280-22 Part I

Original Proposal

IECC: SECTION 202

Proponents: Fredric Zwerg, Southwest Gas Corporation, Southwest Gas Corporation (fredric.zwerg@swgas.com)

2024 International Energy Conservation Code [RE Project]

Delete without substitution:

~~**ZONAL HEATING.** A heating system in which each zone or room has a separate heater with a single controller in each zone~~.

Reason: Delete this definition entirely. Each HVAC zone is already required to have their own separate unit and controller. They are independent and considered separate units and could be confused with central HVAC systems with different zones. This definition is not necessary.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No cost impact.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: supports action on REPI-99 and RED1-325.

Final Hearing Results

RED1-280-22 Part I	AS

RED1-280-22 Part II

Original Proposal

IRCECC: SECTION 202

Proponents: Fredric Zwerg, Southwest Gas Corporation, Southwest Gas Corporation (fredric.zwerg@swgas.com)

2024 ENERGY Chapter11

Delete without substitution:

~~**ZONAL HEATING.** A heating system in which each zone or room has a separate heater with a single controller in each zone~~.

Reason: Delete this definition entirely. Each HVAC zone is already required to have their own separate unit and controller. They are independent and considered separate units and could be confused with central HVAC systems with different zones. This definition is not necessary.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

No cost impact.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: supports action on REPI-99 and RED1-325.

Final Hearing Results

RED1-280-22 Part II	AS

RED1-281-22

Original Proposal

IECC: ASTM Chapter 06

Proponents: Theresa Weston, The Holt Weston Consultancy, ABAA (Air Barrier Association of America) (holtweston88@gmail.com)

2024 International Energy Conservation Code [RE Project]

Update standard(s) as follows:

ASTM

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

E283/E283M ~~—2004(2012):~~ (2019)	Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen
E779 ~~—2010(2018):~~ 2019	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
E1554/E1554M ~~—E2013:~~ 2013 (2018)	Standard Test Methods for Determining Air Leakage of Air Distribution Systems by Fan Pressurization
E1827 ~~—: 2011(2017):~~ 2022	Standard Test Methods for Determining Airtightness of Building Using an Orifice Blower Door
D8052/D8052M ~~—2017:~~ 2022	Standard Test Method for Quantification of Air Leakage in Low-Sloped Membrane Roof Assemblies
E1186 ~~-17~~ 2022	Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems

Reason: This is to update reference standards related to air leakage assessment in order to keep the references current.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The updates to these standards do not constitute changes in code requirements, therefore, will not effect the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: needed update to reference standards

Final Hearing Results

RED1-281-22 AS

RED1-283-22

Original Proposal

IECC: SECTION 202

Proponents: Shannon Corcoran, American Gas Association, American Gas Association

2024 International Energy Conservation Code [RE Project]

Revise as follows:

CONTINUOUS PILOT ~~LIGHT, CONTINUOUSLY BURNING~~. ~~A small gas flame used to ignite gas at a larger burner. Once lit, a continuously pilot light remains in operation until manually interrupted. Pilot light ignition systems with the ability to switch between intermittent and continuous mode are considered continuous.~~ Pilot which, once placed in operation, is intended to remain ignited continuously until it is manually interrupted.

INTERMITTENT IGNITION ~~PILOT LIGHT, INTERMITTENT~~. ~~A pilot which is automatically ignited when an appliance is called on to operate and which remains continuously ignited during each period of main burner operation. The pilot is automatically extinguished when each main burner operating cycle is completed.~~ Type of ignition which is energized when an appliance is called on to operate and which remains continuously energized during each period of main burner operation and where the ignition is deenergized when the main burner operating cycle is completed.

~~PILOT LIGHT,~~ INTERRUPTED IGNITION. ~~A pilot which is automatically ignited prior to the admission of fuel to the main burner and which is automatically extinguished after the main flame is established.~~ Type of ignition which is energized prior to the admission of fuel to the main burner and which is deenergized when the main flame is established.

ON-DEMAND PILOT ~~LIGHT, ON-DEMAND~~. ~~A pilot which, once placed into operation, is intended to remain ignited for a predetermined period of time following an automatic or manual operation of the main burner gas valve.~~ A pilot which, once placed into operation, is intended to remain ignited for a predetermined period of time following an automatic or manual operation of the main burner gas valve, after which the pilot is automatically extinguished when no automatic or manual operation of the main burner gas valve occurs during the predetermined period of time.

Reason: Definitions of industry terms should be consistent with the source of the definition. The various types of pilot lights are defined in the Standard for Automatic electrical controls — Part 2-5: Particular requirements for automatic electrical burner control systems, CSA/ANSI Z21.20:22 • CSA C22.2 No. 60730-2-5:22 ◆ UL 60730-2-5. The code should be consistent with the ANSI standard.

these proposed changes ot the definitions apply to both the IECC Residential Code as well as the IRC Chapter 11.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal will not affect the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: align with industry defintions

Final Hearing Results

RED1-283-22	AS

RED1-285-22

Original Proposal

IECC: SECTION 202 (New), SECTION 202, R401.3, R402.2.9, TABLE R402.5.1.1, SECTION R403, R403.3, R403.3.1, R403.3.2, R403.3.3, R403.3.3.1, R403.3.4, R403.3.4.1, R403.3.5, R403.3.6, TABLE R403.3.6, R403.3.7, R403.3.8, TABLE R403.6.2, SECTION R405, R405.3.2.1, TABLE R405.4.2(1), TABLE R405.4.2(2), SECTION R408, TABLE R408.2, R408.2.4, SECTION R502, R502.2.2, SECTION R503, R503.1.2, R503.1.2.1, R503.1.2.3; IECC: R403.3.1 (New)

Proponents: Gary Klein, President, Gary Klein and Associates, Inc., Self (gary@garykleinassociates.com); Mark Lyles, New Buildings Institute, California IOUs (markl@newbuildings.org); Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

Add new definition as follows:

AIR-HANDLING UNIT. A blower or fan used for the purpose of distributing supply air to a room, space or area.

Revise as follows:

CONDITIONED SPACE. An area, room or space that is enclosed within the *building thermal envelope* and is directly or indirectly heated or cooled. 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~~*ducts*, piping or other sources of heating or cooling.

Add new definition as follows:

DAMPER. A manually or automatically controlled device to regulate draft or the rate of flow of air or combustion gases.

Revise as follows:

DUCT SYSTEM. ~~A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances~~ A system that consists of *space conditioning equipment*, *ductwork*, and includes any apparatus installed in connection therewith.

Add new definition as follows:

DUCTWORK. The assemblies of connected *ducts*, *plenums,* boots, fittings, *dampers*, supply registers, return grilles, and filter grilles through which air is supplied to or returned from the space to be heated, cooled, or ventilated. Supply ductwork delivers air to the spaces from the *space conditioning equipment*. Return ductwork conveys air from the spaces back to the *space conditioning equipment*. Ventilation ductwork conveys air to or from any space.

HEAT EXCHANGER. A device that transfers heat from one medium to another.

OCCUPIABLE SPACE. An enclosed space intended for human activities, excluding those spaces intended primarily for other purposes, such as storage rooms and equipment rooms, that are only intended to be occupied occasionally and for short periods of time.

PLENUM. An enclosed portion of the building structure, other than an *occupiable space* being conditioned, that is designed to allow air movement, and thereby serve as part of the supply or return *ductwork*.

SPACE CONDITIONING. The treatment of air so as to control the temperature, humidity, filtration or distribution of the air to meet the requirements of a conditioned space.

SPACE CONDITIONING EQUIPMENT. The *heat exchangers*, *air-handling units*, filter boxes, and any apparatus installed in connection therewith used to provide *space conditioning*.

Revise as follows:

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

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls*, *crawl space walls* and floors and *ducts* ~~ducts~~ outside *conditioned spaces.*
2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required *duct system* ~~duct system~~ and building envelope air leakage testing performed on the building.
4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted, the compliance path used, and where applicable, the additional efficiency measures selected for compliance with R408.
8. Where a solar-ready zone is provided, the certificate shall indicate the location, and dimensions.

R402.2.9 Basement walls. Basement walls shall be insulated in accordance with Table R402.1.3.

Exception: Basement walls associated with unconditioned basements where ~~all of~~ the following requirements are met:

1. The floor overhead, including the underside stairway stringer leading to the basement, is insulated in accordance with Section R402.1.3 and applicable provisions of Sections R402.2 and R402.2.8.
2. There are no uninsulated ~~duct~~ *ductwork*, domestic hot water piping, or hydronic heating surfaces exposed to the basement.
3. There are no HVAC supply or return diffusers serving the basement.
4. The walls surrounding the stairway and adjacent to *conditioned space* are insulated in accordance with Section R402.1.3 and applicable provisions of Section R402.2.
5. The door(s) leading to the basement from *conditioned spaces* are insulated in accordance with Section R402.1.3 and applicable provisions of Section R402.2, and weatherstripped in accordance with Section R402.5.
6. The building thermal envelope separating the basement from adjacent *conditioned spaces* complies with Section R402.5.

TABLE R402.5.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

Portions of table not shown remain unchanged.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Shafts, penetrations	*Duct* Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.5.5.	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried in or surrounded with insulation.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Electrical,communication, and other equipment boxes, housings, and enclosures	Boxes, housing, and enclosures that penetrate the air barrier shall be caulked, taped, gasketed, or otherwise sealed to the air barrier element being penetrated. All concealed openings into the box, housing, or enclosure shall be sealed. The continuity of the air barrier shall be maintained around boxes, housings, and enclosures that penetrate the air barrier. Alternatively, air-sealed boxes shall be installed in accordance with R402.5.6.	Boxes, housing, and enclosures shall beburried buried in or surrounded by insulation.
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	HVAC supply and return register boots located in within a the building's thermal envelope *building thermal envelope* assembly shall be buried burried in or and surrounded by insulation.

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

b. Insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

SECTION R403 SYSTEMS

Revise as follows:

R403.3 Duct systems. ~~Ducts and air handlers~~*Duct systems* shall be installed in accordance withSections R403.3.1through ~~R403.3.87~~ R403.3.9.

Exception: ~~*Ducts* serving ventilation systems~~ Ventilation *ductwork* that is ~~are~~ not integrated with duct systems serving heating or cooling systems.

R403.3.1 ~~Ducts~~ Ductwork located outside conditioned space. Supply and return *ductwork*~~*ducts*~~ located outside *conditioned space* shall be insulated to an *R*-value of not less than R-8 for *ducts* 3 inches (76 mm) in diameter and larger and not less than R-6 for*ducts* smaller than 3 inches (76 mm) in diameter. *Ductwork*~~*Ducts*~~ buried beneath a building shall be insulated as required per this section or have an equivalent *thermal distribution efficiency*. Underground *ductwork*~~*ducts*~~ utilizing the *thermal distribution efficiency* method shall be listed and *labeled* to indicate the *R*-value equivalency.

R403.3.2 Duct~~s~~ systems located in conditioned space. For ~~ductwork~~ *duct systems* to be considered inside a *conditioned space,* the *space conditioning equipment* shall be located completely on the conditioned sie of*building thermal envelope*. The *ductwork*~~it~~ it shall comply with ~~one of~~ the followingas applicable:

1. The ~~duct system~~ *ductwork*shall be located completely ~~within the *continuous air barrier* and within~~ on the conditioned side of the building thermal envelope.
2. *Ductwork* ~~Ductwork~~in ventilated attic spaces or unvented attic s with vapor diffusion ports shall be buried within ceiling insulation in accordance with Section R403.3.3 and ~~all of~~ shall comply with the following ~~conditions shall exist~~:

2.1. ~~The air handler is located completely within the *continuous air barrier* and within the *building thermal envelope*.~~

2.2 1. The ~~duct~~ *ductwork*leakage, as measured either by a rough-in test of thesupply and return ~~ducts~~ *ductwork* or a post-construction ~~total~~ *duct system* leakage test to outside the *building thermal envelope* in accordance with Section R403.3.5 ~~6~~, ~~is less than or equal to~~ is not greater than 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area* served by the *duct system*.

2.3 2. The ceiling insulation *R*-value installed against and above the insulated ~~duct~~ *ductwork* is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the ~~duct~~ *ductwork*.

3. *Ductwork* ~~located in~~ contained within wall or floor ~~building~~ assemblies separating unconditioned from conditioned space shall comply with the following:
   3.1. A *continuous air barrier* shall be installed as part of the building assembly between the~~duct~~ *ductwork* and the unconditioned space.
   3.2. ~~Ducts~~ *Ductwork* shall be installed in accordance with Section R403.3.1.

      Exception: Where the building assembly cavities containing ~~ducts~~ *ductwork* have been air sealed in accordance with Section R402.5.1,ductinsulation is not required.

   3.3. Not less than R-10 insulation, ~~and~~ or not less than 50 percent of the requiredinsulation R-value specified in Table R402.1.3, whichever is greater, shall be located between the ~~duct~~ *ductwork* and the unconditioned space.
   3.4 ~~For ducts in these building assemblies to be considered within conditioned space, the air handling equipment shall be installed within conditioned space.~~ Segments of ductwork contained within these building assemblies shall not be considered completely inside conditioned space in Sections R405 or R406.

R403.3.3 Ductwork ~~Ducts~~ buried within ceiling insulation. Where supply and return *ductwork* ~~air ducts are~~ is partially or completely buried in ceiling insulation, such *ductwork* ~~ducts~~ shall comply with ~~all of~~ the following:

1. The supply and return ~~ducts~~ *ductwork* shall be insulated with ~~have an insulation *R*-value~~ not less than R-8 insulation.
2. At all points along ~~each duct~~ the *ductwork* , the sum of the ceiling insulation *R*-value against and above the top of the ~~duct~~ *ductwork*, and against and below the bottom of the~~duct~~*ductwork*, shall be not less than R-19, excluding the *R*-value of the duct insulation.
3. In Climate Zones 0A, 1A, 2A and 3A, the supply~~ducts~~ *ductwork* shall be completely buried within ceiling insulation, insulated to an *R*-value of not less than R-13 and in compliance with the vapor retarder requirements of Section 604.11 of the International Mechanical Code or Section M1601.4.6 of the International Residential Code, as applicable.

   Exception: Sections of the supply ~~ducts~~ *ductwork* that are less than 3 feet (914 mm) from the supply outlet ~~shall not be required to comply with these requirements.~~

4. In Climate Zones 0A, 1A, 2A and 3A ~~when~~ where installed in an unvented attic with vapor diffusion porst , the supply ~~ducts~~ *ductwork* shall be completely buried within ceiling insulation, insulated to an *R*-value of not less than R-8 and in compliance with the vapor retarder requirements of Section 604.11 of the *International Mechanical Code* or Section M1601.4.6 of the *International Residential Code*, as applicable.

   Exception: Sections of the supply ~~ducts~~ *ductwork* duct that are less than 3 feet (914 mm) from the supply outlet ~~shall not be required to comply with these requirements.~~

   4.1 Air permeable insulation installed in unvented attics shall ~~be in compliance~~ comply with ~~the requirements of Section R806.5.2~~ Section R806.5.5.2 of the *International Residential Code*.

R403.3.3.1 Effective R-value of deeply buried ducts. Where complying using Section R405,~~the Building Simulated Performance Compliance Option in accordance with Section R401.2.2,~~ sections of ~~ducts~~ *ductwork* that are installed in accordance with Section R403.3.3 surrounded with blown-in attic insulation having an *R*-value of R-30 or greater and located such that the top of the~~duct~~ *ductwork* is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation *R*-value of R-25.

R403.3.4 Sealing. ~~Ducts, air handlers~~ *Ductwork ,air-handling units* and filter boxes shall be sealed. Joints and seams shall comply with either the International Mechanical Code orthe International Residential Code, as applicable.

R403.3.4.1 Sealed ~~air handler~~ air-handling unit. ~~Air handlers~~*Air-handling units* shall have a manufacturer's designation for an air leakage of not greater than 2 percent of the design airflow rate when tested in accordance with ASHRAE 193.

R403.3.5 Duct system testing. Each *duct system* ~~ducts system~~ shall be tested for air leakage in accordance with ANSI/RESNET/ICC 380 or ASTM E1554. Total leakage shall be measured with a pressure differential of 0.1 inchwater gauge ~~w.g.~~(25 Pa) across the ~~system~~ *duct system* and shall include the measured leakage from the supply and return*ductwork*. ~~Registers shall be sealed during the test.~~ A written report of the test results shall be signed by the party conducting the test and provided to the *code official*. *Duct system* ~~Duct system~~ leakage testing at either rough-in or post-construction shall be permitted with or without the installation of registers or grilles. Where installed, registers and grilles shall be sealedduring the test. Where registers and grilles are not installed, the face of theregister boots shall be sealed during the test.

Exceptions:

1. Testing shall not be required for *duct systems* ~~duct systems~~ serving ventilation systems that are not integrated with *duct systems* ~~duct systems~~ serving heating or cooling systems.
2. Testing shall not be required where there is not more than 10 feet of total*ductwork* external to the *space conditioning equipment* and both the following are met: a. The *duct system* is located entirely within *conditioned space*.b. The *ductwork* does not include *plenums* constructed of building cavities or gypsum board.
3. Where the *space conditioning equipment* is not installed, testing shall be permitted. The total measured leakage of the supply and return *ductwork*shall be less than or equal to 3.0 cubic feet per minute (85 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area*.

~~2~~ 4. Where tested in accordance with Section R403.3.7, testing of each *duct system* ~~duct system~~ is not required.

R403.3.6 Duct system leakage. The total measured ~~duct system~~ *duct system* leakage shall not be greater than the values in Table R403.3.6, based on the conditioned floor area, number of ducted returns, and location of the*duct system.* For buildings complying with Section R405 or R406, where ~~duct system~~ *duct system* duct system leakage to outside is tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554, the leakage to outside value shall not be used for compliance with this section, but shall be permitted to be used in the calculation procedures of Section R405 and R406.

TABLE R403.3.6 MAXIMUM TOTAL DUCT SYSTEM LEAKAGE

ROUGH IN	POST CONSTRUCTION	
~~**Duct systems serving more than 1,000 ft^2 of conditioned floor area**~~	**cfm/100 ft^2** ~~**(LPM/9.29 m^2)**~~	**cfm/100 ft^2** ~~**(LPM/9.29 m^2)**~~
Air handler is not installed	3 (85)	NA
Air handler is installed	4 (113.3)	4 (113.3)
Duct systems located in conditioned space, with air handler installed	8 (226.6)	8 (226.6)
~~**Duct systems serving less than or equal to 1,000 ft^2 of conditioned floor area**~~	**cfm (LPM)**	**cfm (LPM)**
Air handler is not installed	30 (849.5)	NA
Air handler is installed	40 (1132.7)	40 (1132.7)
Duct systems located in conditioned space, with air handler installed	80 (2265.4)	80 (2265.4)

***Duct systems* serving more than 1,000 ft^2 of conditioned floor area**		***Duct systems* serving less than or equal to 1,000 ft^2 of conditioned floor area**	
cfm/100 ft^2 (LPM/9.29 m^2)		**cfm (LPM)**	
	Number of ducted returns [a]		
< 3	≥ 3	Any	
Space conditioning equipment is not installed [b, c]	3 (85)	4 (113)	30 (850)

All components of the *duct system* are installed[c]	4 (113)	6 (170)	40 (1133)
Space conditioning equipment is not installed, but the ductwork is located entirely in conditioned space[cd]	6 (170)	8 (227)	60 (1699)
All components of the *duct system* are installed and entirely located in *conditioned space* [c]~~–~~	8 (227)	12 (340)	80 (2265)

a. A ducted return is a *duct* made of sheet metal or flexible *duct* that connects one or more return grilles to the return-side inlet of the *air-handling unit.* Any other method to convey air from return or transfer grille(s) to the *air-handling unit* does not constitute a ducted return for the purpose of determining maximum total *duct system* leakage allowance.

b. ~~Where the *space conditioning equipment* is not installed, *duct system* testing shall be permitted and shall include the measured leakage from both the supply and return *ductwork*. *Duct system* testing shall not be performed if the return *ductwork* is not installed.~~Duct system testing is permitted where space conditioning equipment is not installed, provided the return ductwork is installed, and the measured leakage from the supply and return ductwork is included.

c. For *duct systems* to be considered inside a *conditioned space*, where the *ductwork* is located in ventilated attic spaces or unvented attics with vapor diffusion ports, *duct system* leakage to outside must comply with Item 2.1 of Section R403.3.2.

d. Prior to certificate of occupancy, where the air-handling unit is not verified as being located in *conditioned space*, the total *duct system* leakage must be re-tested.

R403.3.7 Dwelling unit sampling. For buildings with eight or more *dwelling units* the duct systems in the greater of seven, or 20 percent of the *dwelling units* in the building shall be tested, including a top floor unit, a ground floor unit, a middle floor unit, and the unit with the largest conditioned floor area. Where buildings have fewer than eight *dwelling units*, the duct systems in each unit shall be tested. Where the leakage ~~rate~~ of a *duct system* is greater than the maximum permitted *duct system* leakage ~~rate~~, corrective actions shall be made to the *duct system* ~~system~~ and the *duct system* shall be retested until it passes. For each tested *dwelling unit* that has a greater total *duct system* leakage ~~rate~~ than the maximum permitted *duct system* leakage ~~rate~~, an additional three *dwelling units*, including the corrected unit, shall be tested.

R403.3.~~8~~.2 Building cavities. *Building* framing cavities shall not be used as ~~ducts~~ *ductwork* or *plenums*.

TABLE R403.6.2 WHOLE-DWELLING MECHANICAL VENTILATION SYSTEM FAN EFFICACY[a]

Portions of table not shown remain unchanged.

SYSTEM TYPE	AIRFLOW RATE (CFM)	MINIMUM EFFICACY (CFM/WATT)	TEST PROCEDURE
Air-handler ~~*Air-handling unit*~~ that is integrated to tested and *listed* HVAC equipment	Any	1.2	Outdoor airflow as specified. ~~*Air-handling unit*~~ Air-handler fan power determined in accordance with the HVAC appliance's test method referenced by Section C403.3.2 of the IECC-Commercial Provisions.

For SI: 1 cubic foot per minute = 0.47 L/s.

a. Design outdoor airflow rate/watts of fan used.

SECTION R405
SIMULATED BUILDING PERFORMANCE

Revise as follows:

R405.3.2.1 Compliance report for permit application. A compliance report submitted with the application for building permit shall include the following:

1. Building street address, or other *building site* identification.
2. The name of the individual performing the analysis and generating the compliance report.
3. The name and version of the compliance software tool.
4. Documentation of all inputs ~~entered into~~ to the software used to produce the results for the reference design and/or the rated home.
5. A certificate indicating that the proposed design complies with Section R405.3. The certificate shall document the building components' energy specifications that are included in the calculation including: component-level insulation *R*-values or *U*-factors; ~~duct system~~ *duct system* and building envelope air leakage testing assumptions; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
6. Where a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN	
Thermal distribution systems	Duct system *Duct system* leakage to outside: For *duct systems* serving > 1,000ft^2 of conditioned floor area, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area. For *duct systems* serving ≤ 1,000ft^2 of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).	*Duct System* Leakage to Outside: The measured total *duct system* leakage rate shall be entered into the software as the *duct system* leakage to outside rate. **Exceptions:** 1. When Where *duct system* leakage to outside is tested in accordance ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered. 2. When Where total *duct system* leakage is measured without the *space conditioning equipment* air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 f^{2}t (9.29 m^2) of conditioned floor area.	
	Distribution System Efficiency (DSE): For hydronic systems and ductless systems a thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies.	Distribution System Efficiency (DSE): For hydronic systems and ductless systems, DSE shall be as specified in Table R405.4.2(2).	

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, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design the following assumptions shall be made for both the proposed design and standard reference design.

Fuel Type: Same as the predominant heating fuel type

Rated Storage Volume: 40 Gallons

Draw Pattern: Medium

Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

AF $= A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and
where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.

2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.

3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.

4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.

5. The basement or attic shall be counted as a story when it contains the water heater.

6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a proposed design with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the standard reference design.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the standard reference design shall be the same as proposed design.

l. Only sections of *ductwork* that are installed in accordance with Items 1 or 2 of Section R403.3.2, are assumed to be located completely inside *conditioned space*. All other sections of *ductwork* are not assumed to be located completely inside *conditioned space*.

m. Sections of *ductwork* installed in accordance with Section R403.3.3.1, are assumed to have an effective duct insulation R-value of R-25.

TABLE R405.4.2(2) DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS[b]
Distribution system components located in unconditioned space	NA	0.95
Distribution system components entirely located in *conditioned space*[c]	NA	1
~~"~~Ductless~~"~~ systems[d]	1	NA

a. Default values in this table are for untested distribution systems, which must still ~~meet minimum requirements form~~ comply with Section R403 ~~for duct system insulation~~.

b. Hydronic systems ~~shall mean~~ means those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed-loop piping and that do not depend on ducted, forced airflow to maintain space temperatures.

c. Entire system in *conditioned space* ~~shall mean~~ means that no component of the distribution system, ~~including the air-handling unit,~~ is located outside of the *conditioned space*.

d. Ductless systems ~~shall be~~ are allowed to have forced airflow across a coil but ~~shall~~ must not have greater than 10 ft. of ~~any~~ ducted airflow external to the ~~manufacturer's air-handler enclosure~~ *space conditioning equipment*.

SECTION R408
ADDITIONAL EFFICIENCY REQUIREMENTS

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Portions of table not shown remain unchanged.

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 4C	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.4(2)	100% of *duct systems* ~~ducts~~ in *conditioned space*	4	6	8	12	12	15	17	19	20
R408.2.4(3)	≥80% of ductwork inside *conditioned space*	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.4(4~~3~~)	Reduced total duct leakage									

R408.2.4 More efficient ~~duct~~ thermal distribution system option. The thermal distribution system shall ~~meet one of the~~ comply with one of the following efficiencies:

1. ~~100 percent of~~ The ductless thermal distribution system or hydronic thermal distribution system is located completely ~~inside~~ on the conditioned side of the *building thermal envelope*.
2. ~~100 percent of~~ The space conditioning equipment is located inside conditioned space. In addition, 100 percent of the *duct system* ~~thermal distribution system~~ is located ~~in~~ completely inside *conditioned space* as defined by item 1 and item 2 of Section R403.3.2.
3. The *space conditioning equipment* is located inside conditioned space and no less than 80 percent of ductwork is located completely inside conditioned space as defined by item 1 and item 2 of Section R403.3.2. In addition, no more than 20 percent of *ductwork* is contained within building assemblies separating unconditioned from *conditioned space* as defined by item 3 of Section R403.3.2.

~~3.~~ 4. ~~When ducts are~~ Where *ductwork* is located outside *conditioned space*, the total leakage ~~of the ducts,~~ of the *duct system* measured in accordance with R403.3.5, ~~shall be in accordance with~~ is one of the following:

~~3.1~~ 4.1 Where the *space conditioning equipment* ~~air handler~~ is installed at the time of testing, total leakage is not greater than 2.0 cubic feet per minute (0.94 L/s) per 100 square feet (9.29 m^2) of conditioned floor area.

~~3.2~~ 4.2 Where the *space conditioning equipment* ~~air handler~~ is not installed at the time of testing, total leakage is not greater than 1.75 cubic feet per minute (0.83 L/s) per 100 square feet (9.29 m^2) of conditioned floor area.

SECTION R502
ADDITIONS

Revise as follows:

R502.2.2 Heating and cooling systems. HVAC *ductwork* ~~ducts~~ newly installed as part of an *addition* shall comply with Section R403.

Exception: Where *ductwork* ~~ducts~~ from an existing heating and cooling system ~~are~~ is extended into an *addition* Section R403.3.5 and Section R403.3.6 shall not be required.

SECTION R503
ALTERATIONS

Revise as follows:

R503.1.2 Heating and cooling systems. New heating and cooling systems and *ductwork* ~~duct systems~~ that are part of the alteration shall comply with Section R403 and this section. Alterations to existing heating and~~,~~ cooling systems and *ductwork* ~~duct systems~~ shall comply with this section.

Exception: Where *ductwork* ~~ducts~~ from an existing heating and cooling system~~are~~ is extended to an *addition*.

R503.1.2.1 ~~Ducts~~ *Ductwork*. HVAC *ductwork*~~ducts~~ newly installed as part of an alteration shall comply with Section R403.

Exception: Where *ductwork*~~ducts~~ from an existing heating and cooling system~~are~~ is extended to an *addition*.

R503.1.2.3 Duct system leakage. Where an *alteration* includes any of the following, *duct systems* ~~ducts~~ shall be tested in accordance with Section R403.3.5 and shall have a total leakage less than or equal to 12.0 cubic feet per minute (339.9 L/min) per 100 square feet (9.29 m^2) of conditioned floor area:

1. Where 25 percent or more of the registers that are part of the duct system are relocated.
2. Where 25 percent or more of the total length of all *ductwork* ~~ducts~~ in the *duct system* are relocated.
3. Where the total length of all *ductwork* ~~ducts~~ in the *duct system* is increased by 25 percent or more.

Exception: *Duct systems* located entirely inside a *conditioned space* in accordance with Section R403.3.2.

2024 International Energy Conservation Code [CE Project]

Add new text as follows:

R403.3.1 Duct system design. *Duct systems* serving one or two *dwelling units* shall be designed and sized in accordance with ANSI/ACCA Manual D. *Duct systems* serving more than two dwelling units shall be sized in accordance with the ASHRAE Handbook of Fundamentals, ANSI/ACCA Manual D, or other equivalent computation procedure.

Reason: This public comment is being submitted to achieve the following:

- Better define what the code means when it says “ducts”, “ductwork”, and “duct system”, by using 2021 IMC definitions, modified as needed.
- Use these defined terms to better clarify what is meant by “ducts in conditioned space” and what components are included in the “total duct leakage test”
- Clarify what must be tested during the total duct leakage test (i.e., ALWAYS the return ‘ductwork’ which now clearly includes sheetrocked plenums, but sometimes air-handler can be excluded if lower allowance is met)
- Reduce the use of the phrase “rough-in” and “post-construction” since that is not actually the criteria of importance
- Add a test exemption for ductless systems, including ducted systems with less than 10 ft of ductwork, when in conditioned space
- Provide a greater duct leakage allowance where a greater amount of return ductwork (ducted returns) is installed (like ENERGY STAR).

Bibliography: None

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed changes clarify existing provisions and do not increase the stringency of the requirements.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Better define what the code means when it says “ducts”, “ductwork”, and “duct system”, by using 2021 IMC definitions, modified as needed. Use these defined terms to better clarify what is meant by “ducts in conditioned space” and what components are included in the “total duct leakage test”.Clarify what must be tested during the total duct leakage test. Reduce the use of the phrase “rough-in” and “post-construction” since that is not actually the criteria of importance.

Final Hearing Results

RED1-285-22	AM

RED1-286-22

Original Proposal

IECC: CHAPTER 4 [RE], SECTION R402, R402.5.1, R402.5.2, R402.5.2.1, SECTION R403, R403.1, R403.1.1, R403.1.2, R403.1.3, R403.14 (New), R403.14.1 (New), SECTION R405, TABLE R405.2, SECTION R406, TABLE R406.2, CHAPTER 6 [RE], CSA Chapter 06, ANSI Chapter 06, R404.1.5 (New)

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

CHAPTER 4 [RE]
RESIDENTIAL ENERGY EFFICIENCY

SECTION R402
BUILDING THERMAL ENVELOPE

R402.5.1 Building thermal envelope. The *building thermal envelope* shall comply with Sections R402.5.1.1 through R402.5.1.3. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.5.2 Fireplaces. New wood-burning fireplaces shall have tight-fitting flue dampers or doors, and outdoor combustion air. Where using tight-fitting doors on factory-built fireplaces *listed* and *labeled* in accordance with UL 127, the doors shall be tested and*listed* for the fireplace.

Delete without substitution:

~~**R402.5.2.1 Gas fireplace efficiency.** All gas fireplace heaters rated to ANSI Z21.88 shall be listed and labeled with a fireplace efficiency (FE) rating of 50 percent or greater in accordance with CSA P.4.1. Vented gas fireplaces (decorative appliances) certified to ANSI Z21.50 shall be listed and labeled, including their FE ratings, in accordance with CSA P.4.1.~~

SECTION R403
SYSTEMS

R403.1 Controls. Not less than one thermostat shall be provided for each separate heating and cooling system.

R403.1.1 Programmable thermostat. The thermostat controlling the primary heating or cooling system of the *dwelling unit* shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of day and different days of the week. This thermostat shall include the capability to set back or temporarily operate the system to maintain *zone* temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C). The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 78°F (26°C).

R403.1.2 Heat pump supplementary heat. Heat pumps having supplementary electric-resistance heat shall have controls that are configured to prevent supplemental heat operation when the capacity of the heat pump compressor can meet the heating load. Limit supplemental heat operation to only those times when one of the following applies:

1. The vapor compression cycle cannot provide the necessary heating energy to satisfy the thermostat setting.
2. The heat pump is operating in defrost mode.

3. The vapor compression cycle malfunctions.
4. The thermostat malfunctions.

Delete without substitution:

~~**R403.1.3 Continuously burning pilot light.** Gas fireplace systems are not permitted to be equipped with a continuously burning pilot light.~~

~~**Exception:** Any fireplace equipped with an on-demand, intermittent or interrupted ignition pilot light (as defined in ANSI Z21.20) is not considered to have a continuously burning pilot light.~~

Add new text as follows:

R403.14 Gas fireplaces. Gas fireplace systems shall not be equipped with a*continuous pilot* and shall be equipped with an*on-demand pilot*, *intermittent ignition*, or *interrupted ignition* (as defined by ANSI Z21.20).

Exception: Gas-fired appliances using pilots within a listed combustion safety device.

R403.14.1 Gas fireplace efficiency. Vented gas fireplace heaters shall have a fireplace efficiency (FE) rating not less than 50 percent as determined in accordance with CSA P.4.1, and shall be listed and labeled in accordance with CSA/ANSI Z21.88 ◦ CSA 2.33. Vented gas fireplaces (decorative appliances) shall be listed and labeled in accordance with CSA/ANSI Z21.50 ◦ CSA 2.22.

SECTION R405
SIMULATED BUILDING PERFORMANCE

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR SIMULATED BUILDING PERFORMANCE

Portions of table not shown remain unchanged.

SECTION[a]	TITLE
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3	Duct systems
R403.4	Mechanical system piping insulation
R403.5 except Section R403.5.2	Service hot water system
R403.5.2	Hot water pipe insulation
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice system controls
R403.11	Energy consumption of pools and spas
R403.12	Portable spas
R403.13	Residential pools and permanent residential spas

R403.14	Gas fireplaces

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

SECTION R406 ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

Revise as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

Portions of table not shown remain unchanged.

SECTION[a]	TITLE
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3	Duct systems
R403.4	Mechanical system piping insulation
R403.5 except Section R403.5.2	Service hot water systems
R403.5.2	Hot water pipe insulation
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice system controls
R403.11	Energy consumption of pools and spas
R403.12	Portable spas
R403.13	Residential pools and permanent residential spas
R403.14	Gas fireplaces

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

CHAPTER 6 [RE] REFERENCED STANDARDS

Revise as follows:

CSA

CSA Group
8501 East Pleasant Valley Road
Cleveland, OH 44131-5516

P.4.1-2021 Testing method for measuring fireplace efficiency

R403.14.1

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

ANSI Z21.20-2005 (R2016)	Automatic Gas Ignition Systems And Components R403.14
Z21-50-2019/CSA 2.22-19	Vented Decorative Gas Applieances R403.14.1
Z21.88-2019/CSA 2.23-19	Vented Gas Fireplace Heaters R403.14.1

Add new text as follows:

R404.1.5 Gas lighting. Gas-fired lighting appliances shall not be equipped with a continuous pilot and shall be equipped with an on-demand pilot, intermittent ignition, or interrupted ignition as defined by ANSI Z21.20.

Reason: This Public Comment is a clean-up proposal to move a gas fireplace efficiency requirement from the R402.5 Building Thermal Envelope section, into the more appropriate R403 (Systems) section. This PC also combines the moved requirement with another gas fireplace requirement for pilot lights, that does not belong in the R403.1 Controls section. They are combined in proposed new section R403.14 and this new added section is then added to Table R405.2 and Table R406.2 and updated in the Referenced Standards.

Bibliography: N/A

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
N/A

Public Hearing Results

Committee Action **As Modified**

Committee Reason: consolidates fireplace requirements and provides editorial cleanups.

Final Hearing Results

RED1-286-22 AM

RED1-287-22

Original Proposal

IECC: R402.5.2.1

Proponents: Shannon Corcoran, American Gas Association, American Gas Association (corcoransm@att.net)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R402.5.2.1 Gas fireplace efficiency. All gas fireplace heaters rated toCSA/ANSI Z21.88 • CSA 2.33 shall be listed and labeled with a fireplace efficiency (FE) rating of 50 percent or greater in accordance with CSA P.4.1. Vented gas fireplaces (decorative appliances) certified to CSA/ANSI Z21.50 • CSA 2.22 shall be listed and labeled~~, including their FE ratings~~,in accordance with CSA P.4.1.

Reason: The code should use the full designation of the referenced standards.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Editorial change to use the full designation of the referenced standard, and will have no impact on construction cost.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: updates standards for applicances.

Final Hearing Results

RED1-287-22	AM

RED1-290-22

Original Proposal

IECC: R403.1.2

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.1.2 Heat pump supplementary heat. Heat pumps having supplementary electric-resistance heat shall have controls that are configured to prevent supplemental heat operation when the capacity of the heat pump compressor can meet the heating load. ~~Limit supplemental~~ Supplemental heat operation shall be limited to only ~~those times when~~where one of the following applies:

1. The vapor compression cycle cannot provide the necessary heating energy to satisfy the thermostat setting.
2. The heat pump is operating in defrost mode.
3. The vapor compression cycle malfunctions.
4. The thermostat malfunctions.

Reason: Preferable code language.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Editorial.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: the edit is proper.

Final Hearing Results

RED1-290-22	AS

RED1-292-22

Original Proposal

IECC: R403.1.2; IRCECC: N1103.1.2

Proponents: Adam Berry, Colorado Energy Office, Colorado Energy Office (adam.berry@state.co.us)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.1.2 Heat pump supplementary heat. Heat pumps having a supplementary electric-resistance, fuel gas, or fuel oil heat system shall have controls that are configured to prevent supplemental heat operation when the capacity of the heat pump compressor can meet the heating load. Limit supplemental heat operation to only those times when one of the following applies:

1. The vapor compression cycle cannot provide the necessary heating energy to satisfy the thermostat setting.
2. The heat pump is operating in defrost mode.
3. The vapor compression cycle malfunctions.
4. The thermostat malfunctions.

2024 ENERGY Chapter11

Revise as follows:

N1103.1.2 Heat pump supplementary heat. Heat pumps having a supplementary electric-resistance, fuel gas, or fuel oil heat system shall have controls that are configured to prevent supplemental heat operation when the capacity of the heat pump compressor can meet the heating load. Limit supplemental heat operation to only those times when one of the following applies:

1. The vapor compression cycle cannot provide the necessary heating energy to satisfy the thermostat setting.
2. The heat pump is operating in defrost mode.
3. The vapor compression cycle malfunctions.
4. The thermostat malfunctions.

Reason: Heat pumps in colder climates, such as those of Colorado, often are supported by backup systems that are not limited to just electric resistance systems. Many homeowners that upgrade to an electric heat pump will keep their natural gas furnace, propane heating system, or other non-electric heating system to function as the backup during the coldest periods where the heat pump is not able to meet the demand. Controls for these backup systems should apply to all types of systems, whether electric, fuel gas, or fuel oil, to ensure that the heat pump is the primary source of heating and that the backup systems are being used only in very limited circumstances when the heat pump is unable to keep up.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal should not increase the cost of construction, as it just widens the applicability for backup controls to apply to non-electric backup heating systems.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: provides clarity on dual fuel systems

Final Hearing Results	
RED1-292-22	AS

RED1-296-22

Original Proposal

IECC: R403.1.3

Proponents: Eric Tate, Atmos Energy, Atmos Energy (eric.tate@atmosenergy.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.1.3 Continuously burning pilot light. Gas fireplace systems ~~are not permitted to~~ shall not be equipped with a continuously burning pilot light.

Exceptions: 1. Any fireplace equipped with an on-demand, intermittent or interrupted ignition pilot light (as defined in ANSI Z21.20) is not considered to have a continuously burning pilot light.
2. Gas-fired appliances using pilots within a listed combustion safety device.

Reason: Appliances such as space heaters use continuously burning pilots in oxygen depletion sensors (ODS) as a means of shutting off the appliance in the event that room oxygen is reduced to 18% by volume and as a correlated indoor air quality accumulation of carbon monoxide (CO). Disruption of the stability of the continuously burning pilot within the ODS, caused by oxygen depletion, closes the gas valve shutting of the appliance. Banning continuously burning pilots, *per se*, would disqualify use of ODS systems despite its listing and incorporation in the gas appliance. Changes to alternate means of achieving gas shut off are not currently recognized in standards for safety for gas appliances.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed language will not affect cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: based on proponents reason statement

Final Hearing Results

RED1-296-22 AM

RED1-298-22

Original Proposal

IECC: R403.1.3

Proponents: Shannon Corcoran, American Gas Association, American Gas Association (corcoransm@att.net)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.1.3 ~~Continuously burning~~ Continuous pilot ~~light~~. Gas fireplace systems are not permitted to be equipped with a ~~continuously burning~~ continuous pilot ~~light~~.

> **Exception:** Any fireplace equipped with an on-demand, intermittent or interrupted ignition pilot light (as defined inCSA/ANSI Z21.20:2 • CSA C22.2 No. 60730-2-5:22 •UL 60730-2-5) is not considered to have a continuous pilot ~~light~~.

Reason: The code should use proper designation of the referenced standard - CSA/ANSI Z21.20:22 • CSA C22.2 No. 60730-2-5:22 ◆ UL 60730-2-5. Terminology and definitions should be consistent with the standard (since the exception states "as defined in").

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal does not affect construction codes.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: updates references

Final Hearing Results

RED1-298-22	AS

RED1-299-22

Original Proposal

IECC: R403.11.2

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

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.11.2 Time switches. Time switches or other control methods that can automatically turn heaters and pump motors off and on according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built-in time switches shall be in compliance with this section.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Pumps that operate ~~solar-~~ on-site renewable energy- and waste-heat-recovery pool heating systems.

Reason: This proposed change updates the exception language to be consistent with other changes in the code, such as in 403.11.3 for pool covers (which also has the same language in its exception).

In addition, there are multiple types of renewable energy systems that can be used for pool heating and should qualify for the exception.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is language for an exception to a requirement. It may change the cost of the exception, as more renewable energy systems will be allowed to be used for the exception, but it does not change the cost of the required time switch.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: brings consistency to section.

Final Hearing Results

RED1-299-22	AS

RED1-302-22

Original Proposal

IECC: R403.3.2

Proponents: Vladimir G. Kochkin, NAHB, NAHB (vkochkin@nahb.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.3.2 Ducts located in conditioned space. For ductwork to be considered inside a *conditioned space,* it shall comply with one of the following:

1. The duct system shall be located completely within the *continuous air barrier* and within the building thermal envelope.
2. Ductwork in ventilated attic spaces or unvented attic with vapor diffusion port shall be buried within ceiling insulation in accordance with Section R403.3.3 and all of the following conditions shall exist:
   - 2.1. The air handler is located completely within the *continuous air barrier* and within the *building thermal envelope*.
   - 2.2. The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the *building thermal envelope* in accordance with Section R403.3.6, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area* served by the duct system.
   - 2.3. The ceiling insulation *R*-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the duct.
3. Ductwork located in wall or floor building assemblies separating unconditioned from conditioned space shall comply with the following:
   - 3.1. A *continuous air barrier* shall be installed as part of the building assembly between the duct and the unconditioned space.
   - 3.2. Ducts shall be installed in accordance with Section R403.3.1.

     Exception: Where the building assembly cavities containing ducts have been air sealed in accordance with Section R402.5.1 <u>and insulated in accordance with Item 3.3</u>, duct insulation is not required.
   - 3.3. Not less than R-10 insulation, and not less than 50 percent of the required R-value specified in Table R402.1.3, shall be located between the duct and the unconditioned space.
   - 3.4 For ducts in these building assemblies to be considered within conditioned space, the air handling equipment shall be installed within conditioned space.

Reason: This is clarification of intent. The exception applies to duct insulation. The building assembly insulation requirements of Item 3.3 must be met.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Clarification of intent.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: the proposal cleans up the language in R403.3.2 clarifying the provisions.

Final Hearing Results

RED1-302-22	AS

RED1-305-22

Original Proposal

IECC: R403.3.3

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.3.3 Ducts buried within ceiling insulation. Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

1. The supply and return ducts shall have an insulation *R*-value not less than R-8.
2. At all points along each duct, the sum of the ceiling insulation *R*-value against and above the top of the duct, and against and below the bottom of the duct, shall be not less than R-19, excluding the *R*-value of the duct insulation.
3. In Climate Zones 0A, 1A, 2A and 3A, the supply ducts shall be completely buried within ceiling insulation, insulated to an *R*-value of not less than R-13 and in compliance with the vapor retarder requirements of Section 604.11 of the International Mechanical Code or Section M1601.4.6 of the International Residential Code, as applicable.

   Exception: Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

4. In Climate Zones 0A, 1A, 2A and 3A when installed in an unvented attic with vapor diffusion port, the supply ducts shall be completely buried within the ~~ceiling~~ insulation in the ceiling assembly at the floor of the attic, insulated to an *R*-value of not less than R-8 and in compliance with the vapor retarder requirements of Section 604.11 of the *International Mechanical Code* or Section M1601.4.6 of the *International Residential Code*, as applicable.

   Exception: Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

   4.1 Air permeable insulation installed in unvented attics shall be in compliance with the requirements of Section R806.5.2 of the *International Residential Code*.

Reason: Item 4 in Section R403.3.3 was newly added during the initial public input phase. It addresses the case of a conditioned (unvented) attic space using a diffusion port to remove water vapor from the attic space by diffusion instead of ventilation. However, these unvented attic systems in the building code may be constructed with insulation at the ceiling of the attic (e.g., on or between rafters) or at the floor of the attic which is the ceiling of the story below. For Section R403.3.3, the former condition (placing buried ducts in insulation between rafters because it is consider the "ceiling" of the attic) is not intended but could be interpreted that way when constructing an unvented attic in accordance with the building code with insulation between or on rafters at the ceiling of the attic space. This would cause the diffusion port methodology to potentially not function properly. Therefore, text is added to clarify that the "ceiling insulation" being discussed in Item 4 of Section R403.3.3 is on the ceiling of the story below at the floor of the attic, not at the ceiling of the unvented attic as permitted option in the building code for unvented attics.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal clarifies what is intended and does not change requirements. Therefore, it should have no cost impact and should help avoid unintended consequences in coordination with building code requirements for unvented attics.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: The Committee voted against Disapproval in order to afford the Proponent the opportunity to speak to their proposal and be able to consider modifications, given the confusion on whether it was or was not included in 285. The committee voted to approve, after a friendly amendment which improved the original proposed wording.

Final Hearing Results	
RED1-305-22	AS

RED1-309-22

Original Proposal

IECC: TABLE R403.3.6

Proponents: Alex Smith, NAHB, NAHB (asmith@nahb.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R403.3.6 MAXIMUM TOTAL DUCT SYSTEM LEAKAGE

ROUGH IN	POST CONSTRUCTION	
Duct systems serving more than 1,000 ft^2 of conditioned floor area	**cfm/100 ft^2 (LPM/9.29 m^2)**	**cfm/100 ft^2 (LPM/9.29 m^2)**
Air handler is not installed	3 (85)	NA
Air handler is installed	4 (113.3)	4 (113.3)
<u>Duct systems located in conditioned space, with air handler not installed</u>	<u>6 (170)</u>	<u>6 (170)</u>
Duct systems located in conditioned space, with air handler installed	8 (226.6)	8 (226.6)
Duct systems serving less than or equal to 1,000 ft^2 of conditioned floor area	**cfm (LPM)**	**cfm (LPM)**
Air handler is not installed	30 (849.5)	NA
Air handler is installed	40 (1132.7)	40 (1132.7)
<u>Duct systems located in conditioned space, with air handler not installed</u>	<u>60 (1699.1)</u>	<u>60 (1699.1)</u>
Duct systems located in conditioned space, with air handler installed	80 (2265.4)	80 (2265.4)

Reason: It's common practice in many markets around the country to test ducts in conditioned space before the air handler is installed. Air handlers in these situations are often installed after the drywall. Therefore, the code needs to provide a compliance metric for this construction scenario.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The change would have no effect on the cost of construction

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Committee voted to support the proposal to enable homes with duct systems inside conditioned space to test for duct leakage without the AHU installed, as long as the AHU is later verified to be inside conditioned space.

Final Hearing Results

RED1-309-22 AM

RED1-310-22
Original Proposal

IECC: R403.5.1.1; IECC: R403.5.1.1.1

Proponents: Alisa McMahon, sel, self (mcmahon.gbac@cox.net)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

R403.5.1.1 Circulation systems. Heated water circulation systems shall be provided with a circulation pump.Gravity and thermosyphon circulation systems shall be prohibited. ~~The system return pipe shall be a dedicated return pipe or a cold water supply pipe.Gravity and thermosyphon circulation systems shall be prohibited.~~ Controls for circulating hot water system pumps shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water. The system return pipe shall be a dedicated return pipe or a cold water supply pipe.Where a cold water supply pipe is used as the return pipe, a temperature sensor connected to the controls shall be located on the hot water supply no more than two feet from the connection to the cold water supply pipe. The controls shall limit the temperature of the water entering the cold water piping to not greater than 104ºF (40ºC).

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.5.1.1.1 Demand recirculation water systems. ~~Where installed, d emand~~Demand recirculation water systems shall have controls that start the pump upon receiving a signal from the action of a user of a fixture or appliance~~, sensing the presence of a user of a fixture~~ sensing the presence of a user of a fixtureor sensing the flow of hot or tempered water to a fixture fitting or appliance.The controls shall limit pump operation by:

1. Shutting off the pump when the temperature sensor detects one of the following:
   1.1 An increase in the water temperature of not more than 10^{O}F (5.6^{O}C) above the initial temperature of the water in the pipe.
   1.2 The temperature of the water in the pipe reaches 104^{O}F (40^{O}C).
2. Limiting pump operation to a maximum of five minutes following activation.
3. Not activating the pump for at least five minutes following shutoff or when the temperature of the water in the pipe exceeds 104^{O}F (40^{O}C).

Reason: Using a control that senses the presence of a user (i.e., an occupancy sensor) means that every time someone walks up to, or even past, a fixture – *for any reason* – the demand recirculation pump activates and may in turn activate the water heater.

There are many reasons to approach a bathroom or kitchen sink that do not involve the use of hot water. In fact, anecdotally, I kept track of my approaches and found I use hot water < 5% of the time, often using no water at all (e.g., comb hair, look in mirror, get something from cabinet under sink).

Push button control is preferred because it eliminates these "false signals" for pump operation that an occupancy sensor would generate. (California Energy Commission Building Energy Efficiency Standards Residential Compliance Manual)

"False signals" waste energy, both transporting unneeded hot water and when the draw triggers the water heater to fire up.

California Building Energy Efficiency Standards and California Green Building Standards Code specify the following recirculation system controls:

- manual activation with thermostat automatic shut off in one- and two-family dwellings
- controls that sense hot water demand and recirculation return temperatures for central recirculation systems that serve multiple dwelling units

Both of these controls remain represented in R403.5.1.1.1 after this proposed change.

The City of Scottsdale (Arizona) recently adopted the 2021 IECC with this proposed change as a local amendment.

Bibliography: https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2019-building-energy-efficiency-0
https://up.codes/viewer/california/ca-green-code-2019/chapter/A4/residential-voluntary-measures#A4.303.5
https://up.codes/viewer/california/ca-green-code-2019/chapter/2/definitions#demand_hot_water_recirculation_system

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The code change proposal will neither increase nor decrease the cost of construction, but will decrease the cost of energy use.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: addresses recommended distance language in R403.5.1.1 text in red. For R403.5.1.1.1.2 and 3 simplify language with recommendation adding friendly amendment to the "as modified."

Final Hearing Results

RED1-310-22	AM

RED1-313-22
Original Proposal

IECC: R403.5.4, R408.2.3, R408.2.3.1, R408.2.3.1.1 (New); IECC: TABLE R403.5.4

Proponents: Gary Klein, President, Gary Klein and Associates, Inc., Self (gary@garykleinassociates.com); Mark Lyles, New Buildings Institute, California IOUs (markl@newbuildings.org)

2024 International Energy Conservation Code [RE Project]

Delete without substitution:

~~**R403.5.4 Water volume determination.** The water volume in the piping shall be calculated in accordance with this section. Water heaters, circulating water systems and heat trace temperature maintenance systems shall be considered to be sources of heated water. The volume shall be the sum of the internal volumes of pipe, fittings, valves, meters and manifolds between the nearest source of heated water and the termination of the fixture supply pipe. The volume in the piping shall be determined from Table R403.5.4. The volume contained within fixture shutoff valves, within flexible water supply connectors to a fixture fitting and within a fixture fitting shall not be included in the water volume determination. Where heated water is supplied by a recirculating system or heat-traced piping, the volume shall include the portion of the fitting on the branch pipe that supplies water to the fixture.~~

Revise as follows:

R408.2.3 Reduced energy use in service water-heatingoptions. For measure numbers R408.2.3 (1) through R408.2.3 (5), the hot water system shall meet one of the Uniform Energy Factors (UEF) or Solar Uniform Energy Factors (SUEF)~~:~~ in Table R408.2.3. For measure number R408.2.3 (6), ~~the~~ a compact hot water distribution system shall comply with R408.2.3.1. ~~To field or plan review verify that the system meets the prescribed limit, one of the following must be done:~~

1. ~~At plan review, referencing ounces of water per foot of tube on plans as per Table R403.5.4~~.
2. ~~At rough in (plumbing), referencing ounces of water per foot of tube installed as per Table R403.5.4~~.
3. ~~At final inspection. In accordance with Department of Energy's Zero Energy Ready Home National Specification (Rev. 07 or higher) footnote on Hot water delivery systems.~~

R408.2.3.1 Compact hot water distribution system option. ~~To claim the For Ccompact Hhot Wwater Ddistribution system credit, the volume~~ Thepipe shall store not more than 16 ounces of water~~in~~ between the nearest source of heated water and the termination of the fixture supply pipe when calculated using section R403.5.4.Where the source of heated water is a circulation loop, the loop shall be primed with a *demand recirculation water system*. There shall be a dedicated return line for the loop that begins after the branch to the last fixture on the supply portion of the loop and runs back to the water heater. ~~When the hot water source is the nearest primed plumbing loop or trunk, this must be primed with an on-demand recirculation pump and must run a dedicated ambient return line from the furthest fixture or end of loop to the water heater. In order to claim this credit, the dwelling must have a minimum of 1.5 bathrooms.To field or plan review, verify that the system meets the prescribed limit, one of the following must be done:~~

1. ~~At plan review, referencing ounces of water per foot of tube on plans as per Table R403.5.4.~~1
2. ~~At rough in (plumbing), referencing ounces of water per foot of tube installed as per Table R403.5.4.~~1
3. ~~At final inspection, in accordance with Department of Energy's Zero Energy Ready Home National Specification (Rev. 07 or higher) footnote on Hot water delivery systems.~~

Add new text as follows:

R408.2.3.1.1 Water volume determination. The water volume in the piping between a source of heated water and the termination of a fixture supply shall be calculated in accordance with this section. Water heaters, circulating water systems and heat trace temperature maintenance systems shall be considered to be sources of heated water. The volume shall be the sum of the internal volumes of pipe, fittings, valves, meters and manifolds between the nearest source of heated water and the termination of the fixture supply pipe. The volume in the piping shall be determined from Table R408.2.3.1. The volume contained within fixture shutoff valves, within flexible water supply connectors to a fixture fitting and within a fixture fitting shall not be included in the water volume determination. Where heated water is supplied by a recirculating system or heat-traced piping, the volume shall include the portion of the fitting on the branch pipe that supplies water to the fixture.

2024 International Energy Conservation Code [CE Project]

Revise as follows:

TABLE ~~R403.5.4~~R408.2.3.1 INTERNAL VOLUME OF VARIOUS WATER DISTRIBUTION TUBING

OUNCES OF WATER PER FOOT OF TUBE									
NOMINAL SIZE (inches)	COPPER TYPE M	COPPER TYPE L	COPPER TYPE K	CPVC CTS SDR 11	CPVC SCH 40	CPVC SCH 80	PE-RT SDR 9	COMPOSITE ASTM F1281	PEX CTS SDR 9
3/8	1.06	0.97	0.84	N/A	1.17	-	0.64	0.63	0.64
1/2	1.69	1.55	1.45	1.25	1.89	1.46	1.18	1.31	1.18
3/4	3.43	3.22	2.90	2.67	3.38	2.74	2.35	3.39	2.35
1	5.81	5.49	5.195.17	4.43	5.53	4.57	3.91	5.56	3.91
1 1/4	8.70	8.36	8.09	6.61	9.66	8.24	5.81	8.49	5.81
1 1/2	12.18	11.83	11.45	9.22	13.20	11.38	8.09	13.88	8.09
2	21.08	20.58	20.04	15.79	21.88	19.11	13.86	21.48	13.86

For SI: 1 foot = 304.8 mm, 1 inch = 25.4 mm, 1 liquid ounce = 0.030L, 1 oz/f^{2}t = 305.15 g/m^2.

N/A = Not available.

Reason: Minor edits were made to the language which clarify the requirements. This public comment removes the minimum requirement of 1.5 bathrooms to claim this credit. If there is only one bathroom, a kitchen and perhaps a laundry room, they could be close to each other and to the water heater or far from each other and the water heater, or one could be close and the other far. The intent of the credit is to encourage the architect to get the fixtures close to the water heater(s). If this is somehow not possible, then installing an on-demand primed circulation loop gives them good performance.

The requirements for field or plan review are recommended to be moved to the Code Commentary section. Modifications were made to these provisions and specificity was added for clarity. The proposed new language is presented below.

Recommended for inclusion in the commentary:

R408.2.3.1 Compact hot water distribution systems. The purpose of a compact hot water distribution system is to minimize the volume in the piping between the sources of hot water and the uses of hot water. Sources of hot water include water heaters, circulating water systems and heat trace temperature maintenance systems. There are many ways to meet the requirements as long as the maximum volume between the source and the use is not exceeded.

To verify compliance with R408.2.3.1

1. *Construction documents* shall indicate the lengths, diameters and ounces of water in the piping between the sources of heated water and the termination of the fixture supply.

2. At plumbing rough-in, compare the length and diameter of the piping from the sources of heated water to the termination of the fixture supply pipes to those contained in the *construction documents*.

3. At final inspection verify that either:

a.	No more than 32 ounces of water comes out of the fixtures before the temperature of the water rises above 105F.

b.	No more than 20 ounces of water shall come out of the fixtures before the temperature of the water rises 10F above the ambient water temperature.

c.	If there is a *demand recirculation water system* or a heat trace system, ensure that these are primed with hot water prior to verifying the volume.

Bibliography: none

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The changes that have been proposed clarify the language, but do not add provisions, so there is no impact on construction costs.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: recommends moving all the provisions related to compact hot water distribution systems to Section 408. This recommendation incorporates language from RED1-311 and RED1-312 (the pipe volume table) into this one proposal. Have tried to align language with other sections in R408.

Final Hearing Results

RED1-313-22	AM

RED1-315-22

Original Proposal

IECC: R403.5.5; IECC: Table R403.5.5 (New); IECC: 6 AHRI (New)
Proponents: Mary Koban, AHRI, AHRI (mkoban@ahrinet.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.5.5 Demand responsive water heating. Electric storage water heaters with a rated water storage volume of 40 gallons (150L) to 120 gallons (450L) and a nameplate input rating equal to or less than 12kW shall be provided with demand responsive controls in accordance with Table R403.5.5 ~~or another equivalent approved standard.~~

Exceptions:

1. Water heaters that are capable of delivering water at a temperature of 180°F (82°C) or greater.
2. Water heaters that comply with Section IV, Part HLW or Section X of the ASME Boiler and Pressure Vessel Code.
3. Water heaters that use 3-phase electric power.

2024 International Energy Conservation Code [CE Project]

Revise as follows:

Table R403.5.5 DEMAND RESPONSIVE CONTROLS FOR WATER HEATING

-	Controls	-
Equipment Type	Manufactured before 7/1/2025	Manufactured On or After 7/1/2025
Electric storage water heater	AHRI Standard 1430-2022 (I-P) or ANSI/CTA-2045-B Level 1 and also capable of initiating water heating to meet the temperature set point in response to a demand response signal	AHRI Standard 1430-2022 (I-P) ANSI/CTA-2045-B Level 2, except "Price Stream Communication" functionality as defined in the standard

2024 International Energy Conservation Code [RE Project]

Add new standard(s) as follows:

Reason: AHRI notes that AHRI Standard 1430 is a harmonized specification for demand flexible electric resistance storage and electric heat pump water heaters (HPWH)s capable of load management that policymakers can use, state government, electric utilities, authorized third parties, manufacturers, designers, installers, contractors, and users. By providing standardized requirements for Demand Flexible Electric Storage Water Heaters (DFWH), utilities and load management program managers can be assured that DFWHs can communicate using standard hardware and software.

AHRI Standard 1430 published December 2022. Therefore, the standard is ready to be included in the code to guide DFWHs.

Bibliography: AHRI notes that AHRI Standard 1430 is available as a free download at the following link: https://www.ahrinet.org/sites/default/files/2022-12/AHRI%20Standard%201430-2022%20%28I-P%29.pdf.

The standard has also been uploaded for convenience.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Referencing AHRI Standard 1430 will neither increase nor decrease the cost of construction. If anything, since manufacturers will already employ AHRI 1430, the expected cost to manufacture products will decrease.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: provides standard for demand flexible electric resistance storage and electric heat pump water heaters.

Final Hearing Results

RED1-315-22	AM

RED1-318-22

Original Proposal

IECC: R403.6; IRCECC: N1103.6

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.6 Mechanical ventilation. The *buildings* and *dwelling units* complying with Section R402.5.1.1 shall be provided with mechanical *ventilation* that complies with the requirements of Section M1505 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.

2024 ENERGY Chapter11

Revise as follows:

N1103.6 Mechanical ventilation. The *buildings* and *dwelling units* complying with Section N1102.5.1.1 shall be provided with mechanical *ventilation* that complies with the requirements of Section M1505 or with other *approved* means of *ventilation*. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the *ventilation* system is not operating.

Reason: Based on approval of RE132-19 Part 1, as modified, the text of Section R403.6/N1103.6 of the 2021 IECC-R/IRC should read as follows:

R403.6 (IRC N1103.6). Mechanical ventilation. Buildings and dwelling units complying with Section 402.4.1 shall be provided with mechanical ventilation that complies with the requirements of M1505 of the International Residential Code or International Mechanical Code, as applicable, or with other approved means of ventilation...

(Note that in the PC draft #1, the numbering of the reference has editorially changed to R402.5.1.)

In consultation with ICC staff, an erratum has been submitted to ICC to correct the 2021 IECC-R/IRC language to read as shown above. This proposal seeks to modify the corrected 2021 IECC/IRC language by changing the R402.5.1/N1102.5.1 reference to R402.5.1.1/N1102.5.1.1. Use of the current reference could be misinterpreted to mean that mechanical ventilation is only required when each subsection of R402.5.1/N1102.5.1 is completed, including a blower door test. There are many adopting jurisdictions that waive blower door test requirements based on lack of access to qualified testers, but perhaps without exception, these jurisdictions retain the prescriptive air sealing requirements in R402.5.1.1/N1102.5.1.1. The requirement for mechanical ventilation should not be determined by whether a blower door test has been conducted but by whether air sealing measures have been pursued. The blower door test is simply there to confirm that the air sealing required by R402.5.1.1/N1102.5.1.1 has been executed properly. By modifying the reference in R403.6, the IECC sends the right message that mechanical ventilation is required in tightly constructed dwelling units and buildings, while ensuring that mechanical ventilation requirements are not inadvertently dropped by adopting jurisdictions that do not have access to blower door testers.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal clarifies existing requirements and does not affect construction costs.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Provides proper reference for air sealing requirements

Final Hearing Results	
RED1-318-22	AS

RED1-321-22

Original Proposal

IECC: TABLE R403.6.2

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R403.6.2 (N1103.6.2) WHOLE-DWELLING MECHANICAL VENTILATION SYSTEM FAN EFFICACY[a]

SYSTEM TYPE	AIRFLOW RATE (CFM)	MINIMUM EFFICACY (CFM/WATT)	TEST PROCEDURE
HRV or ERV	Any	1.2[a]	CAN/CSA C439
HRV, ERV, or balancedBalanced ventilation system without heat or energy recovery	Any	1.2[a]	HRV or ERV: CAN/CSA 439; Balanced without heat or energy recovery: ASHRAE Standard 51 (ANSI/AMCA Standard 210)
Range hood	Any	2.8	ASHRAE 51 (ANSI/AMCA Standard 210)
In-line supply or exhaust fan	Any	3.8	
Other exhaust fan	< 90	2.8	
	≥ 90 and < 200	3.5	
	≥ 200	4.0	
Air-handler that is integrated to tested and *listed* HVAC equipment	Any	1.2	Outdoor airflow as specified. Air-handler fan power determined in accordance with the HVAC appliance's test method referenced by Section C403.3.2 of the IECC-Commercial Provisions.

For SI: 1 cubic foot per minute = 0.47 L/s.

a. ~~Design outdoor airflow rate/watts of fan used~~.

For balanced systems, HRVs, and ERVs, determine the efficacy as the outdoor airflow divided by the total fan power.

Reason: This proposal modifies the fan efficacy table to provide editorial changes that improve clarity and improve alignment with the IECC-C fan efficacy table, as published in PC#1 of the 2024 IECC-C.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These are editorial changes that neither increase nor decrease costs.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Aligns with IECC Commercial table

Final Hearing Results

RED1-321-22 AS

RED1-322-22

Original Proposal

IECC: TABLE R403.6.2

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R403.6.2 WHOLE-DWELLING MECHANICAL VENTILATION SYSTEM FAN EFFICACY[a]

Portions of table not shown remain unchanged.

SYSTEM TYPE	AIRFLOW RATE (CFM)	MINIMUM EFFICACY (CFM/WATT)	TEST PROCEDURE
HRV, ERV, or balanced	Any	1.2	HRV or ERV: CAN/CSA 439; Balanced without heat or energy recovery: ASHRAE Standard 51 (ANSI/AMCA Standard 210)
Range hood	Any	2.8	ASHRAE 51 (ANSI/AMCA Standard 210)
In-line supply or exhaust fan	Any	3.8	
Other exhaust fan	< 90	2.8	
	≥ 90 and < 200	3.5	
	≥ 200	4.0	
Air-handler that is integrated to tested and *listed* HVAC equipment	Any	1.2	Outdoor airflow as specified. Air-handler fan power determined in accordance withthe HVAC appliance's the applicable US Department of Energy Code of Federal Regulations DOE10 CFR 430, or other approvedtest method referenced by Section C403.3.2 of the IECC-Commercial Provisions.

For SI: 1 cubic foot per minute = 0.47 L/s.

a. Design outdoor airflow rate/watts of fan used.

Reason: Section 105 requires residential buildings to comply with the IECC-Residential and not the IECC-Commercial provisions. Referencing the IECC-C is additionally inappropriate because of ICC commitments to industry and the chance of the IECC-C not being adopted by the jurisdiction.

More technically competent persons can provide the appropriate test method(s) direct reference(s) if approval by the code official is deemed inadequate.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is a formatting issue.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Referencing federally required commercial equipment efficiency test procedures is potentially problematic for Residential equipment. The proposed modification changes the reference to require alignment with requirements for residential equipment efficiency ratings.

Final Hearing Results

RED1-322-22 AM

RED1-324-22

Original Proposal

IECC: R403.6.3

Proponents: Mary Koban, AHRI, AHRI (mkoban@ahrinet.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.6.3 Testing. Mechanical ventilation systems shall be tested and verified to provide the minimum ventilation flow rates required by Section R403.6, in accordance with ANSI/RESNET/ICC 380. 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.

Exceptions:

1. Kitchen range hoods that are ducted to the outside with 6-inch (152 mm) or larger , a length of 10ft (3048 mm) or less, and not more than two 90° elbows or equivalent shall not require testing.
2. A third-party test shall not be required where the ventilation system has an integrated diagnostic tool used for airflow measurement, ~~programmable airflow settings,~~ and a user interface that communicates the installed airflow rate.

Reason: AHRI notes that this language is not necessary. By reference, ANSI/RESNET/ICC 380 allows manufacturer-integrated devices to qualify airflow measurements, but it does not include the limitations of having programmable airflow settings and a communicating user interface. This language is contrary to the RESNET standard and could be directed toward specific existing equipment.

Furthermore, since this language contradicts ANSI/RESNET/ ICC 380, it may cause confusion regarding how to apply the code. Therefore, AHRI notes that this exception should be deleted.

Bibliography: AHRI notes that the RESNET/ICC 380 standard can be reviewed at this link https://codes.iccsafe.org/content/RESNET3802019P1

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

It is expected that by removing the exception, construction costs will decrease. Manufacturers will have clear direction on which standard to use and additional ambiguity noted in the exception will be removed. Therefore, construction costs will decrease.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: proposal eliminates conflict with ANSI/RESnet 380.

Final Hearing Results

RED1-324-22 AM

RED1-325-22

Original Proposal

IECC: R403.7, R403.7.1

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com); Mary Koban, AHRI, AHRI (mkoban@ahrinet.org)

2024 International Energy Conservation Code [RE Project]

R403.7 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 have an efficiency rating equal to or greater than the minimum required by federal law for the geographic location where the *equipment* is installed.

Revise as follows:

R403.7.1 Electric-resistance space heating ~~zone heated units~~. ~~All d~~Detached one- and two-family dwellings and townhouses in Climate Zones 4 through 8~~4-8~~ using electric-resistance ~~zonal~~ space heating shall limit the total installed heating capacity of all electric-resistance space heating serving the *dwelling unit* to no more than 2.0 kW, or shall install a heat pump in the largest space that is not used as a bedroom.~~as the primary heat source shall install one additional heating unit in the largest living zone. The additional unit shall have an HSPF greater than 7.4 (6.3 HSPF2). Building permit drawings shall specify the heating equipment type and location of the heating system.~~

~~**Exceptions:**~~

1. ~~Total installed heating capacity of 2 kW per dwelling or less.~~
2. ~~Dwellings that have central ducted or ductless cooling or heating systems~~

Reason: The intent of this Public Comment is to retain the intent of the original requirement as introduced and justified by REPI-99, but to use simpler, clearer language. A 3rd exception is introduced for homes where the original requirement may not be cost-effective. The language regarding permit drawings is removed because it is redundant to text already required in R103.2. A minimum efficiency is not necessary given that the federal standards for heat pumps (10 CFR 430.32(c)), other than small-duct high-velocity systems and space-constrained heat pumps, require a higher efficiency than 7.4 HSPF (6.3 HSPF2).

Bibliography: None

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
N/A

Public Hearing Results

Committee Action **As Modified**

Committee Reason: moved exception into charging language and provided further cleanup of section.

Final Hearing Results

RED1-325-22 AM

RED1-329-22

Original Proposal

IECC: R403.8; IECC: R403.5.2 (New), R403.9 (New), R403.9.1 (New), R403.9, R403.10, R403.9.4 (New)
Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R403.8 Systems serving multiple dwelling units. Except for systems complying with Section R403.9, systems~~Systems~~ serving multiple *dwelling units* shall comply with Sections C403 and C404 of the *International Energy Conservation Code*–Commercial Provisions instead of Section R403.

2024 International Energy Conservation Code [CE Project]

Revise as follows:

R403.5.2 ~~Controls for hot water storage.~~ ~~The controls on pumps that circulate water between a water heater and a heated-water storage tank shall limit operation of the pump from heating cycle startup to not greater than 5 minutes after the end of the cycle.~~

Add new text as follows:

R403.9 Mechanical systems located outside of the building thermal envelope. Mechanical systems providing heat outside of the thermal envelope of a building shall comply with Sections R403.9.1 through R403.9.4.

R403.9.1 Heating outside a building. Systems installed to provide heat outside a building shall be radiant systems. Such heating systems shall be controlled by an occupancy sensing device or a timer switch, so that the system is automatically de-energized when occupants are not present.

Revise as follows:

~~R403.9~~R403.9.2 Snow melt and ice system controls. Snow- and ice-melting systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the system when the pavement temperature is greater than 50°F (10°C) and precipitation is not falling, and an automatic or manual control that will allow shutoff when the outdoor temperature is greater than 40°F (4.8°C).

~~R403.10~~R403.9.3 Roof and gutter deicing controls. Roof and gutter deicing systems, including but not limited to self-regulating cable, shall include automatic controls configured to shut off the system when the outdoor temperature is above 40°F (4.8°C) maximum and shall include one of the following:

1. A moisture sensor configured to shut off the system in the absence of moisture, or
2. A programmable timer configured to shut off the system for 8 hours minimum at night.

Add new text as follows:

R403.9.4 Freeze protection system controls. Freeze protection systems, such as heat tracing of outdoor piping and heat exchangers, including self-regulating heat tracing, shall include automatic controls configured to shut off the systems when outdoor air temperatures are above 40°F (4.8°C) or when the conditions of the protected fluid will prevent freezing.

Reason: Section R101.5 clearly requires that residential buildings comply with the IECC-R rather than the IECC- commercial provisions.

The original proponent of this section should do the work of incorporating the actual requirements for the benefit of the code user instead of referencing a code that may not be adopted.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There will be no impact if the original proponent completes the work.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The Committee agreed to vote against the Disapproval in order to hear the modification. The modification resolved objections by not fully deleting the reference to IECC-C and by beginning the process of bringing in applicable IECC-C requirements into IECC-R.

Final Hearing Results

RED1-329-22	AM

RED1-330-22

Original Proposal

IECC: R404.1
Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.1 Lighting equipment. All permanently installed luminaires , shall be capable of operation with an efficacy of not less than 45 lumens per watt or shall contain lamps capable of operation ~~at~~ with an efficacy of not less than 65 lumens per watt ~~or greater~~.

Exceptions:

1. ~~Kitchen appliance lighting~~ Appliance lamps.
2. Antimicrobial lighting used for the sole purpose of disinfecting.
3. General service lamps complying with DOE 10 CFR 430.32.
4. Luminaires with a rated electric input of not greater than 3.0 watts.

Reason: This proposal correlates the language in the 2024 IECC-C PC#1 draft with the IECC-R while clarifying that range hoods are exempt from the fan efficacy provisions, maintaining the 2021 IECC-R and IECC-C exception for this product class based on concerns for durability and viability of high-efficacy lighting exposed to the elevated temperatures associated with residential cooking.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This language is an editorial clarification of the current language and will therefore neither increase nor decrease the cost of construction.

Aside: While high-efficacy lighting is now available in range hoods, the cost of products incorporating such lighting is currently much higher than for hoods without such technology.
A survey of range hoods on HomeDepot.com conducted on December 12, 2022, found the following:

- 42 results for 30” range hoods of all lighting types except LED, starting at $69.
- 186 results for 30” range hoods with LED lighting, starting at $139.

A $70 difference is a high premium to pay for a lamp that is expected to have a low duty cycle.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: avoids issue of pre-emption related to federal efficiency laws

Final Hearing Results

RED1-330-22 AM

RED1-335-22

Original Proposal

IECC: R404.5.3

Proponents: Shane Hoeper, City of Dubuque, myself (shoeper@cityofdubuque.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R404.5.3 Water heaters. An ~~individual~~ dedicated branch circuit ~~outlet~~ with a rating not less than either 240-volts, 30-amperes or 120V, 20-amperes shall be installed~~,~~ and terminate within three feet (304 mm) of each ~~fossil fuel~~ water heater.

Exception: Water heaters ~~in a centralized water heating system~~serving multiple dwelling units in an R-2 occupancy.

Reason: The changes are editorial in nature and intended to make all the sections under R404.5 consistent.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The changes are only editorial and does not affect the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: avoids controversy on fuel type of water heater.

Final Hearing Results

RED1-335-22	AS

RED1-336-22

Original Proposal

IECC: R405.4, R405.4.1, R405.4.2, TABLE R405.4.2(1)

Proponents: Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com)

2024 International Energy Conservation Code [RE Project]

R405.4 Calculation procedure. Calculations of the proposed design shall be in accordance with Sections R405.4.1 and R405.4.2.

R405.4.1 General. Except as specified by this section, the *standard reference design* and *proposed design* shall be configured and analyzed using identical methods and techniques.

R405.4.2 Residence specifications. The *standard reference design* and *proposed design* shall be configured and analyzed as specified by Table R405.4.2(1). Table R405.4.2(1) shall include, by reference, all notes contained in Table R402.1.3.

Revise as follows:

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN			
Service water heating[d, g, k]	As proposed. Use, in units of gal/day = 25.5 + (8.5 × N_{br}) where: N_{br} = number of bedrooms.	As proposed Use, in units of gal/day = 25.5 + (8.5 × N_{br}) × (1 − *HWDS*) where: N_{br} = number of bedrooms. *HWDS* = factor for the compactness of the hot water distribution system.			
		Compactness ratio[i] factor		**HWDS**	
		1 story	2 or more stories		
		> 60%	> 30%	0	
		> 30% to ≤ 60%	> 15% to ≤ 30%	0.05	
		> 15% to ≤ 30%	> 7.5% to ≤ 15%	0.10	
		< 15%	< 7.5%	0.15	
	Fuel Type: Same as proposed design	As proposed			
	Rated Storage Volume: Same as proposed design	As proposed			
	Draw Pattern: Same as proposed design	As proposed			
	Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32	As proposed			
	Tank Temperature: 120° F (48.9° C)	Same as standard reference design			

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, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design without a proposed water heater, the following assumptions shall be made for both the proposed design and standard reference design. For a proposed design with a heat pump water heater, the following assumptions shall be made for the standard reference design, except the fuel type shall be electric.

Fuel Type: Same as the predominant heating fuel type

Rated Storage Volume: 40 Gallons

Draw Pattern: Medium

Efficiency: Uniform Energy Factor complying with 10 CFR §4 ~~1~~30.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

AF $= A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and
where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a proposed design with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the standard reference design.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the standard reference design shall be the same as proposed design.

Reason: This Public Comment proposes that the Standard Reference Design should be modeled with a 40 gallon electric resistance storage water heater when the Proposed Design is a heat pump water heater. The current language would require the Standard Reference Design to be a heat pump water heater if that system type is in the Proposed Design. Given that electric storage is permitted by code, there should be more savings associated with this upgrade to a HPWH to encourage its adoption by builders. This approach is also the same as that used in the ERI Path and similar to the approach used to calculate points for HPWHs in R408.2.3.

Note: Some of the edits shown are errata, as they were approved through REPI-122:

1. removing "As Proposed" from the table in both columns
2. adding "without a proposed water heater" to note g.

Bibliography: None.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This public comment does not increase the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: After the motion to Disapprove RED1-336 failed, the Committee considered a Motion to Approve As Modified, in order to hear the modification shown in the agenda. The modification raised additional questions/comments that could not be immediately resolved and therefore the motion was withdrawn and replaced with a motion to Approve as Submitted. The Committee voted to support the proposal, as submitted, such that integrated heat pump water heaters in a Proposed Design in R405 are compared to electric resistance storage water heaters in the Standard Reference Design.

Final Hearing Results

RED1-336-22	AS

RED1-337-22

Original Proposal

IECC: TABLE R405.4.2(1)

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE N1105.4.2(1) R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN	
Air exchange leakage rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 5.0 air changes per hour. Climate Zones 3 , 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour.	The measured air exchange leakage rate.[a]	
Mechanical ventilation rate	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M. where: B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air exchange leakage rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Heat recovery or energy recovery shall be modeled for mechanical ventilation where required by Section R403.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section R403.6.1.	The mechanical ventilation rate[b], Q, shall be in addition to the air leakage rate and shall be as proposed.	
Mechanical ventilation fan energy	Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (8.76 × B × M)/e_f where: B and M are determined in accordance with the Air Exchange Mechanical Ventilation Rate row of this table. e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of B × M. *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed	

Reason: This proposal is an editorial clarification and reorganization to improve usability.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal is editorial and will therefore neither increase nor decrease the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: editorial and sync with other sections and table of proposals.

Final Hearing Results

RED1-339-22

Original Proposal

IECC: TABLE R405.4.2(1)

Proponents: Robert Salcido, PNNL, DOE (victor.salcido@pnnl.gov)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	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: as specified in Table R402.1.2, with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	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 an aperture of 1 ft^2 per 300 ft^2 of 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 as specified in Table R402.1.2.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Vertical fenestration other than opaque doors	Total area[h] = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. (b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: 0.92 - (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 - (0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2:5.0 air changes per hour. Climate Zones 3 , 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M where: B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air exchange rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Heat recovery or energy recovery shall be modeled for mechanical ventilation where required by Section R403.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section R403.6.1.	The mechanical ventilation rate[b], Q, shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (8.76 × B × M)/ef where: B and M are determined in accordance with the Air Exchange Rate row of this table. e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of B × M. *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed
Internal gains	IGain, in units of Btu/day per dwelling unit, shall equal 17,900 + 23.8 ×*CFA* + 4,104 × N_{br} where: *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	Same as standard reference design.
Internal mass	Internal mass for furniture and contents: 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.3, located on the interior side of the walls.	As proposed
	For other walls, ceilings, floors, and interior walls: wood frame construction.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Heating systems[d, e, j, k]	For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC–Commercial Provisions. Capacity: sized in accordance with Section R403.7.	
	Fuel Type/Capacity: Same as proposed design	As proposed
	Product class: Same as proposed design	As proposed
	Efficiencies:	As proposed
	Heat pump: Complying with 10 CFR §430.32	As proposed
	Non-electric furnaces: Complying with 10 CFR §430.32	As proposed
	Non-electric boilers: Complying with 10 CFR §430.32	As proposed
Cooling systems[d, f, k]	As proposed. Capacity: sized in accordance with Section R403.7.	
	Fuel Type: Electric Capacity: Same as proposed design	As proposed
	Efficiencies: Complying with 10 CFR §430.32	As proposed
Service water heating[d, g, k]	As proposed. Use, in units of gal/day = 25.5 + (8.5 × N_{br}) where: N_{br} = number of bedrooms.	As proposed Use, in units of gal/day = 25.5 + (8.5 × N_{br}) × (1 − *HWDS*) where: N_{br} = number of bedrooms. *HWDS* = factor for the compactness of the hot water distribution system.

Compactness ratio[i] factor		HWDS
1 story	2 or more stories	
> 60%	> 30%	0
> 30% to ≤ 60%	> 15% to ≤ 30%	0.05
> 15% to ≤ 30%	> 7.5% to ≤ 15%	0.10
< 15%	< 7.5%	0.15

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	Fuel Type: Same as proposed design	As proposed
	Rated Storage Volume: Same as proposed design	As proposed
	Draw Pattern: Same as proposed design	As proposed
	Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32	As proposed
	Tank Temperature: 120° F (48.9° C)	Same as standard reference design
Thermal distribution systems	Duct location:	Duct location: as proposed.

Foundation Type	Slab on grade	Unconditioned crawl space	Basement or conditioned crawl space
Duct location (supply and return)	One-story building: 100% in unconditioned attic All other: 75% in unconditioned attic and 25% inside conditioned space	One-story building: 100% in unconditioned crawlspace All other: 75% in unconditioned crawlspace and 25% inside conditioned space	

~~5~~	~~%~~ d ditioned space	
~~0~~ ~~%~~ 7 5	i n s i e c o n ~~50%~~25% unconditioned attic	
	Duct insulation: in accordance with Section R403.3.1.	Duct insulation: as proposed.
	- - -	

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	Duct system leakage to outside: For duct systems serving > 1,000ft2 of conditioned floor area, the total duct system leakage to outside rate shall be 48 cfm (113.3 L/min) per 100 ft2 (9.29 m2) of conditioned floor area. For duct systems serving ≤ 1,000ft2 of conditioned floor area, the total duct system leakage to outside rate shall be 480 cfm (1132.7 L/min).	Duct System Leakage to Outside: The measure total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate. **Exceptions:** 1. When duct system leakage to outside is tested in accordance ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered. 2. When total duct system leakage is measured without the air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.
	For hydronic systems and ductless systems a thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies.	For hydronic systems and ductless systems, DSE shall be as specified in Table R405.4.2(2).
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F.	Same as standard reference design.
Dehumidistat	Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None. Where the proposed design utilizes a mechanical ventilation system with latent heat recovery: Dehumidistat type: manual, setpoint = 60% relative humidity. Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.	Same as standard reference design.

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, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design the following assumptions shall be made for both the proposed design and standard reference design.

Fuel Type: Same as the predominant heating fuel type

Rated Storage Volume: 40 Gallons

Draw Pattern: Medium

Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

$$AF = A_S \times FA \times F$$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and
where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

    1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.

    2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.

    3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.

    4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.

    5. The basement or attic shall be counted as a story when it contains the water heater.

    6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a proposed design with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the standard reference design.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the standard reference design shall be the same as proposed design.

Reason: Ducts that are located in unconditioned spaces can significantly increase energy use in the home or dwelling unit due to thermal losses and air leakage outside of the building envelope. As proposed, the 2024 IECC would credit ducts located within conditioned space. While locating ducts within conditioned space is indeed best practice, there is a problem in how R405, as proposed, would handle ducts, effectively crediting every system installed *as if it would have otherwise been installed outside of conditioned space.*The consequences of this approach can be severe and were not sufficiently evaluated in previous committee deliberations.

Pacific Northwest National Laboratory (PNNL) has analyzed the impact of moving ducts from unconditioned space into conditioned space and found that the associated energy impact can be up to 18% of whole-building energy use, and corresponding energy costs of almost $400 per year, with the largest impacts experienced in colder climates. In addition to thermal losses, there are many other widely recognized benefits of locating ducts in conditioned space, such as lower risk of moisture issues and increased indoor air quality, among others. The following table depicts the expected energy use reductions across U.S. climate zones.

	HVAC Distribution System	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
	100 Percent of Ducts In Conditioned Space	3.57%	5.10%	6.65%	9.58%	12.13%	14.04%	16.13%	18.44%
	100 Percent of Ducts In Conditioned Space	$74	$88	$99	$118	$104	$155	$209	$361

The challenge of modeling duct location in performance-based approaches is that it can be difficult to credit positive behaviors (i.e., encouraging ducts to be located within conditioned space) without creating a severe false credit in areas and situations where ducts are already commonly located within conditioned space, which is heavily influenced by geographic location and other design choices (e.g., foundation type and number of floors). The issue of false credit, often referenced as *free ridership*, is especially prominent in colder climate zones. DOE field study data indicates that approximately 25% of homes commonly have 100% of their duct system installed in conditioned space. Over 50% of homes with heated basements, as are common in colder climates, had duct systems located completely within conditioned space. In these areas, the resulting credit is large enough to significantly erode the overall energy efficiency of the home, costing the home owner thousands over the life of the home. This tends to be a binding decision, as duct systems are difficult and costly to relocate after initial design and construction of the home. This challenge of properly rewarding, or penalizing, duct location is a primary reason duct location has not been credited in recent editions of the IECC. As proposed, the 2024 IECC introduces this challenge without appropriate safeguards–and to a magnitude that can dwarf other design choices.

The Committee should reconsider this approach and seek alternatives with lower risk of falsely crediting common design choices. In support of this objective, PNNL is offering two proposals which are intended to function independently or work in tandem; one which specifies ducts within conditioned space as a prescriptive requirement, and the second which addresses duct location in R405. In the latter case, ducts may still be located in unconditioned space, and comply with R405, and the associated (negative) energy impact can be offset through additional energy efficiency achieved elsewhere in the home.

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

The costs of a prescriptive requirement to have ducts in conditioned space can range from $0 (for the many homes that already commonly include ducts in conditioned space) to $400 for dropped ceiling strategy. A higher cost strategy where ducts are installed in a conditioned attic, which typically involves insulating and sealing the roof deck is estimated at a cost of $3,000. An average cost ranges from $1,000 to $1,300 based on previous research studies.
(https://energy.gov/sites/prod/files/2014/01/f6/1_1g_ba_innov_ductsconditionedspace_011713.pdf)

Cost-effectiveness analysis, based on the approach and parameters established by the 2024 IECC development committee, indicates that locating ducts within conditioned space is cost effective across all climate zones and costs up to $1300. Associated paybacks range from 3.8 to 11.0 years, and life-cycle cost savings from $520 to $8,120.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: modification allows flexibility for ducts in conditioned space.

Final Hearing Results

RED1-339-22	AM

RED1-340-22

Original Proposal

IECC: TABLE R405.4.2(1)

Proponents: Shannon Corcoran, American Gas Association, American Gas Association (corcoransm@att.net)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	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: as specified in Table R402.1.2, with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	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 an aperture of 1 ft^2 per 300 ft^2 of 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 as specified in Table R402.1.2.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Vertical fenestration other than opaque doors	Total area[h] = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. (b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: 0.92 – (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 – (0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 5.0 air changes per hour. Climate Zones 3 , 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M where: B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air exchange rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Heat recovery or energy recovery shall be modeled for mechanical ventilation where required by Section R403.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section R403.6.1.	The mechanical ventilation rate[b], Q, shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (8.76 × B × M)/ef where: B and M are determined in accordance with the Air Exchange Rate row of this table. e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of B × M. *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed
Internal gains	IGain, in units of Btu/day per dwelling unit, shall equal 17,900 + 23.8 ×*CFA* + 4,104 × N_{br} where: *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	Same as standard reference design.
Internal mass	Internal mass for furniture and contents: 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.3, located on the interior side of the walls.	As proposed
	For other walls, ceilings, floors, and interior walls: wood frame construction.	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Heating systems[d, e, j, k]	For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC–Commercial Provisions. Capacity: sized in accordance with Section R403.7.	
	Fuel Type/Capacity: Same as proposed design	As proposed
	Product class: Same as proposed design	As proposed
	Efficiencies:	As proposed
	Heat pump: Complying with 10 CFR §430.32	As proposed
	~~Non-electric~~ Natural gas, propane and fuel oil furnaces: Complying with 10 CFR §430.32	As proposed
	~~Non-electric~~ Natural gas, propane and fuel oil boilers: Complying with 10 CFR §430.32	As proposed
Cooling systems[d, f, k]	As proposed. Capacity: sized in accordance with Section R403.7.	
	Fuel Type: Electric Capacity: Same as proposed design	As proposed
	Efficiencies: Complying with 10 CFR §430.32	As proposed
Service water heating[d, g, k]	As proposed. Use, in units of gal/day = 25.5 + (8.5 × N_{br}) where: N_{br} = number of bedrooms.	As proposed Use, in units of gal/day = 25.5 + (8.5 × N_{br}) × (1 − *HWDS*) where: N_{br} = number of bedrooms. *HWDS* = factor for the compactness of the hot water distribution system.

Compactness ratio[i] factor		HWDS
1 story	2 or more stories	
> 60%	> 30%	0
> 30% to ≤ 60%	> 15% to ≤ 30%	0.05
> 15% to ≤ 30%	> 7.5% to ≤ 15%	0.10
< 15%	< 7.5%	0.15

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	Fuel Type: Same as proposed design	As proposed
	Rated Storage Volume: Same as proposed design	As proposed
	Draw Pattern: Same as proposed design	As proposed
	Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32	As proposed
	Tank Temperature: 120° F (48.9° C)	Same as standard reference design
Thermal distribution systems	Duct location:	Duct location: as proposed.

Foundation Type	Slab on grade	Unconditioned crawl space	Basement or conditioned crawl space
Duct location (supply and return)		One-story building: 100% in unconditioned attic	All other: 75% in unconditioned attic and 25% inside conditioned space

One-story building: 100% in unconditioned crawlspace

All other: 75% in unconditioned crawlspace and 25% inside conditioned space

50% inside conditioned space

50% unconditioned attic

Duct insulation: in accordance with Section R403.3.1.

Duct insulation: as proposed.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	Duct system leakage to outside: For duct systems serving > 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft2 (9.29 m2) of conditioned floor area. For duct systems serving ≤ 1,000ft2 of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).	Duct System Leakage to Outside: The measure total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate. **Exceptions:** 1. When duct system leakage to outside is tested in accordance ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered. 2. When total duct system leakage is measured without the air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.
	For hydronic systems and ductless systems a thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies.	For hydronic systems and ductless systems, DSE shall be as specified in Table R405.4.2(2).
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F.	Same as standard reference design.
Dehumidistat	Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None. Where the proposed design utilizes a mechanical ventilation system with latent heat recovery: Dehumidistat type: manual, setpoint = 60% relative humidity. Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.	Same as standard reference design.

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, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design the following assumptions shall be made for both the proposed design and standard reference design.

Fuel Type: Same as the predominant heating fuel type

Rated Storage Volume: 40 Gallons

Draw Pattern: Medium

Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

$AF = A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and
where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the “hot water rectangle”) divided by the floor area of the dwelling.

   1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.
   2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
   3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
   4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
   5. The basement or attic shall be counted as a story when it contains the water heater.
   6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a proposed design with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the standard reference design.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the standard reference design shall be the same as proposed design.

Reason: To use proper terminology for the energy source for these appliances

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This does not affect construction costs

Public Hearing Results

Committee Action **As Modified**

Committee Reason: provides clarification

Final Hearing Results

RED1-340-22 AM

RED1-343-22

Original Proposal

IECC: SECTION 202 (New), TABLE R408.2, R408.2.5

Proponents: Mark Lyles, New Buildings Institute, California IOUs (markl@newbuildings.org); Gayathri Vijayakumar, Steven Winter Associates, Inc., Steven Winter Associates, Inc. (gvijayakumar@swinter.com); Vladimir G. Kochkin, NAHB, NAHB (vkochkin@nahb.org); Jennifer Amann, ACEEE, ACEEE (jamann@aceee.org)

2024 International Energy Conservation Code [RE Project]

Add new definition as follows:

BALANCED VENTILATION SYSTEM. A ventilation system that simultaneously supplies outdoor air to and exhausts air from a space, where the mechanical supply airflow rate and the mechanical exhaust airflow rate are each within 10% of the average of the two airflow rates.

Revise as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 4C	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.5(1)	ERV or HRV installed	TBD	TBD	TBD	TBD	TBD	TBD	0	0	0
R408.2.5(~~1~~ 2)	≤2.0 ACH50 air leakage rate with ERV or HRV installed	1	4	5	10	10	13	15TBD	~~8~~TBD	~~8~~.TBD
R408.2.5(~~2~~ 3)	≤2.0 ACH50 air leakage rate with balanced ventilationa *balanced ventilation system*	2	3	2	4	4	5	~~6~~TBD	~~6~~TBD	~~6~~ TBD
R408.2.5(~~3~~ 4)	≤1.5 ACH50 air leakage rated with ERV or HRV installed	2	4	6	12	12	15	18TBD	11TBD	11TBD
R408.2.5(~~4~~ 5)	≤1.0 ACH50 air leakage rate with ERV or HRV installed	2	5	6	14	14	17	21TBD	14TBD	14TBD

R408.2.5 Improved air sealing and efficient ventilation system option.~~The measured air leakage rate shall be less than or equal to 3.0 ACH50, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed. Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent Sensible Recovery Efficiency (SRE), less than or equal to 1.1 cubic feet per minute per watt (0.03 m3/min/watt) and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent Latent Recovery/Moisture Transfer (LRMT)~~ The measured air leakage rateand ventilation system shall meet ~~be~~ one of the following:

1. ~~Less than or equal to 2.0 ACH50, with e~~ Either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed.
2. Less than or equal to 2.0 ACH50, with either an ERV or HRV installed.

~~2.~~ 3. Less than or equal to 2.0 ACH50, witha *balanced ventilation* *system* ~~as defined in Section 202 of the 2021~~~~*International Mechanical Code*~~.

~~3.~~ 4. Less than or equal to 1.5 ACH50, with either an ERV or HRV installed.

~~4.~~ 5. Less than equal to 1.0 ACH50, with either an ERV or HRV installed.

In addition, for measures requiring either an ERV or HRV, ~~Mminimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent Sensible Recovery Efficiency (SRE), less than or equal to 1.1 cubic feet per minute per watt (0.03 m^3/min/watt) and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent Latent Recovery/ Moisture Transfer (LRMT).~~ HRV and ERV Sensible Recovery Efficiency (SRE) shall be no less than 75 percent at 32°F (0°C), at the lowest listed net airflow. ERV Latent Recovery/Moisture Transfer (LRMT) or Net Moisture Transfer (NMT) shal be no less than 50 percent, at the lowest listed net airflow. In Climate Zone 8, recirculation shall not be used as a defrost strategy.

Reason: We propose an additional efficiency option in R408.2.6. The option provides credit for installing ERV/HRV for buildings meeting prescriptive air leakage rates, as defined in Section R402.5.1.3.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

NA

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Replaces 2021 IMC definition for 'balanced ventilation' with a 2024 IRC definition for 'balanced ventilation system', and then revised as needed where the term is used. Also, replaces the credits awarded in CZ 6, 7, & 8 with 'TBD', given that 2.5 ACH50 and ERV/HRVs are now required in those CZs and the points may need to be re-calculated by PNNL.

Final Hearing Results

RED1-343-22	AM

RED1-351-22

Original Proposal

IECC: R408.2.2, TABLE R408.2

Proponents: Mary Koban, AHRI, AHRI (mkoban@ahrinet.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

R408.2.2 More efficient HVAC equipment performance option. Heating and cooling *equipment* shall meet one of the following efficiencies as applicable for the climate zone. Where multiple heating or cooling systems are installed serving different zones, credits shall be earned based on the weighted average of square footage of the zone served by the system.~~Centrally Ducted Systems~~:HVAC options applicable to all climate zones:

1. Ground source Heat Pump -Greater than or equal to 16.1 EER and 3.1 COP ground source heat pump.
2. Cooling (Option 1)-Greater than or equal to 15.2 SEER2 and 12.0 EER2 air conditioner.
3. Cooling (Option 2)-Greater than or equal to 16.0 SEER2 and 12.0 EER2 air conditioner.
4. Gas Furnace (Option 1)-Greater than or equal to 97 % AFUE fuel gas furnace.
5. Gas Furnace (Option 2)- Greater than or equal to 95% AFUE fuel gas furnace.

HVAC options applicable to climate zones 0, 1, 2, and 3:

6. Gas Furnace (Option 3)-Greater than or equal to 90% AFUE fuel gas furnace.
7. Gas Furnace and Cooling (Option 1)- Greater than or equal to 90% AFUE fuel gas furnace and 15.2 SEER2 and 10.0 EER2 air conditioner.
8. Gas Furnace and Cooling (Option 2) - Greater than or equal to 95% AFUE fuel gas furnace and 16.0 SEER2 and 10.0 EER2 air conditioner.
9. Gas Furnace and Heat Pump (Option 1) - Greater than or equal to 90% AFUE fuel gas furnace and 7.8 HSPF2, 15.2 SEER2 and 10.0 EER2 air source heat pump.
10. Heat Pump (Option 1)-Greater than or equal to 7.8 HSPF2, 15.2 SEER2, and 11.7 EER2 air source heat pump.

HVAC options applicable to climate zones 4, 5, 6, 7, and 8:

11. Gas Furnace and Cooling (Option 3)-Greater than or equal to 95% AFUE fuel gas furnace and 15.2 SEER2 and 12.0 EER2 air conditioner.
12. Gas Furnace and Cooling (Option 4)-Greater than or equal to 97% AFUE fuel gas furnace and 16.0 SEER2 and 12.0 EER2 air conditioner.
13. Gas Furnace and Heat Pump (Option 2)- Greater than or equal to 95% AFUE fuel gas furnace and 8.1 HSPF2 and 15.2 SEER2 air source heat pump capable of meeting a capacity ratio ≥ 70% of heating capacity at 5 °F versus rated heating capacity at 47 °F.
14. Heat Pump (Option 2)-Greater than or equal to 8.1 HSPF2 and 15.2 SEER2 air source heat pump capable of meeting a capacity ratio ≥ 70% of heating capacity at 5 °F versus rated heating capacity at 47 °F.

~~1. High Performance Cooling (Option 1)-Greater than or equal to 16 15.2 SEER2 and 12 EER2 air conditioner in all Climate Zones~~

2. ~~High Performance Cooling (Option 2) Greater than or equal to 18 SEER (16.90SEER2) and 14 EER (13.412 EER2) air conditioner in all Climate Zones.~~

3a. ~~High Performance Gas Furnace (Option 1) Greater than or equal to 925% AFUE natural gas furnace in Climate Zones 4A, 4C, 5, 6, 7, and 8.~~

3b. ~~High Performance Gas Furnace (Option 1) Greater than or equal to 90% AFUE natural gas furnace in Climate Zones 0,1,2,3 and 4B~~

4a. ~~High Performance Gas Furnace and Cooling (Option 1) -Greater than or equal to 95% AFUE natural gas furnace and 15.2 SEER2/ 12 EER2 in Climate Zones 4A,4C, 5, 6 and 7 and 8.~~

4b ~~High Performance Gas Furnace and Cooling (Option 1) Greater than or equal to 90% AFUE natural gas furnace and 15.2 SEER2/ 10 EER2 in climate zones 0, 1, 2, 3, and 4B for air conditioner~~

5a. ~~High Performance Gas Furnace and Cooling (Option 2) Greater than or equal to 957% AFUE natural gas furnace and 16.0 SEER2/12 EER in other Climate Zones for air conditionerin Climate Zones 4A, 4C, 5,6,7 and 8.~~

5b. ~~High Performance Gas Furnace and Cooling (Option 2) - Greater than or equal to 95% AFUE and 16 SEER2/10 EER2 air conditioner in climate zones 0, 1, 2, 3, and 4B~~

6a. ~~High Performance Gas Fornace and HP (Option 1) Greater than or equal to 95% AFUE natural gas furnace and 8.51 HSPF2/16.015.2 SEER2 air source heat pumpin Climate Zones 4A, 4C, 5,6,7,and 8.~~

6b. ~~High Performance Gas Furnace and HP (Option 1) - Greater than or equal to 90% AFUE furnace and 7.8 HSPF2 / 15.2 SEER2/10.0 EER2 air source heat pump in Climate Zones 0, 1,2,3, and 4B~~

7a. ~~High Performance Gas Furnace (Option 2) -Greater than or equal to 967 % in AFUE natural gas furnace inc Climate Zones 4A, 4C, 5, 6, 7 and 8.~~

7b ~~High Performance Gas Furnace (Option 2) Greater than or equal to 95% AFUE natural gas furnace in Climate Zones 0, 1, 2, 3, and 4B.~~

8a. ~~High Performance HP (Option 1) Greater than or equal to 8.51 HSPF2/16.015.2 SEER2 air source heat pumpin Climate Zones 4A, 4C, 5, 6,7 and 8.~~

8b ~~High Performance HP (Option 1) Greater than or equal to 7.8 HSPF2/ 15.2 SEER2/ 11.7 EER2 air source heat pump in Climate Zones 0, 1, 2, 3, and 4B~~

9a. ~~High Performance HP (Option 2) Greater than or equal to 9 HSPF (7.68.5 HSPF2) /16 SEER (15.2SEER2/12 EER2) air source heat pump in Climate Zones 4A,4C,5,6,7 and 8.~~

~~10. 9b High Performance HP (Option 2) Greater than or equal to 10 HSPF (8.52 HSPF2 /) /16SEER (15.2 16.9 SEER2/12 EER2) air source heat pump in Climate Zones 0,1,2,3, and 4B.~~

~~11.10. Ground source HP Greater than or equal to 16.1 EER/ 3.51 COP ground source heat pump~~.

~~Ductless Systems:~~

~~121a. Single Zone: Greater than or equal to 8.5 HSPF2/16.915.2 SEER2 variable speed air source heat pumpin Climate Zones 4A, 4C, 5, 6, 7 and 8.~~

~~11b. Single Zone: Greater than or equal to 7.8 HSPF2/15.2 SEER2 / 11.7 EER2 variable spped air source heat pump in climate zones 0, 1, 2, 3, and 4B.~~

~~132. Multi Zone: 8.5 HSPF2/16.9 SEER2 variable speed air source heat pump (Non-Ducted Indoor Units~~).

~~143. Multi Zone: 8.5 HSPF2/15.2 SEER2 variable speed air source heat pump (Ducted or Mixed Indoor Units~~)

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Portions of table not shown remain unchanged.

Measure Number	Measure Description	Credit Value

		Climate Zone 0 & 1	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4A	Climate Zone 4B	Climate Zone 4C	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.2(1)	Ground source heat pump	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(2)	Cooling (Option 1)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(3)	Cooling (Option 2)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(4)	Gas Furnace (Option 1)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(5)	Gas Furnace (Option 2)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(6)	Gas Furnace (Option 3)	TBD	TBD	TBD	TBD	-	-	-	-	-	-	-
R408.2.2(7)	Gas Furnace and cooling (Option 1)	TBD	TBD	TBD	TBD	-	--	-	-	-	-	-
R408.2.2(8)	Gas Furnace and Cooling (Option 2)	TBD	TBD	TBD	TBD	-	--	-	-	-	-	-
R408.2.2.(9)	Gas Furnace and Heat Pump (Option 1)	TBD	TBD	TBD	TBD	-	-	-	-	-	-	-
R408.2.2(10)	Heat Pump (Option 1)	TBD	TBD	TBD	TBD	-	-	--	-	-	-	
R408.2.2(11)	Gas Furnace and Cooling (Option 3)	-	-	-	-	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(12)	Gas Furnace and Cooling (Option 4)	-	-	-	-	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2.(13)	Gas Furnace and Heat Pump (Option 2)	-	-	-	-	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R408.2.2(14)	Heat pump (Option 2)	-	-	-	-	TBD	TBD	TBD	TBD	TBD	TBD	TBD

SEER2: Seasonal Energy Efficiency Ratio, HSPF2: Heating Season Performance Factor, EER2: Energy Efficiency Ratio, COP: Coefficient of Performance

Reason: Dear IECC Residential SC and Committee Members, we noted that Table 408.2 was difficult to update in cdpaccess. We did truncate the table and only concentrated on the HVAC portion for the submission. However, cdpaccess still did not capture our edits clearly. Therefore, we are attaching a spreadsheet (PDF) for your reference so you can see what we did. We provded more energy efficient product options by climate zones matched with potential credits.This caused us to add rows 3b, 4b, 5b, 6b, 7b, 8b, and 11b. (The concept in 9b was already captured in the original table.) We also split out Climate zones 4A, 4B, and 4C since credits are noted by granularity of climate zone 4. We also split out climate zones 0, 1 as we are still waiting for analysis from PNNL. Therefore, climate zones 0 and 1 may be different.

On August 16, 2022, President Joe Biden signed the Inflation Reduction Act (IRA) into law. The Act, which contains dozens of provisions related to climate change and prescription drug prices, includes measures that provide federal income tax credits for high efficiency HVAC and water heater products. This proposal aligns Additional Energy Credits with the IRA, provides even more energy credits for higher-efficiency equipment, and will encourage homeowners and builders to install efficient water heater products. Therefore, AHRI members suggest to align with Energy Star product specifications and CEE tiers when defining efficiency levels for HVAC options in R408.2.2. AHRI notes that the following sections of R408.2.2 align with these sections of either Energy Star v5.0 or CEE Tier 2 or 3. AHRI members note that aligning with these options provide the industry at large multiple product options that provide energy benefits and potentially provide tax credits.

AHRI reiterates that data from PNNL was not available. Therefore, AHRI felt it was prudent to provide multiple options/scenarios to ensure energy-efficient options are available to the marketplace based on the current energy efficiency levels noted by Energy Star and CEE.

- **R408.2.2.1 –** The proposal aligns with Energy Star

- **R408.2.2.2**- The proposal aligns with CEE Tier 2
- **R408.2.2.3a**- The proposal aligns with Energy Star
- **R408.2.2.3b**- The proposal aligns with Energy Star
- **R408.2.2.4a-** The proposal aligns with Energy Star
- **R408.2.2.4b-** The proposal aligns with Modified Energy Star due to lack of exact equipment type under Energy Star
- **R408.2.2.5a-** The proposal aligns with CEE Tier 3/ CEE Tier 2
- **R408.2.2.5b-** The proposal aligns with Modified CEE Tier 2 due to lack of exact equipment type under Energy Star
- **R408.2.2.6a-** The proposal aligns with Energy Star
- **R408.2.2.6b-** The proposal aligns with Modified Energy Star due to lack of exact equipment type under Energy Star
- **R408.2.2.7a-** The proposal aligns with CEE Tier 3
- **R408.2.2.7b-** The proposal aligns with CEE Tier 2
- **R408.2.2.8a-** The proposal aligns with Energy Star
- **R408.2.2.8b-** The proposal aligns with Energy Star
- **R408.2.2.9a-** The proposal aligns with Energy Star Most Efficient
- **R408.2.2.9b-** The proposal aligns with Energy Star Most Efficient
- **R408.2.2.10**- The proposal aligns with Energy Star
- **R408.2.2.11a-** The proposal aligns with Energy Star
- **R408.2.2.11b-** The proposal aligns with Energy Star

Bibliography: AHRI notes that the Tax Provisions in the Inflation Reduction Act of 2022 can be found at this link https://crsreports.congress.gov/product/pdf/R/R47202

For convenience, AHRI also provided AHRI's review of the Inflation Reduction Act.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change is not expected to increase or decrease the cost of construction. This code will enable more architects, builders and consumers to use energy efficient products due to potential Tax Incentives provided by the Inflation Reduction Act. Therefore, since there are more energy efficient HVAC options available, which may shorten lead time to complete residential build, this code may actually result in decreased construction costs.

Public Hearing Results

Committee Action **As Modified**

Final Hearing Results

RED1-351-22 AM

RED1-358-22

Original Proposal

IECC: TABLE R408.2.3

Proponents: Mary Koban, AHRI, AHRI (mkoban@ahrinet.org); Mark Lyles, New Buildings Institute, California IOUs (markl@newbuildings.org)

2024 International Energy Conservation Code [RE Project]

Delete and substitute as follows:

~~TABLE R408.2.3 Service water-heating efficiencies~~

~~Measure Number~~	~~Water Heater~~	~~Size and Draw Pattern~~	~~Type~~	~~Efficiency~~
~~R408.2.3(1)~~	~~Gas-fired storage water heaters~~	~~≤ 55 gallons, Medium~~		~~UEF ≥0.81~~
		~~≤ 55 gallons, High~~		~~UEF ≥0.86~~
		~~>55 gallons, Medium or High~~		~~UEF ≥0.86~~
~~R408.2.3 (2)~~	~~Gas-fired instantaneous water heaters~~	~~Medium or High~~		~~UEF ≥0.95~~
~~R408.2.3 (3)~~	~~Electric water heaters~~	~~Low, Medium, or High~~	~~Integrated HPWH~~	~~UEF ≥ 3.30~~
~~R408.2.3 (4)~~	~~Electric water heaters~~	~~Low, Medium, or High~~	~~Integrated HPWH, 120 Volt/15 Amp Circuit~~	~~UEF ≥ 2.20~~
		~~Low, Medium, or High~~	~~Split-system HPWH~~	~~UEF ≥ 2.20~~
~~R408.2.3 (5)~~	~~Solar water heaters~~		~~Electric backup~~	~~SUEF ≥ 3.00~~
			~~Gas backup~~	~~SUEF ≥ 1.80~~

TABLE R408.2.3 Service water-heating efficiencies

Measure Number	Water Heater	Size and Draw Pattern	Type	Efficiency
R408.2.3(1)(a)	Gas-fired storage water heaters (option 1)	All storage volumes, all draw patterns		UEF≥0.81
R408.2.3(1)(b)	Gas-fired storage water heaters (option 2)	≤ 55 gallons; Medium		UEF≥0.81
		≤ 55 gallons; High		UEF≥0.86
		>55 gallons; Medium or High		UEF≥0.86
R408.2.3(2)(a)	Gas-fired instantaneous water heaters (option 1)	All storage volumes, Medium or High		UEF≥0.92
R408.2.3(2)(b)	Gas-fired instantaneous water heater (option 2)	All storage volumes, Medium or High		UEF≥0.95
R408.2.3(3)(a)	Electric water heaters (option 1)	All storage volumes, Low, Medium or High	Integrated HPWH	UEF≥3.30
R408.2.3(3)(b)	Electric water heaters (option 2)	Low, Medium or High	Integrated HPWH	UEF≥3.75
R408.2.3(4)	Electric water heaters (option 3)	Low, Medium or High	Integrated HPWH, 120 Volt/15 Amp Circuit	UEF≥2.20
R408.2.3(5)(a)	Electric water heaters (option 4)	Low, Medium or High	Split-system HPWH	UEF≥2.20

R408.2.3(5)(b)	Electric water heaters (option 5)	Low, Medium or High	Split-system HPWH	UEF≥3.75
R408.2.3(6)(a)	Solar water heaters (option 1)	All storage volumes, all draw patterns	Electric backup	SUEF≥3.00
R408.2.3(6)(b)	Solar water heaters (option 2)	All storage volumes, all draw patterns	Gas backup	SUEF≥1.80

Reason: Dear IECC Residential Sub-Committee and Committee members, please note that the cdpacess system did not allow me to edit the existing table. Therefore, I attached the code modification in track changes to this proposal. Please note we only changed a few items and not the entire table as it appears in the code proposal.

This table comes from aligning process for former code proposals (RECPI-10, REPI-18, REPI-33).

AHRI further notes that we made these changes due to new potential tax incentives. On August 16, 2022, President Joe Biden signed the Inflation Reduction Act (IRA) into law. The Act contains dozens of provisions related to climate change and prescription drug prices. It includes measures that provide federal income tax credits for high-efficiency HVAC and water heater products. This proposal aligns Additional Energy Credits with the IRA, provides even more energy credits for higher-efficiency equipment, and will encourage homeowners and builders to install efficient water heater products. Therefore, AHRI members suggest aligning with Energy Star product specifications and CEE tiers when defining efficiency levels for HVAC options in R408.2. AHRI notes that the following sections of R408.2.3 align with Energy Star and CEE tiers

R408.2.3(1)(a)- this is the proposed CEE level for all draw patterns, baseline condensing type WH. R408.2.3(1)(b)- this is aligned with Energy Star v5.0

R408.2.3(2)(a)- this is a baseline condensing level well above the minimum in the market and will probably align with utility incentives.

R408.2.3(2)(b)- this is aligned with Energy Star v5.0, but it is also important to note that this level is well above current products on the market.

R408.2.3(3)(a)-aligns with Energy Star v5.0

R408.2.3(3)(b)-aligns with CEE levels

R408.2.3(4)-aligns with both CEE levels and Energy Star v5.0

R408.2.3.(5)(a)-aligns with Energy Star v5.0

R408.2.3(5)(b)-aligns with CEE levels

R408.2.3.6(a)-aligns with Energy Star v5.0

R408.2.3.(6)-aligns with Energy Star v5.0 and may qualify for federal tax incentives

Bibliography: AHRI notes that the Tax Provisions in the Inflation Reduction Act of 2022 can be found at this link https://crsreports.congress.gov/product/pdf/R/R47202
AHRI provides the following link to Energy Star version 5.0 https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Residential%20Water%20Heaters%20Version%2 provides the following link to the CEE Residential Water Heating Specification https://library.cee1.org/content/cee-residential-water-heating-specification/

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change is not expected to increase or decrease the cost of construction. This code will enable more architects, builders and consumers to use energy efficient products due to potential Tax Incentives provided by the Inflation Reduction Act.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: updates requirements for water heater types and draw patterns.

Final Hearing Results

RED1-358-22	AM

RED1-360-22

Original Proposal

IECC: TABLE R408.2.6, R408.2.6; IECC: SECTION 202 (New)

Proponents: Mark Lyles, New Buildings Institute, California IOUs (markl@newbuildings.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

TABLE R408.2.6 MINIMUM EFFICIENCY REQUIREMENTS: APPLIANCES ~~SPECIFICATION REFERENCE DOCUMENT~~

Appliance	Efficiency Improvement	Test Procedure
Refrigerator	Energy Star Program Requirements, Product Specification for Consumer Refrigeration Products, Version 5.1 (08/05/2021) Maximum Annual Energy Consumption (AEC), No greater than 620 kWh/yr	10 CFR 430, Subpart B, Appendix A
Dishwasher	Energy Star Program Requirements for Residential Dishwashers, Version 6.0 (01/29/2016) Maximum Annual Energy Consumption (AEC), No greater than 240 kWh/yr	10 CFR 430, Subpart B, Appendix C1
Clothes dryer	Energy Star Program Requirements, Product Specification for Clothes Dryers, Version 1.1 (05/05/2017)	
Clothes Washer and Clothes Dryer	Energy Star Program Requirements, Product Specification for Clothes Washers, Version 8.1 (02/05/2018) Clothes washer located within dwelling units: Maximum Annual Energy Consumption (AEC), No greater than 130 kWh/yr,and Integrated Modified Energy Factor (IMEF) > 1.84 cu.ft/kWh/cycle Clothes washer not located within *dwelling units* and where *dwelling units* are not provided with laundry facilities: Modified Energy Factor (MEF)>2.0 cu.ft/kWh/cycle	10 CFR 430 Subpart B, Appendix J2 and 10 CFR 430, Subpart B, Appendices D1 and D2

R408.2.6 Energy efficient appliances. Appliances installed in a *residential building* ~~dwelling unit~~ shall ~~meet~~ comply with the ~~product energy~~ efficiency requirements specified ~~specifications listed~~ in Table R408.2.6~~, or equivalent energy efficiency specifications~~. Not less than three appliance types from Table R408.2.6 shall be installed ~~for compliance with this section~~.

Exception: In Group R-2 occupancies where a dishwasher is not installed in each *dwelling unit*, not less than two appliance types complying with Table R408.2.6 shall be installed. In *common areas* each appliance type shall comply with Table R408.2.6.

2024 International Energy Conservation Code [CE Project]

Add new definition as follows:

COMMON AREAS. All conditioned spaces within Group R occupancy buildings that are not dwelling units or sleeping units.

Reason: The objective of Section R408.2.5 was to encourage installation of appliances meeting ENERGY STAR criteria. Unfortunately, IECC does not allow direct reference to ENERGY STAR product specifications. The intent of the proposed change is to specify requirements which will meet the Energy Star product specification criteria in a way that is easily confirmed by a code official. Specifically, the proposed changes remove the reference to Energy Star program requirements and introduce maximum Annual Energy Consumption requirements for Refrigerators, Dishwashers and Clothes Washers and Clothes Dryers. Code officials will be able to readily confirm compliance by comparing the Annual Energy. Consumption listed on the Energy Guide label of products in the building with these maximum Annual Energy Consumption requirements.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

NA

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Improves clarity of the requirements to meet the appliance credit.

Final Hearing Results

RED1-360-22	AM

RED1-365-22

Original Proposal

IECC: R403.6.3, R403.6.4 (New)
Proponents:

2024 International Energy Conservation Code [CE Project]

Revise as follows:

R403.6.3 Testing. Mechanical ventilation systems shall be tested and verified to provide the minimum ventilation flow rates required by Section R403.6, in accordance with ANSI/RESNET/ICC 380. 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.

Exceptions:

1. Kitchen range hoods that are ducted to the outside with 6-inch (152 mm) or larger , a length of 10ft (3048 mm) or less, and not more than two 90° elbows or equivalent shall not require testing.
2. A third-party test shall not be required where the ventilation system has an integrated diagnostic tool used for airflow measurement, programmable airflow settings, and a user interface that communicates the installed airflow rate.
3. <u>Where tested in accordance with Section R403.6.4, testing of each mechanical ventilation system is not required</u>.

Add new text as follows:

<u>**R403.6.4 Dwelling unit sampling.**</u> <u>For buildings with eight or more dwelling units the mechanical ventilation systems in seven, or 20 percent of the dwelling units, whichever is greater shall be tested., Tested systems shall include a systems in a top floor unit, systems in a ground floor unit, systems in a middle floor unit, and the systems in the dwelling unit with the largest conditioned floor area. Where buildings have fewer than eight dwelling units, the mechanical ventilation systems in each unit shall be tested. Where the ventilation flow rate of a mechanical ventilation system is less than the minimum permitted rate, corrective actions shall be taken and the system retested until it passes. For each tested dwelling unit system with a ventilation flow rate lower than the minimum permitted three additional systems, including the corrected system, shall be tested</u>

Reason: The committee approved a sampling methodology for demonstrating compliance in the envelope leakage and duct leakage sections. Not approving the same methodology and as a result requiring every bath fans, kitchen hoods, and supply fans to be tested in every dwelling unit does not make sense. The ventilation testing can be more time-consuming that the duct leakage and envelope testing while the resulting negative impact of non-compliance of ventilation systems is less than that of the envelope and duct leakage testing.

Updated Simulated Path table to give direction on how to input results when testing is performed with or with a sampling methodology.

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

Reducing the number of tests required to demonstrate compliance will reduce the burden and cost of compliance verification.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The Committee agreed that since sampling in Group R-2 buildings had already been approved for air leakage and duct leakage testing, that same sampling approach could be permitted for ventilation air flow testing, without adverse effects on energy consumption, while also decreasing costs for multifamily buildings to comply with the energy code.

Final Hearing Results

RED1-365-22 AM

REPI-4-21

Original Proposal

IECC®: R102.1.1

Proponents: William Fay, Energy Efficient Codes Coalition; Amy Boyce, Institute for Market Transformation, Energy Efficient Codes Coalition (amy.boyce@imt.org); Amber Wood, ACEEE, Energy Efficient Codes Coalition (awood@aceee.org); Jason Reott, Alliance to Save Energy, Energy Efficient Codes Coalition

2021 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 to be in compliance with this code where such buildings also meet the requirements identified in Table R405.2 and the proposed total *building thermal envelope* UA, which is the sum of *U*-factor times assembly area, shall be less ~~is greater~~ than or equal to the building thermal envelope UA using the prescriptive *U*-factors from Table R402.1.2 multiplied by 1.15 in accordance with Equation 4-1. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30. ~~levels of efficiency and solar heat gain coefficients in Tables 402.1.1 and 402.1.3 of the 2009 *International Energy Conservation Code*.~~

$UA_{\text{Proposed design}} \leq 1.15 \times UA_{\text{Prescriptive reference design}}$

(Equation 4-1)

Reason: The purpose of this code change proposal is to improve the mandatory thermal envelope trade-off backstop applicable to the above code programs compliance alternative in Section R102.1.1. This proposal improves the efficiency and usability of the *IECC* by combining two successful concepts incorporated into the 2021 *IECC*. First, it adds flexibility for code users who are complying with the *IECC* through approved above-code programs by changing the thermal envelope backstop from being based on the 2009 *IECC* prescriptive tables to a calculation based on a percentage of the Total UA of the current code's envelope requirements. This would make the thermal envelope backstop that applies to above-code programs consistent with the backstop that applies to the ERI (which is often used in above-code programs). The ERI backstop, which was originally based on the 2009 *IECC* in the 2015 and 2018 editions of the *IECC*, was changed to a Total UA-based backstop in the 2021 *IECC* as a result of Proposal No. RE150-19 (as modified by the Committee). We believe that code users would benefit from both trade-off backstops working in the same way.

Second, this proposal will improve efficiency and streamline future code development by replacing a reference to an older code edition with a reference to the current code requirements. Basing the calculation on the current code helps ensure that improvements to the code baseline in 2024 and in future code editions will be reflected in the backstop without a need for additional code change proposals in the future. This will also simplify compliance and enforcement efforts by reducing the need to refer to other code books.

An effective thermal envelope backstop is crucial to ensure that the home retains reasonable envelope performance similar to the prescriptive path under alternative compliance paths such as above-code programs, the performance path, ERI, etc., and that the envelope is not unduly traded-off for other measures. Trading off envelope and associated occupant comfort can have direct impacts on energy usage. For example, if the occupant responds to discomfort from a “cold” or “hot” room due to an inadequate building envelope by adjusting the thermostat, the additional energy use from the adjusted thermostat can be substantial. Below is a summary of estimated energy use increases associated with adjusting a thermostat 1 degree higher or lower, broken out by climate zone.

[R7 table pix.png]

Increased Energy Use Resulting from Thermostat Adjustment									
Measure	Nat'l Avg	1	2	3	4	5	6	7	8
+1 Degree Heating	4.1%	0.5%	3.0%	4.2%	4.4%	4.7%	4.5%	4.0%	2.9%
-1 Degree Cooling	3.2%	7.8%	5.3%	3.9%	2.6%	1.8%	1.4%	0.7%	0.4%

An effective envelope trade-off backstop can help improve occupant comfort and can save significant energy and energy cost.

As the *IECC* and above-code programs play an increasingly important role in helping states and cities achieve energy efficiency and carbon reduction goals, it is more important than ever to put in place improved and streamlined trade-off backstops. These backstops are critical consumer protections that will maintain a minimum level of efficiency across all new homes, providing long-term comfort and energy savings for homeowners, and more broadly, reducing peak demand and greenhouse gas production at the state and national level.

Bibliography: Pacific Northwest National Laboratory, *National Cost Effectiveness of the Residential Provisions of the 2021 IECC*(June 2021)

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal will neither increase nor decrease the cost of construction. This proposal does not increase the baseline stringency of the *IECC*, and whether the proposal results in increased or decreased costs ultimately depends on compliance choices made by the code user in each case. The added flexibility of moving to a UA-based backstop will allow builders to use what they conclude is the optimal combination of envelope measures to meet the building thermal envelope UA under the code, which may reduce construction costs as compared with the current backstop in some cases.

COST-EFFECTIVNESS

This proposal does not increase or otherwise affect the stringency of the prescriptive code values or necessarily result in increased costs. Instead, the above-code-programs thermal envelope backstop only places limits on choices under an alternative compliance path (which is optional), so a cost-effectiveness analysis does not apply.

The ICC Board of Directors set the 2021 *IECC* as the baseline for future IECC development – and by extension made the 2021 *IECC* the basis for cost-effectiveness analyses. This means for purposes of analyzing code proposals, the existing provisions of the 2021 *IECC* are considered cost-effective and reasonable, since they are the starting point for analyses of code changes and no rollbacks are permitted. It should also be noted that US DOE found the entire 2021 *IECC* cost effective, including section R406. *See* Pacific Northwest National Laboratory, *National Cost Effectiveness of the Residential Provisions of the 2021 IECC*(June 2021). Changes to trade-off backstops like this code change proposal, which utilizes U-factors and SHGCs less stringent than the prescriptive measures of the 2021 *IECC*, do not increase the stringency of that baseline or impose any additional costs to meet specific measures. In addition, if the prescriptive values are cost-effective, then the backstop values would be cost-effective. These backstops serve only as a consumer protection against excessive trade-offs, but do not require anything more than what would be required for base code compliance. Thus, a cost-effectiveness analysis would be difficult or impossible to apply and would not be informative.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Recommendation to support proposal since this will provide consistent backstop between all compliance paths when assessing alternative methods

Final Hearing Results

REPI-4-21	AM

REPI-9-21

Original Proposal

IECC®: R105.2, R105.2.1, R105.2.2, R105.2.3 (New), R105.2.3, R105.2.4, R105.2.5
Proponents: Aaron Gary, Tempo, Inc., Seft (aaron.gary@texenergy.org)

2021 International Energy Conservation Code

Revise as follows:

R105.2 Required inspections. The *code official* or his or her designated agent, upon notification, shall make the inspections set forth in Sections R105.2.1 through R105.2.6 ~~R105.2.5~~.

R105.2.1 Footing and foundation inspection. Inspections associated with footings and foundations shall verify compliance with the code as to *R*-value, location, thickness, depth of burial and protection of insulation as required by the code and *approved* plans and specifications.

Revise as follows:

R105.2.2 Framing and air-barrier rough-in inspection. Air barrier inspections at framing and rough-in shall be made before application of air permeable insulation ~~interior finish~~ and shall verify compliance with the code as to: ~~types of insulation and corresponding *R*-values and their correct location and proper installation; fenestration properties such as *U*-factor and SHGC and proper installation~~; air leakage controls as required by the code; and *approved* plans and specifications. Exterior air barriers may be inspected after insulation is installed.

Add new text as follows:

R105.2.3 Insulation and fenestration rough-in inspection. Inspections at insulation and fenestration rough-in shall be made before application of interior finish and shall verify compliance with the code as to: types of insulation and corresponding R-values and their correct location and proper installation; fenestration properties such as U-factor and SHGC and proper installation.

Revise as follows:

R105.2.4 ~~R105.2.3~~ Plumbing rough-in inspection. Inspections at plumbing rough-in shall verify compliance as required by the code and *approved* plans and specifications as to types of insulation and corresponding *R*-values and protection, and required controls.

R105.2.5 ~~R105.2.4~~ Mechanical rough-in inspection. Inspections at mechanical rough-in shall verify compliance as required by the code and *approved* plans and specifications as to installed HVAC equipment type and size, required controls, system insulation and corresponding *R*-value, system air leakage control, programmable thermostats, dampers, whole-house ventilation, and minimum fan efficiency.

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

R105.2.6 ~~R105.2.5~~ Final inspection. The *building* shall have a final inspection and shall not be occupied until *approved*. The final inspection shall include verification of the installation of all required *building* systems, equipment and controls and their proper operation and the required number of high-efficacy lamps and fixtures.

Reason: In many cases the inspection of the air-sealing of the air-barrier is greatly obstructed by the presence of insulation in the thermal envelope at the time of inspection. As such, it has become common practice to separate the inspection of the framing and air-barrier from the insulation and fenestration during rough-in. Codifying this current best practice creates a more enforceable and verifiable code.

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

As the separation of the air barrier and insulation inspection is already common practice in many locations for practical reasons, codifying this inspection practice should not significantly increase the cost of construction, if at all.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Recommendation to approve with modification to add words “Air Permeable” after the word of and before the word insulation in section 105.2.2

Final Hearing Results

REPI-9-21	AM

REPI-11-21

Original Proposal

IECC®: SECTION 202 (New), R303.1.1

Proponents: Amanda Hickman, The Hickman Group, Reflective Insulation Manufacturers Association (RIMA) (amanda@thehickmangroup.com)

2021 International Energy Conservation Code

Add new definition as follows:

<u>**ENCLOSED REFLECTIVE AIR SPACE.** An unventilated cavity with a low-emittance surface bounded on all sides by building components.</u>

<u>**REFLECTIVE INSULATION.** A material with a surface emittance of 0.1 or less in an assembly consisting of one or more enclosed reflective air spaces.</u>

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 that is 12 inches (305 mm) or greater in width. Alternatively, the insulation installers shall provide a certification that indicates the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown-in or sprayed fiberglass and cellulose insulation, the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be indicated on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and the *R*-value of the installed thickness shall be indicated on the certification. <u>For reflective insulation, the number of reflective sheet(s), the number and thickness of the enclosed reflective air space(s) and the R-value for the installed assembly, shall be listed on the certification.</u> For insulated siding, the *R*-value shall be on a label on the product's package and shall be indicated on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

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

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

The proposal adds specific requirements similar to those for the other insulation materials (as well as appropriate definitions) for a type of material, (reflective insulation) that has been in the market place for over 35 years and has had nationwide distribution and installation. These products are well established and have two associated ASTM Standards, ASTM C727, Standard Practice for Installation and Use of Reflective Insulation in Building Constructions, and ASTM C1224,Standard Specification for Reflective Insulation for Building Applications.

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

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

IBC 2021

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

2020 Florida Building Code, Energy Conservation, 7th Edition

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

2020 Florida Building Code, Building, 7th Edition

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

2020 Minnesota Building Code

- Section 720 Thermal- and Sound-Insulating Materials
- Section 2614 Reflective Plastic Core Insulation
- Thermal Insulation Standards 2020, Section 7640.0130, Subpart 7

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

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

Public Hearing Results

Committee Action **As Modified**

Committee Reason: agree with need for definitions

Final Hearing Results

REPI-11-21	AM

REPI-13-21

Original Proposal

IECC®: SECTION 202 (New), R303.2.2 (N1101.11.2) (New), ASTM Chapter 06 (New)

Proponents: Amanda Hickman, The Hickman Group, Reflective Insulation Manufacturers Association (RIMA) (amanda@thehickmangroup.com)

2021 International Energy Conservation Code

Add new definition as follows:

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

Add new text as follows:

R303.2.2 (N1101.11.2) Radiant barrier. Where installed, radiant barriers shall comply with the requirements of ASTM C1313/C1313M.

Add new standard(s) as follows:

ASTM

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

C1313/C1313M-13(2019) 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.

The definition for Radiant Barrier is included in the 2021 IBC.

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

Radiant barriers follow two ASTM Standards – ASTM C1313/C1313M, "Standard Specification for Sheet Radiant Barriers for Building Construction Applications," and ASTM C1743, "Standard Practice for Installation and Use of Radiant BarrierSystems (RBS) in Residential Building Construction".

The proposed language is being included in this section specifically because the American Society for Testing andMaterials (ASTM) classifies radiant barriers as thermal insulation. The ASTM committee C16 on Thermal Insulation includespublished 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. The low emittance material can be bonded to plastic film, woven fabric, reinforced paper, OSB or plywood. The thermal performance of radiant barriers depends on emittance and location in the attic, wall or roof assembly. Radiant barriers are predominantly installed in attic spaces below the roof deck. The low-emittance surface of radiant barrier products dramatically reduces the heat gain by radiation into the structure and attic HVAC ducts. For this reason, radiant barriers are especially effective in warm sunny climates where they provide reduced use of air conditioning. Radiant barrier products that are available include single-sheet material, multi-layer assemblies and wood sheathing with attached aluminum film or foil. The single sheet material is installed in roof assemblies by attaching directly to the roof deck, in between the rafters or trusses or to the underside of the rafters or trusses. The foil-faced sheathing is installed with the low-emittance side of the sheathing or panel facing toward the attic space to create a radiant barrier Attic radiant barriers are in extensive use. These products have been on the market for several decades and are used by 87 of the top 100

US Builders. They have an established history and have been accepted into several regional code requirements. Over one billion square feet of the product is being installed annually.

IBC 2021

- Section 1510, Radiant Barriers Installed Above Deck

Hawaii Title 3, Chapter 181.1 2015

- Section 407.2 Requirements
- Table 407.1 Points Option

Texas

- City of Austin Ordinance No. 20210603-055, City Code Chapter 12-25, Article 12, R402.6

2020 Florida Building Code, Energy Conservation, 7th Edition

- R405.7.1 Installation criteria for homes claiming the radiant barrier option
- Figure R405.7.1 Acceptable attic radiant barrier configurations
- Table 303.2.1 Insulation Installation Standards

2019 California Title 24, Part 6

- Section 100.1 Definitions
- Section 110.8 Mandatory requirements for insulation, roofing products and radiant barriers

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

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

Public Hearing Results

Committee Action	**As Modified**

Committee Reason: radiant barriers help reduce heat transfer and installation standard is needed

Final Hearing Results

REPI-13-21	AM

REPI-18-21

Original Proposal

IECC®: R401.2, R401.2.1, R401.2.5, R401.3, R405.2, SECTION R408, R408.1, R408.2, TABLE R408.2 (New), R408.2.1, R408.2.1.1 (New), R408.2.1.2 (New), TABLE R408.2.1.2 (New), R408.2.2, R408.2.3, R408.2.4, R408.2.5, R408.2.7 (New), TABLE R408.2.7 (New), R408.2.8 (New)

Proponents: Mark Lyles, New Buildings Institute, New Buildings Institute (markl@newbuildings.org); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

R401.2 Application . Residential buildings shall comply with ~~Section R401.2.5 and~~ either Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4.

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

R401.2.1 Prescriptive Compliance Option. The Prescriptive Compliance Option requires compliance with Sections R401 through R404 <u>and R408</u>.

Delete without substitution:

~~**R401.2.5 Additional energy efficiency.** This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.~~

1. ~~For buildings complying with Section R401.2.1, one of the additional efficiency package options shall be installed according to Section R408.2.~~
2. ~~For buildings complying under with Section R401.2.2 , the building shall meet one of the following:~~
   2.1. ~~One of the additional efficiency package Options in Section R408.2 shall be installed without including such measures in the proposed design under Section R405; or~~
   2.2. ~~The proposed design of the building under Section R405.3 shall have an annual energy cost that is less than or equal to 95 percent of the annual energy cost of the standard reference design.~~
3. ~~For buildings complying with the Energy Rating Index alternative Section R401.2.3, the Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table R406.5.~~

~~The option selected for compliance shall be identified in the certificate required by Section R401.3~~.

Revise as follows:

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

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls*, *crawl space walls* and floors and ducts outside *conditioned spaces.*

2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required duct system and building envelope air leakage testing performed on the building.
4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted ~~and~~ the compliance path used , and where applicable, the additional efficiency measures selected for compliance with R408.

R405.2 Performance-based compliance. Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.
3. An annual energy cost of the *proposed design* that is less than or equal to 90 percent of the annual energy cost of the *standard reference design* or the additional efficiency credits as required in Section R408.2 shall be installed without including without including such measures in the proposed design under Section R405. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration’s State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

   Exception: The energy use based on source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

SECTION R408
ADDITIONAL EFFICIENCY REQUIREMENTS ~~PACKAGE OPTIONS~~

R408.1 Scope. This section establishes additional efficiency credits ~~package options~~ to achieve additional energy efficiency in accordance with Section R401.2.1.

R408.2 Additional energy efficiency credit requirements ~~package options~~. Two of the aAdditional efficiency ~~package options for compliance with Section R401.2.1 are set forth in Sections R408.2.1 through R408.2.5.~~ measures shall be selected from Table R408.2 that meet or exceed a total of ten credits. Each measure selected shall meet the relevant subsections of Section R408 and receive credit as specified in Table R408.2 for the specific Climate Zone. Interpolation of credits between measures shall not be permitted.

Add new text as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		CZ 0 &1	CZ 2	CZ 3	CZ 4	CZ 4C	CZ 5	CZ 6	CZ 7	CZ 8
R408.2.1.1(1)	≥2.5% Reduction in total UA	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total UA	0	1	1	2	2	3	3	3	3

R408.2.1.1(3)	>7.5% reduction in total UA	0	1	2	2	2	3	3	4	4
R408.2.1.2(1)	0.22 U-factor windows	1	2	2	3	3	4	4	4	5
R408.2.1.2(2)	U-factor and SHGC for windows per Table R408.2.1	1	1	1	0	0	0	0	1	2
R408.2.3(1)	High performance cooling system option 1	7	6	5	3	3	3	1	1	1
R408.2.3(2)	High performance cooling system option 2	5	5	4	3	3	2	1	1	0
R408.2.3(3)	High performance gas furnace option 1	0	2	3	5	5	7	8	8	10
R408.2.3(4)	High performance gas furnace option 2	0	2	2	4	4	5	7	7	8
R408.2.3(5)	High performance heat pump system option 1	8	7	6	6	6	6	5	5	4
R408.2.3(6)	High performance heat pump system option 2	6	6	5	5	5	5	4	4	3
R408.2.3(7)	Ground source heat pump	0	2	4	6	6	8	7	6	5
R408.2.4(1)	Fossil fuel service water heating system	7	6	5	3	3	2	2	3	1
R408.2.4(2)	High performance heat pump water heating system option 1	12	11	11	8	8	6	5	5	3
R408.2.4(3)	High performance heat pump water heating system option 2	12	12	11	8	8	6	5	5	3
R408.2.4(4)	Solar hot water heating system	4	5	6	6	6	6	5	5	4
R408.2.4(5)	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.5(1)	More efficient distribution system	4	6	7	10	10	12	13	15	16
R408.2.5(2)	100% of ducts in conditioned space	4	6	8	12	12	15	17	19	20
R408.2.5(3)	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.6(1)	2 ACH50 air leakage rate with ERV or HRV installed	1	4	5	10	10	13	15	8	8
R408.2.6(2)	2 ACH50 air leakage rate with balanced ventilation	2	3	2	4	4	5	6	6	6
R408.2.6(3)	1.5 ACH50 air leakage rated with ERV or HRV installed	2	4	6	12	12	15	18	11	11
R408.2.6(4)	1 ACH50 air leakage rate with ERV or HRV installed	2	5	6	14	14	17	21	14	14
R408.2.7	Energy efficient appliances	9	8	8	7	7	5	5	5	4
R408.2.8	Renewable energy measures	17	16	17	11	11	9	8	7	4

Revise as follows:

R408.2.1 Enhanced envelope ~~performance~~ options. ~~The total *building thermal envelope* UA, the sum of *U*-factor times assembly area, shall be less than or equal to 95 percent of the total UA resulting from multiplying the *U*-factors in Table R402.1.2 by the same assembly area as in the proposed building. The UA calculation shall be performed in accordance with Section R402.1.5. The area-weighted average SHGC of all glazed fenestration shall be less than or equal to 95 percent of the maximum glazed fenestration SHGC in Table R402.1.2.~~The building thermal envelope shall meet the requirements of Section R408.2.1.1 or R408.2.1.2.

Add new text as follows:

R408.2.1.1 Enhanced envelope performance UA. The proposed total *building thermal envelope* UA shall be calculated in accordance with Section R402.1.5 and shall meet one of the following:

1. Not less than 2.5 percent of the total UA of the *building thermal envelope*.
2. Not less than 5 percent of the total UA of the *building thermal envelope*.
3. Not less than 7.5 percent of the total UA of the *building thermal envelope*.

R408.2.1.2 Improved fenestration. *Vertical fenestration* shall meet one of the following:

1. U-factor equal to or less than 0.22
2. U-factor and SHGC equal or less than that specified in Table R408.2.1.2

TABLE R408.2.1.2 IMPROVED FENESTRATION

Climate Zone	Fenestration U-factor	Fenestration SHGC
0	0.32	0.23
1	0.32	0.23
2	0.30	0.23
3	0.25	0.25

4	NA	NA
5	NA	NA
6	NA	NA
7 and 8	0.25	NR

Revise as follows:

~~R408.2.2~~ R408.2.3 More efficient HVAC equipment performance options. Heating and cooling *equipment* shall meet one of the following efficiencies:

1. Greater than or equal to ~~95 AFUE natural gas furnace and 16~~ 18 SEER and 14 EER air conditioner.
2. Greater than or equal to 16 SEER and 12 EER air conditioner.
3. Greater than or equal to 96 AFUE natural gas furnace.
4. Greater than or equal to 92 AFUE natural gas furnace.

~~2.~~ 5. Greater than or equal to 10 HSPF/~~16~~ 18 SEER air source heat pump.

6. Greater than or equal to 9 HSPF/16 SEE air source heat pump.

~~3.~~ 7. Greater than or equal to 3.5 COP ground source heat pump.

For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the cooling design load. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the heating design load.

~~R408.2.3~~ R408.2.4 Reduced energy use in service water-heating options. The hot water system shall meet one of the following efficiencies:

1. Greater than or equal to 82 EF fossil fuel service water-heating system.
2. Greater than or equal to ~~2.0~~ 2.9 ~~EF~~ UEF electric service water-heating system.
3. Greater than or equal to 3.2 UEF electric service water-heating system.

~~3.~~ 4. Greater than or equal to 0.4 solar fraction solar water-heating system.

5. Compact hot water distribution. For Compact Hot Water Distribution system credit, the volume shall store not more than 16 ounces of water in the nearest source of heated water and the termination of the fixture supply pipe when calculated using section R403.5.4.

To field or plan review verify that the system meets the prescribed limit, one of the following must be done:

1. At plan review, referencing ounces of water per foot of tube on plans as per Table R403.5.4.1.
2. At rough in (plumbing), referencing ounces of water per foot of tube installed as per Table R403.5.4.1.
3. At final inspection. In accordance with Department of Energy's Zero Energy Ready Home National Specification (Rev. 07 or higher) footnote on Hot water delivery systems.

~~R408.2.4~~ R408.2.5 More efficient duct thermal distribution system option. The thermal distribution system shall meet one of the following efficiencies:

~~1. 100 percent of ducts and air handlers located entirely within the *building thermal envelope*.~~

~~2.~~ 1. 100 percent of ductless thermal distribution system or hydronic thermal distribution system located completely inside the *building thermal envelope*.

~~3.~~ 2. 100 percent of duct thermal distribution system located in *conditioned space* as defined by Section R403.3.2.

3. When ducts are located outside conditioned space, the total leakage of the ducts, measured in accordance with R403.3.5, shall be in accordance with one of the following:

   3.1. Where air handler is installed at the time of testing, 2.0 cubic feet per minute (0.94 L/s) per 100 square feet (9.29 m^2) of *conditioned floor area*.

   3.2 Where air handler is not installed at the time of testing, 1.75 cubic feet per minute (0.83 L/s) per 100 square feet (9.29 m^2) of *conditioned floor area*.

~~R408.2.5~~ R408.2.6 Improved air sealing and efficient ventilation system option. ~~The measured air leakage rate shall be less than or equal to 3.0 ACH50, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed. Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent Sensible Recovery Efficiency (SRE), less than or equal to 1.1 cubic feet per minute per watt (0.03 m^3/min/watt) and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent Latent Recovery/Moisture Transfer (LRMT).~~ The measured air leakage rate shall be one of the following:

1. Less than or equal to 32.0 ACH50, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed.
2. Less than or equal to 2.0 ACH50, with balanced ventilation as defined in Section 202 of the 2021 *International Mechanical Code*.
3. Less than or equal to 1.5 ACH50, with either an ERV or HRV installed.
4. Less than equal to 1.0 ACH50, with either an ERV or HRV installed.

Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent Sensible Recovery Efficiency (SRE), less than or equal to 1.1 cubic feet per minute per watt (0.03 m3/min/watt) and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent Latent Recovery/ Moisture Transfer (LRMT).

Add new text as follows:

R408.2.7 Energy efficient appliances. Appliances installed in a dwelling unit shall meet the product energy efficiency specifications listed in Table R408.2.7, or equivalent energy efficiency specifications. Not less than three appliance types from Table R408.2.7 shall be installed for compliance with this section.

TABLE R408.2.7 APPLICANCE SPECIFICATION REFERENCE DOCUMENT

Refrigerator	Energy Star Program Requirements, Product Specification for Consumer Refrigeration Products, Version 5.1 (08/05/2021)
Dishwasher	Energy Star Program Requirements for Residential Dishwashers, Version 6.0 (01/29/2016)
Clothes Dryer	Energy Star Program Requirements, Product Specification for Clothes Dryers, Version 1.1 (05/05/2017)
Clothes Washer	Energy Star Program Requirements, Product Specification for Clothes Washers, Version 8.1 (02/05/2018)

R408.2.8 Renewable energy. *Renewable energy resources* shall be permanently installed that have the rated capacity to produce a minimum of 1.0 watt of *on-site renewable energy* per square foot of conditioned floor area. To qualify for this option, *renewable energy cerftificate* (REC) documentation shall meet the requirements of R404.4.

Reason: This proposal builds on the additional efficiency options in the 2021 IECC by converting those package options into a points-based system similar to the “Additional Efficiency Credits” system in C406 of the commercial section of the energy code. The proposal requires projects to select additional efficiency "credits" equal to achieve a target of 10. There are several options provided, covering all aspects of building performance. The Northwest pioneered the use of the prescriptive residential options that are currently in place in Washington, and formally were used in Oregon, and found them to be an effective method of increasing efficiency for residential construction using the prescriptive approach. This option does not require performance energy modeling or HERS verification which will increase its usefulness. This type of flex points option can also be easily implemented in the U.S. DOE REScheck software. The purpose of this code change proposal is to improve overall residential building efficiency (heating, cooling and water heating energy) by roughly 10%

and to create a scalable, flexible means of improving residential building efficiency for future IECC updates. Instead of requiring efficiency improvements to specific building components that are not equal, the new "credit" approach in Section R408 provides a multitude of options for builders that are calibrated to achieve the efficiency requirements of the IECC. This approach is also scalable according to a jurisdiction's needs – states or localities who need additional energy savings to meet energy or climate policy goals can adjust the number of required credits accordingly. Points-based approaches have been used for several years in Washington and Oregon. This proposal is similar to the Flex Points proposal for the 2021 IECC in overall structure, but the points table has been updated based on the updates included in the 2021 IECC and feedback received. Like the previous version, this proposal also includes alternative compliance pathways for builders who select the simulated performance alternative or the Energy Rating Index (ERI) and will bring roughly equivalent improvements to all three compliance paths.

This additional efficiency credit proposal is cost-effective, since it includes a number of options in every climate zone to achieve 10 points that are cost- effective and will provide three distinct benefits for jurisdictions adopting the 2024 IECC:

1. **This proposal meets a clear need for efficiency improvements in the model energy code now and in the future.** Although the 2021 IECC was determined to be roughly 9% more efficient than the 2018 IECC (PNNL 2021), major gains have plateaued. Buildings still consume an estimated 42% of the nation's energy, 54% of its natural gas, and 71% of its electricity. Governors, legislators, and mayors are increasingly turning to building energy codes to meet energy and climate goals, and those codes should continue to provide reasonable improvements going forward. The U.S. Conference of Mayors, in its fourth consecutive resolution on the subject, reiterated their "concerted support for putting future triennial IECC updates on a "glide path" of steady efficiency gains that will improve the efficiency performance of millions of U.S. residential, multi- family, and commercial buildings." *See* 2018 U.S.C.M. Resolution 86 (June 11, 2018). Several jurisdictions have already created or are in the process of creating package-based compliance paths or improved code provisions to meet their policy needs. The result is improved efficiency, but a lack of consistency in both format and requirements. Incorporating Flex Points into the 2024 IECC will not only provide a 10% boost in energy conservation but will also provide a realistic map for additional improvements going forward. And, by providing more uniform targets for the efficiency of building components, this proposal will contribute to economies of scale, potentially lowering prices for builders and ultimately consumers.
2. **This proposal will provide maximum flexibility for builders to achieve improved efficiency.**Additional efficiency credits trusts that builders and design professionals will select the most cost-effective and sensible efficiency improvements for a given project. There are several alternatives for compliance in each climate zone, along with options to comply in a performance- or rating-based path. There are alternatives related to more insulation, more efficient windows, reduced air and duct leakage and improved equipment. We believe that this approach provides the right incentives for builders to make long-lasting improvements in residential buildings that are in the best interests of homeowners. The credit values were calculated based on the present value of energy cost savings over the 2018 IECC (including relevant federal equipment efficiency standards) and would need to be updated, these values are provided here for reference and reflect the estimated useful life of each measure over an assumed 30-year life of the building. While a 30-year period is consistent with the typical life of a mortgage, it is a very conservative period given the likelihood that some measures will provide efficiency benefits for decades beyond the initial 30-year period. The analysis behind the 2021 IECC proposal , which used the methodology and assumptions included in the U.S. Department of Energy's Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes, including the economic equations to obtain the present value of energy costs within the calculation methodology. The energy consumption calculations take into consideration heating, cooling, and water heating energy, using DOE-2 energy simulation across 105 TMY3 weather locations and 12 building types to account for varying stories, foundations, and fuel types for each of the baseline and upgrade measures. The analysis compares the annual energy savings between a home with and without an efficiency measure over the useful life of the efficiency measure using useful life data from NAHB and other sources. Energy costs were calculated using the most recent national EIA projections for natural gas and electricity.
3. **This proposal will encourage efficiency improvements in building components that are currently difficult to regulate.** Additional efficiency credits addresses two issues that have complicated model energy codes for many years. First, innovative building practices or emerging technologies can benefit from being listed in codes, but states (and national code developing organizations) are reluctant to require new technologies or practices before they are market-tested. As a result, there are high barriers to entry for new technologies, even when they could transform the marketplace and provide energy- or cost-saving benefits for homeowners. As an example, Heat Recovery Ventilators (HRVs) are cost-effective and reasonable for much of the country, but individual circumstances or climate conditions may favor another approach. Rather than require HRVs in every case, or most cases with exceptions, HRVs and Energy Recovery Ventilators are included as one of several options

available to builders in every climate zone. Not only will credits create an opportunity for good technology to be used in more buildings, but it will open the door for market forces to make these technologies more widely available (and presumably less expensive). As new technologies or practices become available, these advances can be quickly and easily added into the credit table, fast-tracking technology that is good for consumers. Second, much of the heating, cooling, and water heating equipment installed in residential buildings is subject to federal preemption under the National Appliance Energy Conservation Act. As has been debated at length in ICC Code Development hearings over the last 15 years, including equipment efficiencies in performance trade-offs tends to weaken the efficiency of the energy code, since federal minimum efficiencies for nearly every covered product is well below the efficiency levels of commonly installed products. When these efficiency levels are used in trade-off baselines, builders use the improved efficiency of common heating, cooling, and water heating products as a means of trading away efficiency of more permanent building components and features, even though the equipment would have been installed anyway. This “free ridership” may provide short-term cost savings for homebuilders, but it saddles homeowners with unexpected high energy costs over the entire useful life of the building. Moreover, this equipment often carries a much shorter useful life, which is not typically captured in code compliance simulations. This credit structure creates a new incentive to improve the efficiency of covered products without resulting in efficiency rollbacks elsewhere in the code. Heating, cooling, and water heating improvements (among others) are included among the Flex Points options with points calculated according to climate-specific energy cost savings and the longevity of the equipment. Each of these upgrades will build upon the current IECC efficiency, rather than trading it away.

In sum, we believe that this proposal will improve efficiency by roughly 10% while unlocking the competitive market for new technologies or building components that are difficult to regulate and will provide a useful new tool for policymakers across the country – all without rolling back the effectiveness or efficiency of the IECC.

Bibliography: Salcido et al; *Energy Savings Analysis: 2021 IECC for Residential Buildings;* PNNL 2021; available at:https://www.energycodes.gov/sites/default/files/202107/2021_IECC_Final_Determination_AnalysisTSD.pdf

Uniting Cities to Accelerate Focus on the Economic and Climate Benefits of Boosting America’s Building Energy Efficiency, 2019 U.S.C.M. Resolution 86 (June 11, 2018), *available at* https://www.usmayors.org/the-conference/resolutions/?category=c9211&meeting=86th%20Annual%20Meeting.

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

Requiring additional efficiency measures, such as more insulation, more efficient windows, reduced air leakage and duct leakage, and/or more efficient equipment, to save 10% energy will increase the cost of construction, but the resulting energy and cost savings will recoup the initial costs and will continue to benefit consumers over the useful life of the home. Additionally, the flexibility of this approach allows for the most cost-effective means of meeting the stated ICC energy reduction goals.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposal to expands the list of options for builders/developers and incorporates input from other proponents. Ensure alignment of action taken on REPI-138-21, REPI-77-21, REPI-73-21, and REPI-136-21.

Final Hearing Results

REPI-18-21	AM

REPI-21-21

Original Proposal

IECC®: R401.2.5, TABLE R406.2
Proponents: Vladimir Kochkin, NAHB, NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Revise as follows:

R401.2.5 (N1101.13.5) Additional energy efficiency. This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.

1. For buildings complying with Section R401.2.1, one of the additional efficiency package options shall be installed according to Section R408.2.
2. For buildings complying under with Section R401.2.2 , the building shall meet one of the following:
   2.1. One of the additional efficiency package Options in Section R408.2 shall be installed without including such measures in the proposed design under Section R405; or
   2.2. The proposed design of the building under Section R405.3 shall have an annual energy cost that is less than or equal to 95 percent of the annual energy cost of the standard reference design.
3. ~~For buildings complying with the Energy Rating Index alternative Section R401.2.3, the Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table R406.5.~~

The option selected for compliance shall be identified in the certificate required by Section R401.3.

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems

R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Reason: This proposal removes the unjustified penalty on the ERI compliance path. The 2018 ERI threshold values in Table R406.5 were developed based on energy modeling that included above-federal minimum equipment efficiencies. Therefore, the ERI path complies with the additional requirements of Sections R401.2.5 and R408 by default via meeting the minimum thresholds. The 2021 IECC further reduced the ERI targets through a separate proposal. Approval of both proposals was due to lack of coordination during the 2021 IECC development process. This change will not impact the DOE determination because DOE analysis does not include the ERI compliance path.

The 5% penalty in combination with the 2021 IECC revised ERI thresholds results in ERI values close to the zero-energy ready levels listed in Appendix RC ZERO ENERGY RESIDENTIAL BUILDING PROVISIONS in the IECC. This level of performance has not been justified for minimum code provisions. According to RESNET, less than 7% of all rated dwelling units reached an ERI/HERS below 50 and only 1% of rated dwelling received an ERI/HERS below 45 in year 2020. Less than 25 percent of dwelling units constructed in the US obtain an ERI/HERS rating.

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

This proposal removes an unjustified penalty on the ERI path.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: streamlines ERI path which is already a performance path by removing the additional 5% efficiency requirement from R408streamlines ERI path which is already a performance path by removing the additional 5% efficiency requirement from R408

Final Hearing Results

REPI-21-21 AM

REPI-26-21

Original Proposal

IECC®: SECTION 202 (New), TABLE R402.1.2, R402.2.9, R402.1.2, R402.1.3, R402.1.5

Proponents: Jeremy Williams, U.S. Department of Energy, U.S. Department of Energy (jeremy.williams@ee.doe.gov)

2021 International Energy Conservation Code

Add new definition as follows:

***F*-Factor (Thermal Transmittance).** The perimeter heat loss factor for slab-on-grade floors (Btu/h·ft·°F) [W/(m·K)].

Revise as follows:

TABLE R402.1.2 (TABLE N1102.1.2) MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

Portions of table not shown remain unchanged.

CLIMATE ZONE	BASEMENT WALL *U*-FACTOR	UNHEATED SLAB F-FACTOR	HEATED SLAB F-FACTOR	CRAWL SPACE WALL *U*-FACTOR
0	0.360	0.73	1.03	0.477
1	0.360	0.73	1.03	0.477
2	0.360	0.73	1.03	0.477
3	0.091[c]	0.54	0.77	0.136
4 except Marine	0.059	0.54	0.68	0.065
5 and Marine 4	0.050	0.54	0.68	0.055
6	0.050	0.48	0.68	0.055
7 and 8	0.050	0.48	0.68	0.055

For SI: 1 foot = 304.8 mm.

g. F-factors for heated slabs correspond to the configuration described by footnote (d) of Table R402.1.3

R402.2.9 (N1102.2.9) Slab-on-grade floors. Slab-on-grade floors, in contact with the ground, with a floor surface within 24 ~~less than 12~~ inches (600 ~~305~~ mm) above or below grade shall be insulated in accordance with Table R402.1.3.

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

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

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

R402.1.5 (N1102.1.5) ~~Total UA~~ Component performance alternative. Where the proposed total *building thermal envelope* thermal conductance ~~UA, the sum of *U*-factor times assembly area,~~ is less than or equal to the required total building thermal envelope conductance using ~~UA resulting from multiplying the *U*-~~factors in Table R402.1.2 ~~by the same assembly area as in the proposed~~ *building*, the *building* shall be considered to be in compliance with Table R402.1.2. The ~~UA calculation~~ total thermal conductance shall be ~~performed~~ determined in accordance with Equation 4-1. Proposed *U*-factors and slab-on-grade *F*-factors shall be taken from ANSI/ASHRAE/IES Standard 90.1 Appendix A or determined using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. In addition to ~~UA~~ total thermal conductance compliance, the SHGC requirements of Table R402.1.2 and the maximum fenestration *U*-factors of Section R402.5 shall be met.

$(U_pA + F_pP) <= (U_rA + F_rP)$ **(Equation 4-1)**

where: U_pA = the sum of proposed *U*-factors times the assembly areas in the proposed building.

F_pP = the sum of proposed *F*-factors times the slab-on-grade perimeter lengths in the proposed building.

U_rA = the sum of *U*-factors in Table R402.1.2 times the same assembly areas as in the proposed building.

$\underline{F_rP}$ = the sum of *F*-factors in Table R402.1.2 times the same slab-on-grade perimeter lengths as in the proposed building.

Reason: Residential building energy codes that are based on any version of the International Energy Conservation Code (IECC) typically allow compliance to be demonstrated in several ways, one of which is a component tradeoff approach whereby prescriptive requirements for some building components may be relaxed in trade for corresponding improvements in other components. Calculations for this component tradeoff are based on maintaining a maximum overall building UA value, which is the sum across all building envelope components of the product of each component's U-factor (conductance) and area. For slabs on grade, the component UA is based on an F-factor rather than a U-factor and is multiplied by the slab-edge perimeter length rather than slab area.

The IECC does not give explicit instruction on calculating slab F-factors, relying instead on external materials such as ASHRAE's Handbook of Fundamentals. Slab insulation is usually required only around the perimeter of the slab, but the 2018 IECC added a new requirement for full under-slab insulation of heated slabs. It is not clear, even using the ASHRAE reference, how to calculate F-factors for such slabs.

The recommended code-change text refers to Appendix A of ASHRAE Standard 90.1, where precomputed F-factors are tabulated for various combinations of slab insulation placement and R-value, but any F-factor source consistent with the ASHRAE Handbook of Fundamentals may be used.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The text presented here does not change the code's requirements in any way; it merely adds clarifying text showing one good source of slab F-factors as a function of insulation R-value and depth. There is no additional cost and no energy impact.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Provides more flexible methods of compliance.

Final Hearing Results

REPI-26-21	AM

REPI-28-21

Original Proposal

IECC®: TABLE R402.1.2, TABLE R402.1.3

Proponents: Thomas Culp, Birch Point Consulting LLC, the Glazing Industry Code Committee (culp@birchpointconsulting.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (TABLE N1102.1.2) MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

Portions of table not shown remain unchanged.

CLIMATE ZONE	FENESTRATION *U*-FACTOR[d]	SKYLIGHT[d] *U*-FACTOR	GLAZED FENESTRATION SHGC[d, e]
0	0.50	0.75 0.60	0.25
1	0.50	0.75 0.60	0.25
2	0.40	0.65 0.60	0.25
3	0.30	0.55 0.53	0.25
4 except Marine	0.30	0.55 0.53	0.40
5 and Marine 4	0.30 0.28[fe,g]	0.55 0.50	0.40NR
6	0.30 0.28[fe,g]	0.55 0.50	NR
7 and 8	0.30 0.27[fe,g]	0.55 0.50	NR

For SI: 1 foot = 304.8 mm.

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

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

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

d. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed ~~0.30~~ 0.28.

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

f. e. A maximum *U*-factor of ~~0.32~~ 0.30 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation above sea level, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

TABLE R402.1.3 (TABLE N1102.1.3) INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

Portions of table not shown remain unchanged.

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]
0	NR 0.50	0.75 0.60	0.25
1	NR 0.50	0.75 0.60	0.25

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	GLAZED FENESTRATION SHGC
2	0.40	0.65 0.60	0.25
3	0.30	0.55 0.53	0.25
4 except Marine	0.30	0.55 0.53	0.40
5 and Marine 4	0.30 0.28[ih,j]	0.55 0.50	0.40 NR
6	0.300.28[ih,j]	0.55 0.50	NR
7 and 8	0.300.27[ih,j]	0.55 0.50	NR

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

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

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

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed ~~0.30~~ 0.28.

c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13 & 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

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

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

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

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

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

i. h. A maximum *U*-factor of ~~0.32~~ 0.30 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

Reason: This proposal advances the residential fenestration criteria in a cost effective manner by aligning with the Energy Star version 6 requirements. EPA is advancing the Energy Star version 7 requirements for Windows, Doors, and Skylights with an implementation date in 2023, so aligning the 2024 IECC with the version 6 requirements allows the energy code to progress while also maintaining the philosophy that the Energy Star criteria be a notch beyond the base code.

In aligning and maintaining consistency with Energy Star, this proposal also corrects a rollback in energy efficiency which occurred last cycle when a maximum SHGC of 0.40 was added in zone 5 in the R-value table, in conflict with Energy Star. The EPA and DOE analyses conducted by Lawrence Berkeley National Laboratory both for version 6 in 2012 and for version 7 in 2021 clearly show that imposing a maximum SHGC in climate zone 5 actually harms energy efficiency and increases use of fossil fuels. Therefore, the Energy Star program has maintained a baseline SHGC of "Any" (or NR) for zones 5-8 in both version 6 and 7, as well as optional U-factor alternatives that include higher SHGC to allow increased flexibility and energy efficiency (footnote g). (Note that the Energy Star Most Efficient program for windows also imposes a minimum SHGC of > 0.20 in zones 5-8. That is not being proposed here, but also supports that a maximum SHGC in zone 4 was an energy rollback that needs to be corrected.)

The current market share of Energy Star version 6 products is very high: 86% for windows, 80% for hinged entry doors, 84% for patio doors and 72% for skylights. The high market share shows that fenestration meeting these proposed requirements are ubiquitous and cost effective.

Bibliography:

- Energy Star Version 6 final specification: https://www.energystar.gov/sites/default/files/ES_Final_V6_Residential_WDS_Spec.pdf
- Energy Star Version 6 draft 1 criteria analysis: https://www.energystar.gov/sites/default/files/specs//Draft6_V1_Criteria_Analysis_Report.pdf
- Energy Star Version 7 draft 1 criteria analysis: https://www.energystar.gov/sites/default/files/asset/document/ES_Residential_WDS_Draft%201_Criteria%20Analysis%20Re
- Energy Star Version 7 presentation: https://www.energystar.gov/sites/default/files/asset/document/V7_Stakeholder%20Meeting_7-27-2021_final.pdf

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

EPA estimates that the current market share of Energy Star version 6 products is very high: 86% for windows, 80% for hinged entry doors, 84% for patio doors, and 72% for skylights. This demonstrates that fenestration meeting the proposed requirements are ubiquitous and will not increase the cost of construction for the vast majority of homeowners. Nonetheless, for the minority of products that do not meet the Energy Star version 6 criteria, there will be a marginal increase in cost. EPA's analysis in 2012-14 of the change to the version 6 criteria "shows that average-cost products offer payback periods of less than 10 years in all but five cities and payback periods of less than seven years in half of the cities for which EPA performed energy savings analysis", and less for lower cost products. As the industry transitions to the Energy Star version 7 requirements, the cost and payback for these version 6 criteria will be even less. Additionally, there would be no increase in construction cost for locations meeting the altitude or windborne debris provisions in footnote f.

- Energy Star version 7 info including market share: https://www.energystar.gov/sites/default/files/asset/document/V7_Stakeholder%20Meeting_7-27-2021_final.pdf
- Energy Star version 6 cost effectiveness review: https://www.energystar.gov/sites/default/files/ESWDS-ReviewOfCost_EffectivenessAnalysis.pdf

Public Hearing Results

Committee Action **As Modified**

Committee Reason: improvement in almost every climate zone and represents broad stakeholder consensus.

Final Hearing Results

REPI-28-21 AM

REPI-30-21

Original Proposal

IECC®: TABLE R402.1.2, TABLE R402.1.3

Proponents: John Woestman, Kellen Company, Extruded Polystyrene Foam Association (XPSA) (jwoestman@kellencompany.com)

2021 International Energy Conservation Code

Delete and substitute as follows:

~~TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS~~

CLIMATE ZONE	FENESTRATION *U*-FACTOR[f]	SKYLIGHT *U*-FACTOR	~~GLAZED FENESTRATION~~ SHGC[d, e]	CEILING *U*-FACTOR	WOOD FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	~~BASEMENT WALL *U*-~~ FACTOR	~~CRAWL SPACE WALL *U*-~~ FACTOR
0	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
1	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.25	0.026	0.084	0.165	0.064	0.360	0.477
3	0.30	0.55	0.25	0.026	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.30	0.55	0.40	0.024	0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.40	0.024	0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	0.024	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	0.024	0.045	0.057	0.028	0.050	0.055

~~For SI: 1 foot = 304.8 mm.~~

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

b. ~~Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.~~

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

d. ~~The SHGC column applies to all glazed fenestration.~~

~~**Exception:** In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.~~

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

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

1. ~~Above 4,000 feet in elevation above sea level, or~~

2. ~~In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.~~

TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

CLIMATE ZONE	0	1	2	3	4 except Marine	5 and Marine 4	6	7 and 8
FENESTRATION U-FACTOR[f]	0.50	0.50	0.40	0.30	0.30	0.30	0.30	0.30
SKYLIGHT U-FACTOR	0.75	0.75	0.65	0.55	0.55	0.55	0.55	0.55
GLAZED FENESTRATION SHGC[d,e]	0.25	0.25	0.25	0.25	0.40	0.40	NR	NR
CEILING U-FACTOR	0.035	0.035	0.026	0.026	0.024	0.024	0.024	0.024
WOOD FRAME WALL U-FACTOR	0.084	0.084	0.084	0.060	0.045	0.045	0.045	0.045
MASS WALL U-FACTOR[b]	0.197	0.197	0.165	0.098	0.098	0.082	0.060	0.057
FLOOR U-FACTOR	0.064	0.064	0.064	0.047	0.047	0.033	0.033	0.028
BASEMENT WALL U-FACTOR	0.360	0.360	0.360	0.091[c]	0.059	0.050	0.050	0.050
CRAWL SPACE WALL U-FACTOR	0.477	0.477	0.477	0.136	0.065	0.055	0.055	0.055

For SI: 1 foot = 304.8 mm.

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

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

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

d. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

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

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

1. Above 4,000 feet in elevation above sea level, or

2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

~~TABLE R402.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]~~

~~CLIMATE~~ ZONE	~~FENESTRATION U-~~ FACTOR[b, i]	~~SKYLIGHT[b]~~ U-FACTOR	GLAZED FENESTRATION SHGC[b, e]	~~CEILING R-VALUE~~	~~WOOD FRAME WALL R-VALUE[g]~~	~~MASS WALL R-VALUE[h]~~	~~FLOOR R-VALUE~~	BASEMENT[c,g] ~~WALL R-VALUE~~	~~SLAB[d]~~ R-VALUE ~~& DEPTH~~	CRAWL SPACE[c,g] ~~WALL R-VALUE~~
~~0~~	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	~~0~~	~~0~~	~~0~~
~~1~~	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	~~0~~	~~0~~	~~0~~
~~2~~	0.40	0.65	0.25	49	13 or 0 & 10ci	4/6	13	~~0~~	~~0~~	~~0~~
~~3~~	.30	0.55	0.25	49	~~20 or 13 & 5ci[h] or~~ 0 & 15ci[h]	8/13	19	5ci or 13[f]	10ci, 2 ft	5ci or 13[f]
~~4 except Marine~~	.30	0.55	0.40	60	~~30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]~~	8/13	19	10ci or 13	10ci, 4 ft	10ci or 13
~~5 and Marine 4~~	0.30[i]	0.55	0.40	60	~~30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]~~	13/17	30	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci
~~6~~	0.30[i]	0.55	NR	60	~~30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]~~	15/20	30	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci
~~7 and 8~~	0.30[i]	0.55	NR	60	~~30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]~~	19/21	38	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci

~~For SI: 1 foot = 304.8 mm~~.

~~NR = Not Required~~.
~~ci = continuous insulation.~~

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

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

~~**Exception:** In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.~~

c. ~~"5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13 & 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.~~

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

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

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

g. ~~The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, "13 & 5" means R-13 cavity insulation plus R-5 continuous insulation.~~

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

i. ~~A maximum *U*-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:~~

1. ~~Above 4,000 feet in elevation, or~~

2. ~~In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.~~

TABLE R402.1.3 INSULATION R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	**0**	**1**	**2**	**3**	**4 except Marine**	**5 and Marine 4**	**6**	**7 and 8**
FENESTRATION U-FACTOR[b,i]	NR	NR	0.40	0.30	0.30	0.30	0.30	0.30
SKYLIGHT U-FACTOR[b]	0.75	0.75	0.65	0.55	0.55	0.55	0.55	0.55
GLAZED FENESTRATION SHGC[b,e]	0.25	0.25	0.25	0.25	0.40	0.40	NR	NR
CEILING R-VALUE	30	30	49	49	60	60	60	60
WOOD FRAME WALL R-VALUE[g]	13 or 0&10ci	13 or 0&10ci	13 or 0&10ci	20 or 13&5ci[h] or 0&15ci[h]	30 or 20&5ci[h] or 13&10ci[h] or 0&20ci[h]	30 or 20&5ci[h] or 13&10ci[h] or 0&20ci[h]	30 or 20&5ci[h] or 13&10ci[h] or 0&20ci[h]	30 or 20&5ci[h] or 13&10ci[h] or 0&20ci[h]
MASS WALL R-VALUE[h]	3/4	3/4	4/6	8/13	8/13	13/17	15/20	19/21
FLOOR R-VALUE	13	13	13	19	19	30	30	38

BASEMENT WALL R-VALUE[c,g]	0	0	0	5ci or 13[f]	10ci or 13	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci
SLAB R-VALUE & DEPTH[g]	0	0	0	10ci, 2 ft	10ci, 4 ft	10ci, 4 ft	10ci, 4 ft	10ci, 4 ft
CRAWL SPACE WALL R-VALUE[c,g]	0	0	0	5ci or 13[f]	10ci, or 13	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

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

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

   Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13 & 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

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

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

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

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

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

i. A maximum *U*-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

   1. Above 4,000 feet in elevation, or

   2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

Reason: Proposed Revisions & Reasons - Swap X and Y axes of Table R402.1.2 and Table R402.1.3 for consistency with IECC-C format; no changes to technical requirements or footnotes. In addition to swapping the X and Y axes on these two tables, Table R402.1.3 may be improved by noting in the table row headings that Fenestration and Skylight U-factors are "maximum", and the SHGC is "maximum". Alternatively, "Maximum" could be inserted in the title of Table R402.1.3: "Insulation Minimum R-Values and Fenestration Maximum Requirements by Component[a] ".

The proposal also includes editorial movement of a couple footnote indicators to improve Table R402.1.3 editorially.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is editorial, and intended to improve the usability of the code.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Recommendation to approve as amended as changes are editorial in nature and makes chart easier to read.

Final Hearing Results

REPI-30-21	AM

REPI-33-21

Original Proposal

IECC RE: CHAPTER 2 [RE], SECTION R202, SECTION 202 (New), CHAPTER 1 [RE], R102.1.1 (New), SECTION R103, R103.2.2 (New), R105.2.3 (New), R105.2.5 (New), R105.2.6 (New), CHAPTER 4 [RE], SECTION R401, 401.2.5 (New), R401.3, SECTION R402, TABLE R402.1.2, TABLE R402.1.3, R402.4.1.3 (New), SECTION R403, R403.6.1 (New), SECTION R404, R404.5 (New), R404.5.1 (New), R404.5.2 (New), R404.5.3 (New), R404.5.4 (New), (New), R404.6 (New), R404.6.1 (New), R404.6.1.1 (New), R404.6.1.2 (New), R404.6.1.3 (New), R404.6.1.4 (New), R404.6.2 (New), R404.7 (New), R404.7.1, R404.7.2 (New), R404.7.3, R404.7.4, 404.7.4.1 (New), R404.7.6 (New), R404.7.6.1 (New), SECTION R405, R405.2, TABLE R405.2, TABLE R405.4.2(1), TABLE R405.4.2(2), SECTION R406, TABLE R406.2, R406.3, SECTION R408, R408.2, TABLE R408.2, R408.2.1, R408.2.1.3, TABLE R408.2.1.3 (New), R408.2.1.3.1 (New), R408.2.10 (New), R408.2.10.1 (New), R408.2.10.2 (New), R408.2.11, CHAPTER 6 [RE], AHRI Chapter 06 (New), ASTM Chapter 06 (New), CRRC (New), CTA (New), DOE (New), IEC (New), OpenADR (New), OpenADR (New), UL (New), APPENDIX XX (New), SECTION XX101 (New), XX101.1 (New), SECTION XX102 (New), SECTION XX103 (New), XX103.1 (New), XX103.2.1 (New), XX103.2.2 (New), XX103.2.3 (New), XX103.2.4 (New), XX103.3 (New)

Proponents: Amanda Hickman, The Hickman Group, Leading Builders of America (LBA) (amanda@thehickmangroup.com)

2024 International Energy Code [RE] [RE Project] R3

CHAPTER 2 [RE]
DEFINITIONS

SECTION R202
GENERAL DEFINITIONS

Add new definition as follows:

AUTOMOBILE PARKING SPACE. A space within a building or private or public parking lot, exclusive of driveways, ramps, columns, office and work areas, for the parking of an automobile.

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and electric motorcycles, primarily powered by an electric motor that draws current from a building electrical service, *EVSE*, a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). Equipment for plug-in power transfer including the ungrounded, grounded and equipment grounding conductors, and the *electric vehicle* connectors, attached plugs, personal protection system and all other fittings, devices, power outlets or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the *electric vehicle*.

ELECTRIC VEHICLE SUPPLY EQUIPMENT INSTALLED SPACE (EVSE space). An *automobile parking space* that is provided with a dedicated *EVSE* connection

ELECTRIC VEHICLE CAPABLE SPACE (EV CAPABLE SPACE). A designated *automobile parking space* that is provided with electrical infrastructure, such as, but not limited to, raceways, cables, electrical capacity, and panelboard or other electrical distribution equipment space, necessary for the future installation of an *EVSE*.

ELECTRIC VEHICLE READY SPACE (EV READY SPACE). An *automobile parking space* that is provided with a branch circuit and either an outlet, junction box or receptacle, that will support an installed *EVSE*.

DEMAND RESPONSE SIGNAL. A signal that indicates a price or a request to modify electricity consumption for a limited time period.

DEMAND RESPONSIVE CONTROL. A control capable of receiving and automatically responding to a*demand response signal*.

LOW-SLOPED ROOF. A roof slope less than 2 units vertical in 12 units horizontal (17 percent slope).

STEEP-SLOPED ROOF. A roof slope 2 units vertical in 12 units horizontal (17 percent slope) or greater.

GRADE PLANE. A reference plane representing the average of the finished ground level adjoining the building at all exterior walls. Where the finished ground level slopes away from the exterior wall, the reference plane shall be established by the lowest points withing the area between the building and the lot line or, where the lot line is more than 6 feet (1829 mm) from the building between the structure and a point 6 feet (1829 mm) from the building.

LIVING SPACE. Space within a dwelling unit utilized for living, sleeping, eating, cooking, bathing, washing and sanitation purposes.

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.

CHAPTER 1 [RE]
SCOPE AND ADMINISTRATION

Revise as follows:

R102.1.1 Above code programs. The *code official* or other authority having jurisdiction shall be permitted to deem a national, state or local energy-efficiency program to exceed the energy efficiency required by this code. *Buildings approved* in writing by such an energy-efficiency program shall be considered to be in compliance with this code where such buildings also meet the requirements identified in Table R405.2 and the proposed total *building thermal envelope* UA, which is the sum of U-factor times assembly area, shall be less~~is greater~~ than or equal to the *building thermal* envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by ~~1.15~~ 1.08 in Climate Zones 0, 1, and 2, and by 1.15 in Climates Zones 3 through 8, in accordance with Equation 4-1. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30. ~~levels of efficiency and solar heat gain coefficients in Tables 402.1.1 and 402.1.3 of the 2009 *International Energy Conservation Code*.~~For Climate Zones 0-2: $UA_{\text{Proposed design}} \leq 1.08 \times UA_{\text{Prescriptive reference design}}$ (Equation 4-1) For Climate Zones 3-8: $UA_{\text{Proposed design}} \leq 1.15 \times UA_{\text{Prescriptive reference design}}$

SECTION R103
CONSTRUCTION DOCUMENTS

Add new text as follows:

R103.2.2 Solar-ready system. The construction documents shall provide details for dedicated roof area, structural design for roof dead and live load, and routing of conduit or pre-wiring from *solar-ready zone* to electrical service panel or plumbing from *solar-ready zone* to *service water heating* system.

Revise as follows:

R105.2.3 Plumbing rough-in inspection. Inspections at plumbing rough-in shall verify compliance as required by the code and *approved* plans and specifications as to types of insulation and corresponding *R -values* and protection, and required controls. Where required, inspections shall verify pathways for routing of plumbing from *solar-ready zone* to *service water heating* system.

Add new text as follows:

R105.2.5 Electrical rough-in inspection. Inspections at electrical rough-in shall verify compliance as required by the code and the approved plans and specifications as to the locations, distribution, and capacity of the electrical system. Where the solar-ready zone is installed for electricity generation, inspections shall verify conduit or pre-wiring from solar-ready zone to electrical panel.

Revise as follows:

~~**R105.2.5**~~ **R105.2.6 Final inspection.** The *building* shall have a final inspection and shall not be occupied until *approved* . The final inspection shall include verification of the installation of all required building systems, equipment and controls and their proper operation and the required number of high-efficacy lamps and fixtures.

CHAPTER 4 [RE]
RESIDENTIAL ENERGY EFFICIENCY

SECTION R401
GENERAL

Revise as follows:

401.2.5 Additional energy efficiency. This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.

~~1.~~ For buildings complying with Section R401.2.1, one of the additional efficiency package options shall be installed according to Section R408.2.

~~2. For buildings complying under with Section R401.2.2 , the building shall meet one of the following~~:

~~2.1. One of the additional efficiency package Options in Section R408.2 shall be installed without including such measures in the proposed design under Section R405; or~~

~~2.2. The proposed design of the building under Section R405.3 shall have an annual energy cost that is less than or equal to 95 percent of the annual energy cost of the standard reference design.~~

~~3. For buildings complying with the Energy Rating Index alternative Section R401.2.3, the Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table R406.5.~~

The option selected for compliance shall be identified in the certificate required by Section R401.3.

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

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls*, *crawl space walls* and floors and *ducts* outside *conditioned spaces.*
2. *U*-factors of *fenestration* and the *solar heat gain coefficient* (SHGC) of *fenestration*. Where there is more than one value for any component of the *building* *thermal* *envelope*, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required *duct* system and *building* *thermal* *envelope* air leakage testing performed on the *building*.
4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.

7. The code edition under which the structure was permitted, the compliance path used, and where applicable, the additional efficiency measures selected for compliance with R408.
8. Where a *solar-ready zone* is provided, the certificate shall indicate the location, and dimensions.

SECTION R402
BUILDING THERMAL ENVELOPE

Revise as follows:

TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

Portions of table not shown remain unchanged.

	FENESTRATION U-FACTOR[f]	SKYLIGHT U-FACTOR	GLAZED FENESTRATION SHGC[d, e]	CEILING U-FACTOR	WOOD FRAME WALLU-FACTOR	MASS WALLU-FACTOR[b]	FLOORU-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALLU-FACTOR
0	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
1	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.25	0.026 0.030	0.084	0.165	0.064	0.360	0.477
3	0.30	0.55	0.25	0.026 0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.30	0.55	0.40	0.024 0.026	0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.40	0.024 0.026	0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	0.024 0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	0.024 0.026	0.045	0.057	0.028	0.050	0.055

TABLE R402.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

Portions of table not shown remain unchanged.

	FENESTRATION U-FACTOR[b, i]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING R-VALUE	WOOD FRAME WALL R-VALUE[g]	MASS WALL R-VALUE[h]	FLOOR R-VALUE	BASEMENT[c,g] WALL R-VALUE	SLAB[d] R-VALUE & DEPTH	CRAWL SPACE[c,g] WALLR-VALUE
0	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	0	0	0
1	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	0	0	0
2	0.40	0.65	0.25	49 38	13 or 0 & 10ci	4/6	13	0	0	0

3	.30	0.55	0.25	49 38		8/13	19	5ci or 13[f]	10ci, 2 ft	5ci or 13[f]
4 except Marine	.30	0.55	0.40	60 49	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	8/13	19	10ci or 13	10ci, 4 ft	10ci or 13
5 and Marine 4	0.30[i]	0.55	0.40	60 49	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	13/17	30	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci
6	0.30[i]	0.55	NR	60 49	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	15/20	30	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci
7 and 8	0.30[i]	0.55	NR	60 49	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	19/21	38	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci

R402.4.1.3 ~~Prescriptive air leakage~~ Leakage rate. . When complying with Section R401.2.1, the building or dwelling unit shall have an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 0, 1 and 2, 3.0 air changes per hour in Climate Zones 3 through 5, and ~~3.0 2.0~~ 2.5 air changes per hour in Climate Zones~~3~~ 6 through 8, when tested in accordance with Section R402.4.1.2.

SECTION R403
SYSTEMS

Revise as follows:

R403.6.1 Heat or energy recovery ventilation. Dwelling units shall be provided with a heat recovery or energy recovery ventilation system in Climate Zones 6, 7, and 8. The system shall be balanced with a minimum sensible heat recovery efficiency of 65 percent at 32°F (0°C) at a flow greater than or equal to the design airflow.

~~Exceptions:~~

1. ~~Dwelling units in single- and two-family dwellings and townhouses in Climate Zones 0-4~~.
2. ~~Dwelling units in Group R occupancies that comply with Section C403.7.4.1~~.

SECTION R404
ELECTRICAL POWER AND LIGHTING SYSTEMS

Add new text as follows:

R404.5 Electric readiness. Systems using fossil fuel: water heaters, household clothes dryers, conventional cooking tops or conventional ovens shall comply with the requirements of Sections R404.5.1 through R404.5.4. All water heating systems shall comply with the space requirements of Section R404.5.5.

R404.5.1 Cooking products. An individual branch circuit outlet with a rating not less than 250-volts, 40-amperes shall be installed, and terminate within three feet of conventional cooking tops, conventional ovens or cooking products combining both.

Exception: Cooking products not installed in an individual dwelling unit.

R404.5.2 Household Clothes Dryers. An individual branch circuit outlet with a rating not less than 240-volts, 30-amperes shall be installed, and terminate within three feet (304 mm) of each household clothes dryer. Exception: Clothes dryers that serve more than one dwelling unit and are located outside of a dwelling unit.

R404.5.3 Water heaters. An individual branch circuit outlet with a rating not less than either 240-volts, 30-amperes or 120V, 20-amperes shall be installed, and terminate within three feet (304 mm) of each fossil fuel water heater.

Exception: Water heaters in a centralized water heating system serving multiple dwelling units in a R-2 occupancy.

R404.5.4 Electrification-ready circuits. The unused conductors required by Sections R404.5.1 through R404.5.3 shall be labeled with the word "spare." Space shall be reserved in the electrical panel in which the branch circuit originates for the installation of an overcurrent device. Capacity for the circuits required by Sections R404.5.1 through R404.5.3 shall be included in the load calculations of the original installation.

Revise as follows:

~~**R404.5.5 Water heater space.** An indoor space that is at least 3 feet (304 mm) by 3 feet (304 mm) wide by 7 feet (2133 mm) high shall be available surrounding or within 3 feet (304 mm) of the installed water heater.~~

~~**Exceptions:**~~

1. ~~Installed heat pump, electric tankless, or fossil fuel tankless water heaters~~
2. ~~Water heaters in a centralized water heating system serving multiple dwelling units in a R-2 occupancy~~.

Add new text as follows:

R404.6 Renewable energy infrastructure.. The building shall comply with the requirements of R404.6.1 or R404.6.2.

Revise as follows:

R404.6.1 One- and two- family dwellings and townhouses. One- and two-family dwellings and townhouses shall comply with Sections R404.6.1.1 through R404.6.1.4.

Exceptions:

1. A *dwelling unit* with a permanently installed on-site renewable energy system.
2. A *dwelling unit* with a solar-ready zone area that is less than 500 square feet (46 m2) of roof area oriented between 110 degrees and 270 degrees of true north.
3. A *dwelling unit* with less than 500 square feet (46m2) of roof area oriented between 110 degrees and 270 degrees of true north.
4. ~~A *dwelling unit* with a solar-ready zone area that is shaded for more than 70 percent of daylight hours annually~~. *Dwelling units* where 50 percent of the solar-ready area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the building for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.
5. A *dwelling unit* that complies with Appendix RC.
6. A *dwelling unit* with a renewable energy power purchase agreement with a duration of not less than 15 years from a utility or a community renewable energy facility and for not less than 80 percent of the estimated whole-building electric use on an annual basis.
7. A *dwelling unit* less than or equal to 1,500 square feet of living space floor area located above grade plane.

R404.6.1.1 Solar-ready zone area.. The total area of the solar-ready zone shall not be less than 250 square feet (23.2 m2) and shall be composed of areas not less than 5.5 feet (1676 mm) in ~~ibe~~ one direction and not less than 80 square feet (7.4 m2) exclusive of access or set back areas as required by the International Residential Code.

Exception: Dwelling units in townhouses three stories or less in height above grade plane and with a total floor area less than or equal to 2,000 square feet (186 m2) per dwelling shall be permitted to have a solar-ready zone area of not less than 150 square feet (14 m2).

Add new text as follows:

R404.6.1.2 Obstructions.. Solar-ready zones shall be free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

R404.6.1.3 Electrical service reserved space. The main electrical service panel shall have a reserved space for a dual pole circuit breaker and shall be labeled "For Future Solar Electric." The reserved space shall be at the opposite (load) end of the busbar from the primary energy source.

R404.6.1.4 Electrical interconnection.. An electrical junction box shall be installed within 24 inches (610 mm) of the main electrical service panel and shall be connected to a capped roof penetration sleeve or a location in the attic that is within 3 feet (914 mm) of the solar-ready zone by a minimum 1 inch (25 mm) nonflexible metallic conduit or permanently installed wire as approved by the code official. Where the interconnection terminates in the attic, location shall be no less than 12 inches (35 mm) above ceiling insulation. Both ends of the interconnection shall be labeled "For Future Solar Electric".

R404.6.2 Group R occupancies.. Buildings in Group R-2, R-3 and R-4 shall comply with Section C405.13.

R404.7 Electric Vehicle Power Transfer Infrastructure. New *automobile parking spaces* for one- and two-family dwellings and townhouses shall be provided in accordance with Sections R404.7.1 through R404.7.5. New residential automobile parking spaces for R-2 occupancies shall be provided with electric vehicle power transfer infrastructure in accordance with Sections R404.4.1 through R404.4.5.

Revise as follows:

R404.7.1 Quantity. New one- and two-family dwellings and townhouses with a designated attached or detached garage or other onsite private parking provided adjacent to the dwelling unit shall be provided with one *EV-capable*, *EV-ready*, or *EVSE installed space* per dwelling unit. R-2 occupancies or allocated parking for R-2 occupancies in mixed-use buildings shall be provided with an EV capable space, EV ready space, or EVSE space for ~~75%~~ 40% of each dwelling units or automobile parking spaces, whichever is less.

Add new text as follows:

R404.7.2 EV Capable Spaces. Each *EV capable space* used to meet the requirements of Section R404.7.1 shall comply with all of the following:

1. A continuous raceway or cable assembly shall be installed between an enclosure or outlet located within 3 feet (914 mm) of the *EV capable space* and a suitable panelboard or other onsite electrical distribution equipment.
2. Installed raceway or cable assembly shall be sized and rated to supply a minimum circuit capacity in accordance with R404.4.4
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have sufficient dedicated space and spare electrical capacity for a 2-pole circuit breaker or set of fuses.
4. The electrical enclosure or outlet and the electrical distribution equipment directory shall be marked: "For future*electric vehicle supply equipment (EVSE)*."

R404.7.3 EV Ready Spaces. Each branch circuit serving *EV ready spaces* shall comply with all of the following:

1. Terminate at an outlet or enclosure, located within 6 feet (1828 mm) of each *EV ready space* it serves and marked "For electric vehicle supply equipment (EVSE)".
2. Be served by an electrical distribution system and circuit capacity in accordance with Section R404.7.5.

3. Be designated on the panelboard or other electrical distribution equipment directory as "For electric vehicle supply equipment (EVSE)"

Revise as follows:

R404.7.4 Circuit Capacity. For one- and two-family dwellings and townhouses, the capacity of electrical infrastructure serving each *EV capable space*, *EV ready space* and *EVSE space* shall have a rated capacity not less than 8.3 kVA (or 40A at 208/240V) for each *EV capable space*, *EV ready space* or *EVSE space* it serves. Where a circuit is shared or managed it shall be in accordance with NFPA 70. For R-2 occupancies, the capacity of electrical infrastructure serving each *EV capable space*, *EV ready space* and *EVSE space* shall comply with one of the following:

1. A branch circuit shall have a rated capacity not less than 8.3kVA (or 40A at 208/240V) for each *EV capable space*, *EV ready space* or *EVSE space* it serves. Where a circuit is shared or managed it shall be in accordance with NFPA 70.
2. The requirements of R404.7.4.1.

Exceptions:

1. Where the local electric distribution entity has certified in writing that it is not able to provide 100% of the necessary distribution capacity within 2 years after the estimated date of the certificate of occupancy. The required EV charging infrastructure shall be reduced based on the available existing electric distribution capacity.
2. ~~For R-2 occupancies, where~~ Where substantiation has been approved that meeting the requirements of Section R404.4.4.1 will alter the local utility infrastructure design requirements on the utility side of the meter so as to increase the utility side cost to the builder or developer by more than $400.00 per dwelling unit.

Add new text as follows:

404.7.4.1 Circuit capacity management. The capacity of each branch circuit serving multiple *EVSE spaces*, *EV ready space* or *EV capable spaces* designed to be controlled by an energy management system providing load management in accordance with NFPA 70, shall have a capacity of not less than 2.7 kVA per space.

R404.7.5 EVSE installation. For one- and two-family dwellings and townhouses, EVSE shall be installed in accordance with NFPA 70 and shall be listed and labeled in accordance with UL 2202 or UL 2594. For R-2 occupancies, EVSE shall be installed in accordance with NFPA 70 and Section R404.7.5.1 and shall be listed and labeled in accordance with UL 2202 and UL 2594.

R404.7.5.1 EVSE minimum charging rate.. Each installed EVSE shall comply with one of the following:

1. Be capable of charging at a rate of not less than 6.2 kVA (or 30A at 208/240V).
2. Where serving EVSE spaces allowed to have a circuit capacity of not less than 2.7 kVA in accordance with R404.7.4.1 and controlled by an energy management system providing load management, be capable of simultaneously charging each EVSE space at a rate of not less than 2.1 kVA.

SECTION R405
SIMULATED BUILDING PERFORMANCE

Revise as follows:

R405.2 Performance-based compliance. Compliance based on total building performance requires that a proposed design meets all of the following:

1. The requirements of the sections indicated within Table R405.2.

2. The proposed total *building thermal envelope* UA, which is the sum of the U-factor times assembly area, shall be less ~~greater~~ than or equal to the *building thermal envelope* UA using the prescriptive U-factors from Table R402.1.2 multiplied by ~~1.15~~ 1.08 in Climate Zones 0, 1 and 2, and 1.15 in Climates Zones 3 through 8, in accordance with Equation 4-.1 ~~levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.~~ The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.
   ~~**Equation 4-1:** $UA_{proposed\ design}$ <=1.15 x $UA_{prescriptive\ reference\ design}$.~~ ~~For Climate Zones 0-2~~:
   $UA_{Proposed\ design} \leq 1.08 \times UA_{Prescriptive\ reference\ design}$ **(Equation 4-1)** For Climate Zones 3-8: $UA_{Proposed\ design} \leq 1.15 \times UA_{Prescriptive\ reference\ design}$
3. For buildings without a fuel burning appliance for space heating or water heating, ~~An~~ the annual energy cost of the *proposed design* that is less than or equal to85 percent of the annual energy cost of the *standard reference design* ~~or the additional efficiency credits as required in Section R408.2 shall be installed without including such measures in the *proposed design* under Section R405~~. For buildings with a fuel burning appliance for space heating or water heating, the annual energy cost of the proposed design that is less than or equal to 80 percent of the annual energy cost of the standard reference design. For *dwelling units* with greater than 5,000 square feet (465 m2) of ~~conditioned~~ *living space* floor area located above *grade plane*, the annual *energy cost* of the proposed design shall be reduced by an additional 5 percent of annual energy cost of the standard reference design.

Energy prices shall be taken from a source*approved* by the *code official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

TABLE R405.2 REQUIREMENTS FOR SIMULATED BUILDING PERFORMANCE

Portions of table not shown remain unchanged.

SECTION[a]	TITLE
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.5	Electric readiness
R404.6	Renewable energy infrastructure
R404.7	Electric Vehicle power transfer infrastructure

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 5.0 air changes per hour. Climate Zone 3, 4, and 5: 3.0 air changes per hour. Climate Zones ~~3~~ 6 through 8: ~~3.0~~ 2.5 air changes per hour.	The measured air exchange rate.[a]

	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than 0.01 × CFA + 7.5 × (N + 1) where: CFA = conditioned floor area, ft^2. N = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Energy recovery shall not be assumed for mechanical ventilation.	The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.
Heating systems[d, e, j, k]		~~As proposed~~
	Fuel Type/Capacity: Same as proposed design	As proposed
	Product class: Same as proposed design	As proposed
	Efficiencies:	As proposed
	Heat pump: Complying with 10 CFR §430.32	As proposed
	Non-electric furnaces: Complying with 10 CFR §430.32	As proposed
	Non-electric boilers: Complying with 10 CFR §430.32	As proposed
Cooling systems[d, f, k]		~~As proposed~~
	Fuel Type: Electric Capacity: Same as proposed design	As proposed
	Efficiencies: Complying with 10 CFR §430.32	As proposed
Service water heating[d, g, k]		
		Compactness ratio[i] factor
		1 story
		> 60%
		> 30% to ≤ 60%
		> 15% to ≤ 30%
		< 15%
	Fuel Type: Same as proposed design	As proposed
	Rated Storage Volume: Same as proposed design	As proposed
	Draw Pattern: Same as proposed design	As proposed
	Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32	As proposed

<table>
<tr><td></td><td>Tank Temperature: 120° F (48.9° C)</td><td>Same as standard reference design</td></tr>
<tr><td>Thermal distribution systems</td><td>Duct insulation: in accordance with Section R403.3.1.

Duct location: same as proposed design

<table>
<tr><th>Foundation Type</th><th>Slab on grade</th><th>Unconditioned crawlspace</th><th>Basement or conditioned crawlspace</th></tr>
<tr><td>Duct location (supply and return)</td><td>One-story building: 100% in unconditioned attic

All other: 75% in unconditioned attic and 25% inside conditioned space</td><td>One-story building: 100% in unconditioned crawlspace

All other: 75% in unconditioned crawlspace and 25% inside conditioned space</td><td>50% inside conditioned space

50% unconditioned attic</td></tr>
</table>
Duct system leakage to outside:

For duct systems serving > 1,000ft^2 of conditioned floor area, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.

For duct systems serving ≤ 1,000ft^2 of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).</td><td>Duct insulation: as proposed.

Duct location: as proposed.

Duct System Leakage to Outside:

The measured total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate.

Exceptions:

1.. When duct system leakage to outside is tested in accordance ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered.

2. When total duct system leakage is measured without the air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.</td></tr>
<tr><td></td><td>For all systems other than tested duct systems. aFor hydronic systems and ductlesssystems.<s>a</s> A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies. for all systems other than tested duct systems.

Exception: For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1.

<s>For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned</s> floor area at a pressure of differential of 0.1 inch w.g. (25 Pa).</td><td>As tested or, where not tested, For hydronic systems and ductless systems, DSE shall be as specified in Table R405.4.2(2).</td></tr>
</table>

g. For a proposed design ~~with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design~~ without a proposed water heater, ~~a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed~~ t he following assumptions shall be madefor both the proposed design and standard reference design.
Fuel Type: Same as the predominant heating fuel type
Rated Storage Volume: 40 Gallons
Draw Pattern: Medium
Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

TABLE R405.4.2(2) DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS[b]
Distribution system components located in unconditioned space	NA	0.95
Untested distribution Distribution system systems components entirely located in conditioned space[c]	0.88 NA	1
Ductless systems[d]	1	NA

a. Default values in this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.

b. Hydronic systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed-loop piping and that do not depend on ducted, forced airflow to maintain space temperatures.

c. Entire system in conditioned space shall mean that no component of the distribution system, including the air-handler unit, is located outside of the conditioned space.

d. Ductless systems shall be allowed to have forced airflow across a coil but shall not have any ducted airflow external to the manufacturer's air-handler enclosure.

SECTION R406
ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

Revise as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

Portions of table not shown remain unchanged.

SECTION[a]	TITLE
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.5	Electric readiness
R404.6	Renewable energy infrastructure
R404.7	Electric Vehicle power transfer infrastructure

R406.3 Building thermal envelope. ~~Building and portions thereof shall comply with Section R406.3.1 or R406.3.2~~.

~~**R406.3.1 On-site renewables are not included.**~~ ~~Where on-site renewable energy is not included for compliance using the ERI analysis of Section R406.4, the~~ The proposed total building thermal envelope UA, which is sum of U-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by ~~1.15~~ 1.08 in Climate Zones 0, 1, and 2, and by 1.15 in Climates Zones 3 through 8, in accordance with Equation 4-1. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.~~$UA_{Proposed\ design} \le = 1.15 \times UA_{Prescriptive\ reference\ design}$~~ ~~**(Equation 4-1)**~~ For Climate Zones 0-2: $UA_{Proposed\ design} \le 1.08 \times UA_{Prescriptive\ reference\ design}$ **(Equation 4-1)** or Climate Zones 3-8: $UA_{Proposed\ design} \le 1.15 \times UA_{Prescriptive\ reference\ design}$

~~**406.3.2 On-site renewables are included.**~~ ~~Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.~~

SECTION R408
ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Revise as follows:

R408.2 Additional energy efficiency credit requirements ~~package options~~. Two additional ~~Additional efficiency package options for compliance with Section R401.2.1 are set forth in Sections Table R408.2.1 through R408.2.5.~~ measures shall be selected from Table R408.2 that ~~are cumulatively equal to or greater than~~meet or exceed a total of ten. Five additional credits shall be selected for dwelling units with greater than 5,000 square feet (465 m2) of ~~conditioned~~ *living space* floor area located above *grade plane*. Each measure selected shall meet the relevant subsections of Section R408 and receive credit as specified in Table 408.2 for the specific Climate Zone. Interpolation of credits between measures shall not be permitted.

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Portions of table not shown remain unchanged.

Measure Number	Measure Description	Credit Value								
		Climate Zone 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4 except Marine	Climate Zone 4 Marine	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.10	Demand Responsive Thermostat	1	1	1	1	1	1	1	1	1

R408.2.1 Enhanced envelope ~~performance~~ options. ~~The total building thermal envelope UA, the sum of U-factor times assembly area, shall be less than or equal to 95 percent of the total UA resulting from multiplying the U-factors in Table R402.1.2 by the same assembly area as in the proposed building. The UA calculation shall be performed in accordance with Section R402.1.5. The area-weighted average SHGC of all glazed fenestration shall be less than or equal to 95 percent of the maximum glazed fenestration SHGC in Table R402.1.2.~~ The building thermal envelope shall meet the requirements of the following:

1. Section R408.2.1.1 or R408.2.1.2.
2. Section R408.2.1.3.

R408.2.1.3 Roof reflectance. Roofs ~~in Climate Zones 0 through 23~~ shall comply with one or more of the options in Table R408.2.1.3.

~~**Exceptions:**~~

1. ~~Roofs with a radiant barrier with an emittance of 0.05 or less~~.
2. ~~Portions of the roof that include or are covered by one or more of the following~~:
   2.1. ~~On-site renewable energy systems or components~~
   2.2. ~~Solar air or water heating systems or components~~
   2.3. ~~Vegetative roofs or landscaped roofs~~
   2.4. ~~Above roof decks or walkways~~
   2.5. ~~Skylights~~
   2.6. ~~HVAC systems and components, and other opaque objects mounted above the roof~~
3. ~~Portions of roof shaded during the peak sun angle of the summer solstice by permanent features of the building or by permanent features of adjacent buildings.~~
4. ~~Portions of roofs that are ballasted with a minimum stone ballast of 17 pounds per square foot (74 kg/m2) or 23 psf (117 kg/m2) pavers.~~
5. ~~Roofs where portions exempted by exceptions 2, 3, and 4 make up not less than 75 percent of the total roof area~~.

Add new text as follows:

TABLE R408.2.1.3 MINIMUM ROOF REFLECTANCE[a]

ROOF SLOPE	THREE-YEAR AGED SOLAR REFLECTANCE INDEX[b]
Low slope	75[b,c]
Steep slope	16

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for solar reflectance shall be assigned a 3-year-aged solar reflectance in accordance with Section R408.2.1.3.1.

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × ft 2 × °F (12 W/m 2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance.

R408.2.1.3.1 Aged solar reflectance. Where an aged solar reflectance required by Section R402.6 is not available, it shall be determined in accordance with Equation 4-X.

(Equation 4-X)

$$R_{aged} = [0.2+0.7(R_{initial}-0.2)]$$

where:Raged = The aged solar reflectance
$R_{initial}$ = The initial solar reflectance determined in accordance with CRRC-5100.

Measure Numberber	Measure Description	Credit Value								
		CZ 0 & 1	CZ 2	CZ 3	CZ 4	CZ 4C	CZ 5	CZ 6	CZ 7	CZ 8
R408.2.1.3	Cool Roof	TBD	TBD	TBD	TBD	TBD	0	0	0	0

R408.2.10 Demand response. The thermostat controlling the primary heating or cooling system of each *dwelling unit* shall be provided with a *demand responsive control* capable of communicating with the Virtual End Node (VEN) using a wired or wireless bi-directional communication pathway that provides the occupant the ability to voluntarily participate in utility demand response programs, where available. The thermostat shall be capable of executing the following actions in response to a *demand response signal*:

1. Automatically increasing the zone operating cooling set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).

2. Automatically decreasing the zone operating heating set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).

Thermostats controlling single stage HVAC systems shall comply with Section R408.2.10.1. Thermostats controlling variable capacity systems shall comply with Section R408.2.10.2. Thermostats controlling multi-stage HVAC systems shall comply with either Section R408.2.10.1 or R408.2.10.2. Where a *demand response signal* is not available the thermostat shall be capable of performing all other functions.

R408.2.10.1 Single stage HVAC system controls . Thermostats controlling single stage HVAC systems shall be provided with a*demand responsive control* that complies with one of the following:

1. Certified OpenADR 2.0a VEN, as specified under Clause 11, Conformance.

2. Certified OpenADR 2.0b VEN, as specified under Clause 11, Conformance.

3. Certified by the manufacturer as being capable of responding to a *demand response signal* from a certified OpenADR 2.0b VEN by automatically implementing the control functions requested by the VEN for the equipment it controls.
4. IEC 62746-10-1.
5. The communication protocol required by a controlling entity, such as a utility or service provider, to participate in an automated demand response program.
6. The physical configuration and communication protocol of CTA 2045-A or CTA-2045-B.

R408.2.10.2 Variable capacity and two stage HVAC system controls. Thermostats controlling variable capacity and two stage HVAC systems shall be provided with a *demand responsive control* that complies with the communication and performance requirements of AHRI 1380.

Revise as follows:

R408.2.11 Opaque walls option. For *buildings* in climate zones 4 and 5, the maximum U-factor of 0.060 shall be permitted to be used for wood frame walls for compliance with Table R402.1.2 where complying with one or more of the following:

1. ~~A heat pump is installed for~~ Primary space heating is provided by a heat pump that meets one of the efficiencies in R408.2.3.
2. All installed water heaters are heat pumps that meet one of the efficiencies in R408.2.4. ~~have a UEF equal to or greater than 2.0 or a COP of greater than 1.0~~
3. In addition to the number of credits required by Section R408.2, three additional credits are achieved.
4. Renewable energy resources are installed to meet the requirements of R408.2.8.

CHAPTER 6 [RE]
REFERENCED STANDARDS

Add new standard(s) as follows:

AHRI

Air-Conditioning, Heating, & Refrigeration Institute
2111 Wilson Blvd, Suite 500
Arlington, VA 22201

AHRI 1380-2019	Demand Response through Variable Capacity HVAC Systems in Residential and Small Commercial Applications

ASTM

ASTM International ASTM InternationalASTM International
100 Barr Harbor Drive, P.O. Box C700 100 Barr Harbor Drive, P.O. Box C700100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA PAPA 19428-2959 19428-29591942

C1549-2016	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
E903-2012	Standard Test Method for Solar Absorptance, Reflectance and Transmittance of Materials Using Integrating Spheres (Withdrawn 2005)
E1918-06(2016)	Standard Test Method for Measuring Solar Reflectance of Horizontal or Low-sloped Surfaces in the Field
E1980- 11	Standard Practice for Calculating Solar Reflectance of Horizontal and Low-sloped Opaque Surfaces

CRRC ANSI/CRRC-5100-2021. Standard Test Methods for Determining Radiative Properties of Materials

CTA ANSI/CTA-2045-B – 2018:. Modular Communications Interface for Energy Management

DOE 10 CFR, Part 430-2021. Energy Conservation Program for Consumer Products: Energy and Water Conservation Standards and their compliance dates

IEC IEC 62746-10-1 - 2018:. Systems interface between customer energy management system and the power management system - Part 10-1: Open automated demand response

OpenADR OpenADR 2.0a and 2.0b – 2019:. Profile Specification Distributed Energy Resources

Add new standard(s) as follows:

UL 2202-2009. Electric Vehicle (EV) Charging System - with revisions through February 2018

Add new text as follows:

UL 2594-2016. Standard for Electric Vehicle Supply Equipment

APPENDIX XX
ELECTRIC ENERGY STORAGE PROVISIONS
The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION XX101
SCOPE

XX101.1 General. These provisions shall be applicable for new construction where solar-ready measures or an onsite solar PV system are required.

SECTION XX102
GENERAL DEFINITIONS

Add new definition as follows:

ENERGY STORAGE SYSTEM (ESS). One or more devices, assembled together, capable of storing energy in order to supply electrical energy at a future time.

Add new text as follows:

SECTION XX103 ELECTRICAL ENERGY STORAGE. One- and two-family dwellings, townhouse units, and Group R-3 occupancies shall either comply with RB103.1 or RB103.2. Buildings with Group R-2 and R-4 occupancies shall comply with RB103.3.

XX103.1 Electrical energy storage energy capacity. Each building shall have a ESS with a minimum rated energy capacity of 5 kWh with a minimum of four ESS supplied branch circuits.

Electrical energy storage system ready. Each building shall be energy storage ready in accordance with Sections RB103.2.1 through RB103.2.4.

XX103.2.1 Energy storage system space. Interior or exterior space with dimensions and locations in accordance with Section R328 of the *International Residential Code* and Section 110.26 of NFPA 70 shall be reserved to allow for the future installation of an*energy storage system*.

XX103.2.2 System Isolation Equipment Space. Space shall be reserved to allow for the future installation of a transfer switch within 3 feet (305mm) of the main panelboard. Raceways shall be installed between the panelboard and the transfer switch location to allow the connection of an ESS.

XX103.2.3 Panelboard with backed-up load circuits. A dedicated raceway from the main service to a panelboard that supplies the branch circuits served by the ESS. All branch circuits are permitted to be supplied by the main service panel prior to the installation of an ESS. The trade size of the raceway shall be not less than one inch. The panelboard that supplies the branch circuits shall be labeled "Subpanel reserved for future battery energy storage system to supply essential loads."

XX103.2.4 Branch circuits served by ESS. A minimum of four branch circuits shall be identified and have their source of supply collocated at a single panelboard supplied by the ESS. The following end uses shall be served by the branch circuits:

1. A refrigerator.
2. One lighting circuit near the primary egress.
3. A sleeping room receptacle outlet.

XX103.3 Electrical energy storage system. Buildings with Group R-2 and R-4 occupancies shall comply with C405.15.

Reason: Modification approved by IECC Residential consensus committee 9/27/22.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.N/A

Cost Impact (Detailed): The change proposal is editorial in nature or a clarification and has no cost impact on the cost of construction

Justification:

N/A

Public Hearing Results

Committee Action **As Modified**

Committee Reason: REPI-33-21 Vote to Approve as modified: This includes modifications to the following code change proposals RECPI-6-21, RECPI-7-21, REPI-7-21, REPI-20-21, REPI-64-21, REPI-68-21, REPI-70-21, REPI-93-21, REPI-111-21, REPI-115-21, and REPI-122. 38 yes 9 no 0 abstain (2/3 majority achieved).

Final Hearing Results

REPI-33-21 AMC1

REPI-35-21

Original Proposal

IECC®: TABLE R402.1.3, R402.2.7

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.1.3 (TABLE N1102.1.3) INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]
Portions of table not shown remain unchanged.

CLIMATE ZONE	FLOOR *R*-VALUE[j]
0	13 or 7+5ci or 10ci
1	13 or 7+5ci or 10ci
2	13 or 7+5ci or 10ci
3	19 or 13+5ci or 15ci
4 except Marine	19 or 13+5ci or 15ci
5 and Marine 4	30 or 19+7.5ci or 20ci
6	30 or 19+7.5ci or 20ci
7 and 8	38 or 19+10ci or 25ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

j. "30 or 19+7.5ci or 20ci" means R30 *cavity insulation* alone or R19 *cavity insulation* with R7.5 *continuous insulation* or R20 *continuous insulation* alone.

R402.2.7 (N1102.2.7) Floors. Floor ~~cavity~~ *insulation* shall comply with one of the following:

1. Installation shall be installed to maintain permanent contact with the underside of the subfloor decking in accordance with manufacturer instructions to maintain required *R*-value or readily fill the available cavity space.
2. Floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing separating the cavity and the unconditioned space below. Insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.
3. A combination of cavity and continuous insulation shall be installed so that the cavity insulation is in contact with the top side of the continuous insulation that is installed on the underside of the floor framing separating the cavity and the unconditioned space below. The ~~combined~~ *R*-values of the cavity and continuous insulation components or the R-value of continuous insulation only shall equal the required insulation component *R*-values for floors. Cavity ~~I~~ insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.

Reason: This proposal adds prescriptive R-value options to Table R402.1.3 for floors above unconditioned spaces (e.g., crawlspaces, floor overhangs, etc.) to align with the primary insulation options as done for above-grade walls. These options are cavity insulation only, cavity plus continuous insulation, and continuous insulation only. This proposal provides prescriptive solutions for a combination of cavity and continuous insulation as currently addressed in Item 3 of Section R402.2.7, but not implemented in Table R402.1.3. Thus, it addresses a gap in the current prescriptive R-value requirements in the code. Finally, it aligns Section R402.2.7 with changes to the table and corrects an error in indicating that cavity and insulation components can be simply summed to meet cavity insulation requirements (which conflicts with clear direction not to do this in Section R402.1.4).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal provides options for floor insulation and, therefore, may actually reduce cost.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Consistent with how assemblies are handled in the code. Provides flexibility where so desired.

Final Hearing Results

REPI-35-21	AS

REPI-37-21

Original Proposal

IECC®: R402.2.10, R402.2.10.1
Proponents: Robby Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

R402.2.10 (N1102.2.10) Crawl space walls. Crawl space walls shall be insulated in accordance with Table R402.1.3.

Exception: Crawl space walls associated with a crawl space that is vented to the outdoors and the floor overhead is insulated in accordance with Table R402.1.3 and Section R402.2.7.

R402.2.10.1 (N1102.2.10.1) Crawl space wall insulation installations. ~~Where c~~Crawl space wall insulation ~~is installed, it~~ shall ~~be permanently fastened to the wall and shall extend downward from the floor to the finished grade elevation and then vertically or horizontally for not less than an additional 24 inches (610 mm).~~ comply with the following:

1. Where exterior crawl space wall insulation is installed, it shall be permanently attached to the wall and extend downward from the sill plate to not less than the base of the foundation wall.
2. Where interior crawl space wall insulation is installed, it shall be permanently attached to the foundation wall and extend downward from the sill plate at the top of the foundation wall to not less than the interior floor of the crawl space.

Exposed earth in ~~unvented~~ crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the International Building Code or *International Residential Code*, as applicable. Joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up stem walls and shall be attached to the stem walls.

Reason: Purpose: This proposal offers direction for installation of foundation insulation that performs, and which makes enforcement easier and more straight forward. The standing language does not address insulating from the outside and ambiguously speaks to insulating the rim joist or “the depth of the floor”.

Language that has been stricken is not enforced and is confusing creating situations where the crawl foundation wall may not be fully insulated especially at the top next to the sill plate connection and at the bottom connection with footings or soils. Performance and efficiency will be increased through consistent application which will benefit jurisdictions and the homeowner by ensuring continuous thermal envelopes that avoid thermal bridging.

There may be a perception that the removal of the requirement to insulate horizontally for 2’ over the dirt floor is a reduction in the stringency of the IECC, however, energy modeling has determined that the horizontal application of insulation inward for 2’ over the crawl dirt vapor retarder does not improve the energy performance of the home. This currently required detail is rarely enforced and or applied in the field. Proposals need to address cost of application and this proposal reduces cost by removing ineffective application.

The IECC has never specifically addressed the application of insulation on the exterior so this proposal clarifies that insulation shall extend above grade to the sill plate and below grade to the footing in this application. Frost protected shallow foundations that are constructed with horizontal insulation extending away from the foundation on the outside of the building are not prohibited by this change in language. As demonstrated in the Bibliography, this type of insulation technique takes the insulation horizontally from the bottom of the installed vertical installed insulation which in this case would be at the bottom of the foundation wall on the exterior.
Regardless of if the crawl space is vented or unvented, exposed earth needs to be covered with a class I vapor retarder. This proposal ensures that there is no confusion about this sound building durability and building science point.

Bibliography: Shallow frost foundation guide
https://www.huduser.gov/publications/pdf/fpsfguide.pdf

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

This proposal will not increase cost and should decrease cost as it is eliminating the requirement to install insulation 2' horizontally on the interior of the foundation wall over the vapor retarder on the dirt floor.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: modification addressed concerns of subcommittee

Final Hearing Results

REPI-37-21	AM

REPI-39-21

Original Proposal

IECC®: SECTION 202 (New), R402.2.3 (N1102.2.3) (New), R402.2.3.1 (N1102.2.3.1) (New), TABLE R405.2
Proponents: Robby Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Add new definition as follows:

Knee wall. An *above-grade wall* assembly, or wall defined by vertical truss members, of any height that separate conditioned space from unconditioned buffer spaces, such as ventilated attics and entry porch roofs, rather than ambient outdoors.

Add new text as follows:

R402.2.3 (N1102.2.3) Attic knee wall. R402.2.3 Attic knee wall assemblies that separate conditioned space from unconditioned attic spaces shall meet the same insulation requirements as above-grade walls. Such knee walls shall have an air barrier between conditioned an unconditioned space.

R402.2.3.1 (N1102.2.3.1) Truss framing separating conditioned and unconditioned space. Where vertical roof truss framing members are used to separate conditioned space and unconditioned space, they shall meet the same insulation requirements as the above-grade walls.

Revise as follows:

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

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3 R402.2.3 R402.2.4	Attic knee or pony wall Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation

R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

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

Reason: Attic knee walls, often named pony walls in the field, are a unique assembly that has been overlooked by the IECC. The assembly separates interior conditioned space from exterior unconditioned space, but it buffered from directly being connected to the ambient outdoors by a ventilated attic. The ventilated attic space often has harsher unconditioned side temperatures that normal above grade walls causing more significant heat loss or gain through the assembly than through normal insulated above grade walls. This being the case we see across the country in the field that attic knee or pony walls are often insulated to a lower R-value than the exterior walls associated with the same house. In addition, the IECC has not been clear about the need for attic side enclosed and sealed air barrier systems installation.

This proposal defines, describes how to address, and adds this unique assembly to the list of required assemblies that must be detailed in the requirements section of the IECC. It will ensure proper air barriers, insulation installation, air sealing of the assembly and will increase the performance of the home.

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

In theory, this assembly has been addressed as an above grade wall so this new section of code should not add cost to the construction of a home. In reality, this assembly has not been viewed in most of the country as a typical above grade wall so cost will be added to construction because of the realization of the significance of the assembly and the heat loss and gain that is driven through it because of it be adjacent to the ventilated attic.

The R-value of this part of the above grade wall assembly could traded off to a lower R-value, or the same R-value that is currently being installed when using the UA alternative, Total Building Performance, or ERI compliance pathways. This would lower the cost associated with this code proposal. However, as cost goes down implementation would still become better because the proposal would ensure that the installed insulation is enclosed in a six-sided air sealed cavity which performs to better mitigate heat loss and gain through the assembly.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: assembly often overlooked and with low compliance rates. Language has issues but it's necessary.

Final Hearing Results

REPI-39-21 AM

REPI-40-21

Original Proposal

IECC®: R402.2.6, TABLE R402.2.6, AISI (New)

Proponents: Jonathan Humble, American Iron and Steel Institute (Jhumble@steel.org)

2021 International Energy Conservation Code

Revise as follows:

R402.2.6 (N1102.2.6) Steel-frame ceilings, walls and floors. Steel-frame ceilings, walls, and floors shall comply with the ~~insulation requirements of Table R402.2.6 or the~~ *U*-factor requirements of Table R402.1.2. The calculation of the *U*-factor for steel-framed ceilings and walls in an envelope assembly shall ~~use a series-parallel path calculation method~~ be determined in accordance with AISI S250 as modified herein.

1. Where the steel-framed wall contains no cavity insulation, and uses continuous insulation to satisfy the *U*-factor maximum, the *steel-framed wall* member spacing is permitted to be installed at any on center spacing.
2. Where the steel-framed wall contains framing spaced at 24 inches (610 mm) on center with a 23% framing factor or framing spaced at 16 inches (400 mm) on center with a 25% framing factor, the next lower framing member spacing input values shall be used when calculating using AISI S250.
3. Where the steel-framed wall contains less than 23% framing factors the AISI S250 shall be used without any modifications.
4. Where the steel-framed wall contains other than standard C-shape framing members the AISI S250 calculation option for other than standard C-shape framing is permitted to be used.

Delete without substitution:

~~TABLE R402.2.6 STEEL-FRAME CEILING, WALL AND FLOOR INSULATION R-VALUES~~

WOOD FRAME *R*-VALUE REQUIREMENT	COLD-FORMED STEEL-FRAME EQUIVALENT *R*-VALUE[a]
Steel Truss Ceilings[b]	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings[b]	
R-30	R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing
R-38	R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10
Steel-frame Wall, 16 inches on center	
R-13 + 4.2 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1	
R-13+5	R-0 + 15 or R-13 + 9 or R-15 + 8.5 or R-19 + 8 or R-21 + 7
R-13+10	R-0+20 or R-13 + 15 or R-15 + 14 or R-19 + 13 or R-21 + 13
R-20	R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-21 + 7.5
R-20 + 5	R-13 + 12.7 or R-15 + 12.3 or R-19 + 11.6 or R-21 + 11.3 or R-25 + 10.9
R-21	R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7
Steel-frame Wall, 24 inches on center	
R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4	
R-13+5	R-0 + 15 or R-13 + 7.5 or R-15 + 7 or R-19 + 6 or R-21 + 6
R-13+10	R-0 + 20 or R-13 + 13 or R-15 + 12 or R-19 + 11 or R-21 + 11
R-20	R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9
R-20+5	R-13 + 11.5 or R-15 + 10.9 or R-19 + 10.1 or R-21 + 9.7 or R-25 + 9.1
R-21	R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9
Steel Joist Floor	
R-13	R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10
R-19	R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10

~~a. The first value is cavity insulation *R*-value; the second value is continuous insulation *R*-value. Therefore, for example, "R-30 + 3" means R-30 cavity insulation plus R-3 continuous insulation.~~

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

Add new standard(s) as follows:

AISI . AISI S250 - 21 North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing

Reason: The purpose of this proposal is to address the issue of having to submit to the code official a request to use the alternative means and methods provisions for cold-formed steel framing designs that are not shown in the IECC. For example, Section C402.1.4.2 addresses only wall framing spacing for 16 and 24 inch on center spacing and is limited to cavity plus continuous insulation options only, whereas, in the market there are many more framing spacing and insulation options used.

This proposal recommends that the Section be modified to recognize the ANSI/AISI/COFS S250 standard. This standard covers cold-formed steel wall framing spacings from 6 inches to 24 inches on center, covers member sizes from 3.5 inches to 12 inches wide, and covers member thicknesses from 0.033 inches thick to 0.064 inches thick. This standard will provide greater latitude for the user of the IECC by mitigating the necessity of having to submit for approval under alternate means and methods provisions. Further, this standard also includes provisions for evaluation of wall assemblies where all the insulation is located outside the wall cavity, which is an option the IECC does not cover.

This standard also contains provisions for calculating ceiling assemblies constructed of cold-formed steel framing with either conventional c-shape framing members, or truss construction with insulation in the attic and with additional continuous insulation below the truss framing. Previous to this proposal we found users applying the 2003 IECC provisions, which contained the calculation procedures, as part of the alternative means and methods submission process to demonstrate compliance. This proposal is intended to mitigate that additional step.

The ANSI/AISI/COFS S250 was approved and published in September 2021.

As part of AISI's effort to make this document user friendly, an excel spread sheet containing all the necessary equations and back-ground data was generated so that users would merely input the basic assembly materials data (e.g. R-values of insulations, sheathings, etc.) and allow the spread sheet to calculate within seconds the result. This excel spread sheet is available at no cost to any potential user (e.g. code official, design professional, building owner, etc.)

The proponent wishes to schedule time to present to the IECC Residential Committee this proposal, discuss, and to take questions from the Committee.

Bibliography: AISI, "Development of a U-factor Calculation Procedure for Cold-Formed Steel C-Shaped Clear Wall Assemblies," American Iron and Steel Institute, Washington, DC, Research Report RP20-2, April 2020.

AISI, "North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing," American Iron and Steel Institute, Washington, DC, AISI S250-21.

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

This proposed change we expect will decease the cost of construction by eliminating the need to prepare an application to the alternative means and methods process. This is because of the standards wider range of envelope assembly options that the user is permitted to calculate in order to demonstrate compliance.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: provides clear and accurate way of determining wall and ceiling assemblies for closed form steel.

Final Hearing Results	
REPI-40-21	AM

REPI-42-21
Original Proposal

IECC®: SECTION 202 (New), R402.3 (N1102.3) (New), ASTM Chapter 06 (New)

Proponents: Wesley Hall - Account Manager, Reflectix, Inc., The Reflective Insulation Manufacturers Association - International (wes.hall@reflectixinc.com)

2021 International Energy Conservation Code

Add new definition as follows:

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

Add new text as follows:

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

Add new standard(s) as follows:

ASTM

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

C1743-2019	Standard Pract ice f o r Inst allat io n and Use o f Radiant Barrier Syst ems (RBS) in Resident ialBuilding Co nst ruct io n

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

The definition for Radiant Barrier is included in the 2021 IBC.

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

Radiant barriers follow two ASTM Standards – ASTM C1313/C1313M, "Standard Specification for Sheet Radiant Barriers for Building Construction Applications," and ASTM C1743, "Standard Practice for Installation and Use of Radiant BarrierSystems (RBS) in Residential Building Construction".

The proposed language is being included in this section specifically because the American Society for Testing andMaterials (ASTM) classifies radiant barriers as thermal insulation. The ASTM committee C16 on Thermal Insulation includespublished 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. The low emittance material can be bonded to plastic film, woven fabric, reinforced paper, OSB or plywood. The thermal performance of radiant barriers depends on emittance and location in the attic, wall or roof assembly. Radiant barriers are predominantly installed in attic spaces below the roof deck. The low-emittance surface of radiant barrier products dramatically reduces the heat gain by radiation into the structure and attic HVAC ducts. For this reason, radiant barriers are especially effective in warm sunny climates where they provide reduced use of air conditioning. Radiant barrier products that are available include single-sheet material, multi-layer assemblies and wood sheathing with attached aluminum film or foil. The single sheet material is installed in roof assemblies by attaching directly to the roof deck, in between the rafters or trusses or to the underside of the rafters or trusses. The foil-faced sheathing is installed with the low-emittance side of the sheathing or panel facing toward the attic space to create a radiant barrier Attic radiant barriers are in extensive use. These products have been on the market for several decades and are used by 87 of the top 100 US Builders. They have an established history and have been accepted into several regional code requirements. Over one billion square feet of the product is being installed annually.

IBC 2021

- Section 1510, Radiant Barriers Installed Above Deck

Hawaii Title 3, Chapter 181.1 2015

- Section 407.2 Requirements
- Table 407.1 Points Option

Texas

- City of Austin Ordinance No. 20210603-055, City Code Chapter 12-25, Article 12, R402.6

2020 Florida Building Code, Energy Conservation, 7th Edition

- R405.7.1 Installation criteria for homes claiming the radiant barrier option
- Figure R405.7.1 Acceptable attic radiant barrier configurations
- Table 303.2.1 Insulation Installation Standards

2019 California Title 24, Part 6

- Section 100.1 Definitions
- Section 110.8 Mandatory requirements for insulation, roofing products and radiant barriers

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

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

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: provides useful definition on reflective insulation and emittance

Final Hearing Results

REPI-42-21	AS

REPI-43-21

Original Proposal

IECC®: R402.4, R402.4.1.2, ASTM Chapter 06 (New)

Proponents: Theresa A Weston, The Holt Weston Consultancy, The Air Barrier Association of America (ABAA) (holtweston88@gmail.com)

2021 International Energy Conservation Code

Revise as follows:

R402.4 Air leakage. The *building thermal envelope* shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through ~~R402.4.5~~ R402.4.6.

R402.4.1.2 Testing. The *building* or *dwelling unit* shall be tested for air leakage. The maximum air leakage rate for any*building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 ~~or~~ ASTM E1827or ASTM E3158 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the*code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the*building thermal envelope* have been sealed.

Exception: For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, *conditioned spaces* in accordance with Sections R402.2.12 and R402.3.5, as applicable.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exception: When testing individual*dwelling units*, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 $m^3/(s \times m^2)$] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779~~or~~ ASTM E1827 or E3158 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:

1. Attached single-family and multiple-family building*dwelling units*.
2. Buildings or *dwelling units* that are 1.500 square feet (139.4 m^2) or smaller.

Mechanical ventilation shall be provided in accordance with Section M1505 of the*International Residential Code* or Section 403.3.2 of the *International Mechanical Code*, as applicable, or with other*approved* means of ventilation.

Add new standard(s) as follows:

ASTM

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

E3158-18	Standard Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building

Reason: This proposal adds an additional reference test method, ASTM E3158. This test method has already been included in the list of acceptable test methods for whole building air leakage testing in the IECC-C but was not added to the parallel section of the IECC-R.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does increase code requirements or introduce new code requirements. It only add an additional test protocol option to the current list of test protocol standards.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: this method for air leakage testing should be allowed in the code.

Final Hearing Results

REPI-43-21 AM

REPI-47-21

Original Proposal

IECC®: TABLE R402.4.1.1

Proponents: Robby Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	~~The~~ A sealed air barrier shall be installed in any dropped ceiling or soffit to separate it from unconditioned space. ~~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 air sealed with gasketing materials that allow for repeated entrance over time.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier. Access hatches and doors shall be installed and insulated in accordance with Section R402.2.4 - Eave Baffles shall be installed in accordance with Section R402.2.3
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, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code.*	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—

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

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

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Air barrier Criteria:

- This section of the code proposal removes insulation requirements that were placed on the wrong side of the table. They are also redundant to insulation requirements that are already in place on the insulation side of the table for this component.
- Driving home the concept of air barriers separating conditioned space from unconditioned space is important to continue here to clarify the requirement to bring drop ceilings into the conditioned space.
- In the field we are continuing to see hatches that are caulked shut and must be cut open. The requirement for air sealing hatches and doors now is clarified that a gasketing air sealing material must be installed that allows for repeated entrance without damaging the air seal.

Insulation Installation Criteria:

- There are many precedents in code language to point to sections for additional clarification, especially for installation guidance that is already in the code but are important to the section of code where the reference has been made. The specific referenced sections in this proposal describe the installation of measures in the requirement section of the code.
- These sections of code are important to reiterate in Table R402.4.1.1 due to the many compliance options that are available. In addition, traditionally Section R402.2.3 and R402.2.4 have been in the prescriptive section of the code. They are currently right after the discussion of prescriptive compliance. As jurisdiction adopt newer code it is important to ensure that although the word mandatory has been removed in the IECC that there are still installation requirements in this table that are explained in other sections of the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed language changes do not increase the cost of construction but rather removes redundancy and offers greater clarity of existing requirements.
Accessibility to attic spaces is new language but is not a new requirements so it should not increase cost but rather increase clarity.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Proposal clarifies that dropped ceilings are inside the thermal envelope. Addresses gasketing of access hatches and doors. The subcommittee agreed it was a needed update.

Final Hearing Results

REPI-47-21 AS

REPI-50-21

Original Proposal

IECC®: TABLE R402.4.1.1

Proponents: Robby Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. 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 or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	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, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots ~~that penetrate building thermal envelope~~ shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	<u>HVAC supply and return register boots located in the building's thermal envelope shall be buried and surrounded by insulation.</u>
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

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

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: This proposal requires that all supply and return registers be sealed to the surface they are penetrating. The origin of this air sealing requirement comes from ENERGY STAR, who has demonstrated that energy loss is associated with duct boot installation in three ways: 1) if the boot directly penetrates the thermal envelope, such as a duct boot coming from a ventilated attic into the house; 2) when air that should be delivered to the conditioned space is redirected into building cavities when it hits the register cover; 3) when Venturi pressure, sometimes called the Coanda effect, is created and pulls air into the building cavity as it is being delivered into the room. See Bibliography for more)

By not being able to deliver the HVAC designed volume of air to the rooms of the house, the occupant is often left with no other choice than to raise the thermostat set point temperature in the winter and to lower it in the summer. This causes energy inefficiencies while not correcting their comfort issue. In addition, building cavities are often connected to unconditioned space which increases duct leakage to the outside, as well as other inefficiencies. Therefore, I also believe that it is an important energy and building durability issue. This needs to be addressed at this time because many builders and contractors have experience implementing this in part, if not in whole and this proposal finished what the code has been intending when it barrowed this requirement from the Energy Star program.There have not been insulation requirements associated with duct boots in the past which continues to make this a significant code change proposal. Ensuring that our building cavities are insulated properly is imperative when duct boots are placed in them, and this proposal directly addresses that issue at the termination of the duct boot and the substrate it passes through.
Lastly, this proposal aligns with

ENERGY STAR requirements that are the basis of the creation of this table that has been adopted by the IECC.

6. Duct Quality Installation: See Bibliography from more information

6.4.1 In addition, all duct boots sealed to the finished surface, Rater-verified at final. 39

Bibliography: Read more here, **https://www.achrnews.com/articles/128615-why-dirt-streaking-occurs-around-vents**

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

As noted during the 2021 IECC development hearings, this proposal changes the scope of the requirement and therefore should slightly increase the cost of execution by the application of additional caulk, but the benefits to the energy performance of the system far out way the small incremental cost. In reality, this proposal, offers better clarity and expansion of existing requirements and for Energy Star builders there would be no increase in cost.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: provide clarification to how insulation is to be installed around HVAC supply and return register boots

Final Hearing Results

REPI-50-21 AM

REPI-51-21

Original Proposal

IECC®: TABLE R402.4.1.1

Proponents: Robby Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. 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 or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	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, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Common walls or double walls	Air sealing materials recognized in a*listed* fire-resistance rated common wall or double wall design and installed in accordance with the listing, or air sealing materials recognized in an *approved* design, shall be used. Common walls or double walls shall be considered an exterior wall for the purposes of air barrier and air sealing application of this Table (R402.4.1.1).	Insulation materials recognized in the listed common wall or double-wall design and installed in accordance with the listing, or insulation materials recognized in the approved design, shall be used.

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

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Air Sealing Criteria:

- Area separation walls have extreme air leakage. The BXUV guide has been updated to allow air sealing and this should be reflected in the IECC and specifically in Table R402.4.1.1. Below is an example of the new language that has been added to the following Shaft Liner assemblies: U336, U347, U366, U373, U375

  8. **Caulk/Sealant —** (Optional, Not Shown, Intended for use as an air barrier - Not intended to be used as fireblocking) — ASTM C834, Type OP, Grade 0° C or -18° C Latex Sealant at the Shaftliner and C-Track (Item 1) and H-Stud (Item 2) framing locations.

  8A. **Caulking and Sealants* —** (Optional - Intended for use as an air barrier - Not intended to be used as fireblocking) - A bead of sealant applied around the partition perimeter in the 3/4 in. air space between wood framing (Item 4) and shaftliner panels (Item 3) to create an air barrier.

  DUPONT DE NEMOURS, INC. – Great Stuff Gaps & Cracks, Great Stuff Pro Gaps & Cracks, Great Stuff Pro Window & Door

- Area Separation wall assemblies need to be treated like any other exterior wall that has a drop ceiling, tub or other air barrier issue associated with this table within it or adjacent to it. The 1” to ¾” gap between the framed portion of the assembly and the gypsum area separation portion of the assembly allows significant air flow between conditioned and unconditioned spaces which the requirements of Table R402.4.1.1 is designed to mitigate. If these issues are not addressed with area separation wall construction, it is even more difficult to achieve the air leakage requirements of the IECC.

Insulation Criteria:

- Insulation in area separations walls have traditionally been ignored as they are assumed to be an adiabatic wall with no heat loss or gain. In reality, a significant amount of air moves behind the interior drywall in these assemblies and therefore insulation installation makes a significant difference in their energy performance.

Bibliography: See attached BXUV Guides for more information regarding air sealing of area separation walls

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

Construction is expected to be impacted by this proposal because air sealing has not been allowed in most jurisdiction because of interpretations (right or wrong) or how area separation walls must be built. It is unclear how these assemblies used in town house and duplex construction, are complying with the air leakage requirements of the code. In the Colorado market most jurisdictions are allowing some level of air sealing and we are seeing compliance with air leakage requirements. So in Colorado, and other similar markets, cost of construction will remain the same, and in other markets construction cost will go up, but air leakage compliance will also go.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Clarifies the air sealing and insulating in insulation requirements for shared wall assemblies

Final Hearing Results

REPI-51-21	AM

REPI-52-21

Original Proposal

IECC®: TABLE R402.4.1.1

Proponents: Robby Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. 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 or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	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, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Showers, tubs, and fireplaces adjacent to the building thermal envelope. ~~on exterior wall~~	~~The~~ An air barrier ~~installed at exterior walls adjacent to showers and tubs~~ shall separate insulation in the ***building thermal envelope*** ~~wall~~ from the shower, ~~or~~ tub, and fireplace assemblies.	Exterior framed walls adjacent to showers, ~~and~~ tubs and fireplaces shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

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

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Component column:

- The 2012 IECC Air barrier and Insulation table was the last table that specifically referenced the void space behind fireplaces that are located on exterior walls. Just like behind tubs and shower pans a supplemental air barrier is needed on the interior side to enclose the insulation as the drywall plane has been moved to the front of the fireplace in a framed wall. The term Framed wall is intentional to ensure that there is no misinterpretation that masonry fireplaces have this detail and or requirement.

Air barrier criteria section:

- This first revision continues to require the installation of a supplemental air barrier in areas were drywall, tile backer, or other air impermeable material is not installed as the finished surface and is not in alignment with the insulation installed in the building's thermal envelope. The only addition, other than clarification, is the addition of the area behind framed fireplaces boxes on exterior walls.
- Air sealing the tub and shower drain trap penetration eliminates a significant leakage source especially when located in floor systems over unconditioned spaces. This air leakage often creates condensation on the back side of tubs and shower pans which leads to mold and other building durability issues.
- Fireplace door air sealing is outlined in the prescriptive section R402.4.2 and clearly describes that this component shall be air sealed. The instruction should not be limited to fireplaces that are installed using the prescriptive compliance options. Therefore, there is need to ensure that the installation criteria is used when assessing R405 and R406 compliance. The addition of this language does that.

Insulation Installation Criteria:

- Again, the term Framed wall is intentional to ensure that there is no misinterpretation that masonry fireplaces have this detail and or requirement.
- Fireplaces was added to this section for consistency.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed language does not increase the cost of construction, but rather offers clarity of existing requirements for better implementation and enforcement.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal clarifies that fireplaces need to be insulated like exterior walls.

Final Hearing Results

REPI-52-21	AM

REPI-53-21

Original Proposal

IECC®: TABLE R402.4.1.1

Proponents: Robby Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. 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 or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	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, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Electrical~~/phone box on exterior~~ walls,communication, and other equipment boxes, housings, and enclosures	~~The air barrier shall be installed behind~~ electrical and communication boxes. Alternatively, air-sealed boxes shall be installed. Boxes, housing, and enclosures that penetrate the air barrier shall be caulked, taped, gasketed, or otherwise sealed to the air barrier element being penetrated. All concealed openings into the box, housing, or enclosure shall be sealed. The continuity of the air barrier shall be maintained around boxes, housings, and enclosures that penetrate the air barrier. - Alternatively, air-sealed boxes shall be installed in accordance with R402.4.6.	Boxes, housing, and enclosures shall be burried in or surrounded by insulation.
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

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

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Component column:

- Although technically speaking, low voltage, speaker, or computer wire boxes are a form of electrical box many builders and trade partners only view true 20- or 15-amp power outlet or switch gang boxes as electrical boxes. By simply broadening the definition to utility box we can ensure that any such box that is installed in an exterior wall or ceiling is insulated, airtight, or air sealed properly.

Air barrier and air sealing criteria section:

- In this section the two requirements have been broken apart for greater clarity. First an airtight box of some sort must be installed and second the box must be and air tight box or air sealed, and must be sealed to the surface that it penetrates.

Insulation Installation Criteria:

- Currently there is not guidance in this table regarding insulating behind electrical boxes in any insulated assembly. This added language rectifies this.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

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

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Revised by proponent to meet suggestions from SC. Latest version was well received, meeting initial intention. With confusion alleviated

Final Hearing Results

REPI-53-21 AM

REPI-54-21

Original Proposal

IECC®: TABLE R402.4.1.1

Proponents: Robby Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. 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 or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	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, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be air sealed.	Framing cavities around windows, skylights and doors shall be completely filled with insulation or insulated per window manufacturer's instructions.
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

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

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Air barrier and air sealing criteria section:

- A simple adjective creates better clarity

Insulation installation criteria section:

- Often the framing around windows creates spaces that are odd sizes and shapes. I think of a recent house that I inspected that had several octangle widows fit into a square opening. The cavities that were created would not be defined as narrow cavities section of this table but would be addressed by the proposed language.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

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

Public Hearing Results

Committee Action **As Modified**

Committee Reason: addressed concerns of subcommittee through modification.

Final Hearing Results

REPI-54-21	AM

REPI-55-21

Original Proposal

IECC®: R402.4.1.1, TABLE R402.4.1.1
Proponents: Vladimir Kochkin, NAHB, NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Revise as follows:

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

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]
Portions of table not shown remain unchanged.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Rim joists	Rim joists shall include an<u>exterior</u> air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]

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

b. ~~Air barrier and insulation~~ <u>Insulation</u> full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: This proposal clarifies and simplifies this provision. The revised language allows the building designer the choice of selecting an air barrier based on the specific wall assembly design. Having the additional word "exterior" can lead to misinterpretation that the air barrier always must be outboard of the rim joist's exterior face. That was never the intent of this provision. Footnote b is revised to coordinate with the change in the table and to clarify that rim joist <u>is not exempt</u> from the air barrier requirements. The footnote is correct in stating that full enclosure of insulation at the rim is not required.

The first row in Table R402.4.1.1 clearly states "breaks and joints in the air barrier shall be sealed." Having the sentence requiring additional sealing of rim to the sill and subfloor can be interpreted that a secondary air barrier is required at those locations in addition to the primary air barrier method.

It is noted that a whole-building tightness test is required to verify the overall air tightness of the house. Exterior WRB is always required for frame construction.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This change primarily is a clarification of intent. The goal is to avoid misinterpretations of the provisions in the field.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: provides clarity to the section

Final Hearing Results

REPI-55-21 AM

REPI-57-21

Original Proposal

IECC®: R402.4.1.2

Proponents: Lisa Rosenow, Evergreen Technology Consulting, Self (lrosenow@evergreen-tech.net); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (N1102.4.1.2) Testing. The *building* or *dwelling unit* shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28cfm/ft^2(1.4 L/s × m^2) ~~cubic feet per minute (CFM) per square foot [0.0079 m^3/(s × m^2)]~~ ofbuilding or *dwelling unit enclosure area*. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure differential of 0.2 inch ~~w.g.~~water gauge (50 ~~Pascals~~ Pa). Where required by the *code official*, testing shall be conducted by an*approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

Exception: For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, *conditioned spaces* in accordance with Sections R402.2.12 and R402.3.5, as applicable.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open**Exception:** When testing individual *dwelling units*, an air leakage rate not exceeding ~~0.30 cubic feet per minute per square foot [0.008 m^3/(s × m^2)]~~ 0.30 cfm/ft^2 (1.5 L/s × m^2) of the *dwelling unit enclosure area*, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure differential of 0.2 inch ~~w.g~~ water gauge (50 Pa), shall be permitted in all climate zones for:

    1. Attached ~~single-family and multiple-family building~~*dwelling units*.
    2. ~~Buildings or d~~ *Dwelling units* that are ~~1.500~~ 1,500 square feet (139.4 m^2) or smaller.

Mechanical ventilation shall be provided in accordance with Section M1505 of the*International Residential Code* or Section 403.3.2 of the *International Mechanical Code*, as applicable, or with other*approved* means of ventilation.

Reason: Purpose of proposed changes is to clarify code intent and align terminology with the commercial air barrier testing provisions.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The intent of this proposal is to improve code language clarity only.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposal was intended to align residential with commercial air leakage testing standards.

Final Hearing Results

REPI-57-21	AM

REPI-58-21

Original Proposal

IECC®: R402.4.1.2

Proponents: William Fay, Energy Efficient Codes Coalition; Amy Boyce, Institute for Market Transformation, Energy Efficient Codes Coalition (amy.boyce@imt.org); Amber Wood, ACEEE, Energy Efficient Codes Coalition (awood@aceee.org); Jason Reott, Alliance to Save Energy, Energy Efficient Codes Coalition

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (N1102.4.1.2) Testing. The *building* or *dwelling unit* shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the*building thermal envelope* have been sealed.

~~Exception~~ Exceptions:

1. When testing individual *dwelling units*, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 $m^3/(s \times m^2)$] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:
   1.1. Attached single and multiple family building*dwelling units*.
   1.2. Buildings or *dwelling units* that are 1,500 square feet (139.4 m^2) or smaller.
2. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, *conditioned spaces* in accordance with Sections R402.2.12 and R402.3.5, as applicable.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

~~**Exception:** When testing individual *dwelling units*, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 $m^3/(s \times m^2)$] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:~~

1. ~~Attached single-family and multiple-family building~~ ~~*dwelling units*~~.

2. ~~Buildings or *dwelling units* that are 1,500 square feet (139.4 m^2) or smaller.~~

Mechanical ventilation shall be provided in accordance with Section M1505 of the *International Residential Code* or Section 403.3.2 of the *International Mechanical Code*, as applicable, or with other *approved* means of ventilation.

Reason: The purpose of this code change proposal is to make an editorial change. Specifically, this proposal moves the air leakage testing exception for small dwelling units to be directly following Section R402.4.1.2, which outlines the air leakage testing requirements for all residential buildings. The exception is currently located at the end of a list of instructions for carrying out an air leakage test, and code users may not understand that the exception allows an alternative to the metric used to measure air leakage under Section R402.4.1.2. This proposal is not intended to change any code requirements, but rather to make the *IECC* more user-friendly.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Because the proposal is only an editorial improvement, there is no cost impact.

COST-EFFECTIVENESS

Because this proposal does not impact code stringency or cost, a cost-effectiveness analysis is not applicable.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: increases legibility of this code.

Final Hearing Results

REPI-58-21 AS

REPI-60-21

Original Proposal

IECC®: R402.4.1.2

Proponents: Robby Schwarz, BUILDTank, Inc., Colorado Chapter of the ICC (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (N1102.4.1.2) Testing. The *building* or *dwelling unit* shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed ~~5.0~~ 4.0 air changes per hour or ~~0.28~~ 0.22 cubic feet per minute (CFM) per square foot [~~0.0079~~0.0063 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

Exception: For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, *conditioned spaces* in accordance with Sections R402.2.12 and R402.3.5, as applicable.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exception: When testing individual *dwelling units*, an air leakage rate not exceeding ~~0.30~~ 0.27 cubic feet per minute per square foot [0.00~~8~~7 $m^3/(s \times m^2)$] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:

1. Attached single-family and multiple-family building *dwelling units*.
2. Buildings or *dwelling units* that are 1.500 square feet (139.4 m^2) or smaller.

Mechanical ventilation shall be provided in accordance with Section M1505 of the *International Residential Code* or Section 403.3.2 of the *International Mechanical Code*, as applicable, or with other *approved* means of ventilation.

Reason: This proposal is intended to make sense of what occurred during the 2021 code development process. Three proposals passed and the correlation of the proposals created confusing language that left the impression that the three and five air leakage rates depending on climate zone has been relaxed to 5 ACH50 across the country.

Because of that confusion it became apparent that this code change proposes should propose a single air leak rate for all climate zones. Building science research and application has determined that tight building envelopes are beneficial to all homes not just homes located in heating dominated climates. Homes in cooling dominated climates also gain efficiency and durability benefits from tight building envelopes. 3 ACH50 is a nationally achievable air leakage rate, and this proposal continues the 2021 IECC leeway by offering leakage concession to two housing types, attached and small dwelling units, that have at times struggled to achieve the leakage target. That being said, there is also a new allowance to use a CFM per square foot of shell area air leakage compliance metric that better assesses the leakage of a home as it is not based on volume but rather actual holes in the building envelope.

This proposal makes sense as demonstrated by the quick brand recognition and dominance of YETI coolers. As with houses, airtight and well insulated coolers keep their contents cold in the summer. If needed they would also keep their contents warm in the winter. The code recognizes this reality in heating dominated climates and it is time it is also recognized in cooling dominated climates. Lastly, with recent extreme weather events we will see a better ability to shelter in place during excessive cold and hot periods when homes are built tighter.

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

This proposal will increase code of construction in some cooling dominated climate projects that have not already incorporated sound building science-based construction practices that are not only being incorporated into the code but also being advanced by industry.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Presented by air leakage working group considered CEPI-60, 63 and 64 together.

Final Hearing Results

REPI-60-21	AM

REPI-61-21
Original Proposal

IECC®: R402.4.1.2, R402.4.1.3, R402.4.1.4 (New)

Proponents: Aaron Gary, Tempo, Inc., Seft (aaron.gary@texenergy.org)

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.2 Testing. The *building* or <u>each</u> *dwelling unit* <u>in the *building*</u> shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

> ~~**Exception**~~ <u>**Exceptions**</u>**:** ~~For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, *conditioned spaces* in accordance with Sections R402.2.12 and R402.3.5, as applicable~~.
>
> 1. <u>For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, *conditioned spaces* in accordance with Sections R402.2.12 and R402.3.5, as applicable.</u>
> 2. <u>Where tested in accordance with R402.4.1.4, testing of each *dwelling unit* is not required.</u>

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

> **Exception:** When testing individual *dwelling units*, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 $m^3/(s \times m^2)$] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:
>
> 1. Attached single-family and multiple-family building *dwelling units*.

2. Buildings or *dwelling units* that are 1.500 square feet (139.4 m^2) or smaller.

Mechanical ventilation shall be provided in accordance with Section M1505 of the *International Residential Code* or Section 403.3.2 of the *International Mechanical Code*, as applicable, or with other *approved* means of ventilation.

R402.4.1.3 Leakage rate. When complying with Section R401.2.1, the building or each dwelling unit in the building shall have an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 0, 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.

Add new text as follows:

R402.4.1.4 Dwelling unit sampling. For *buildings* with eight or more *dwelling units*, the greater of seven or 20 percent of the *dwelling units* in the building shall be tested. Tested units shall include a top floor unit, a ground floor unit, a middle floor unit, and the *dwelling unit* with the largest *dwelling unit enclosure area*. Where the air leakage rate of a tested unit is greater than the maximum permitted air leakage rate, corrective actions shall be made to the unit and the unit re-tested. For each tested unit that has a greater air leakage rate than the maximum permitted air leakage rate, an additional three units, including the corrected unit, shall be tested. Where buildings have fewer than eight *dwelling units*, each *dwelling unit* shall be tested.

Reason: Aligns with the commercial provisions of the 2021 IECC and RESNET sampling guidelines so that envelope leakage testing requirements for a multi-family (R2 classification) project that is 3 stories or lower in height (and that falls under the Residential provisions of the IECC) will be tested at the same rate as apartment building that is 4 stories or taller in height (and falls under the Commercial provisions of the IECC). Sampling provisions were approved as part of the 2021 IECC for Commercial multifamily (R2 classifications) projects because it is very costly and time consuming to test each dwelling unit for projects where there may be dozens of dwelling units in each building. Considering that the same tradesman generally constructs a building, it is reasonable to deem that construction practices are consistent and that if a reasonable sampling of units tested pass, then all units would pass.

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

For multifamily projects that are built and test well, sampling provisions such as those approved in the Commercial provisions of the 2021 IECC will reduce the cost and time required for testing and verification. Projects that do not meet their testing thresholds will understandably be tested as a higher rate, potentially test each, until they too are meeting the required standards consistently and as such will may not see a reduction in testing and verification costs or timelines.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: sampling increase efficiencies

Final Hearing Results

REPI-61-21 AM

REPI-63-21
Original Proposal

IECC®: R402.4.1.2, R402.4.1.3, TABLE R405.4.2(1)

Proponents: William Fay, Energy Efficient Codes Coalition; Amy Boyce, Institute for Market Transformation, Energy Efficient Codes Coalition (amy.boyce@imt.org); Amber Wood, ACEEE, Energy Efficient Codes Coalition (awood@aceee.org); Jason Reott, Alliance to Save Energy, Energy Efficient Codes Coalition

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (N1102.4.1.2) Testing <u>and maximum air leakage rate</u>. The *building* or *dwelling unit* shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an*approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

> **Exception:** For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, *conditioned spaces* in accordance with Sections R402.2.12 and R402.3.5, as applicable.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

> **Exception:** When testing individual*dwelling units*, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 $m^3/(s \times m^2)$] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:
>
> 1. Attached single-family and multiple-family building*dwelling units*.
> 2. Buildings or *dwelling units* that are 1.500 square feet (139.4 m^2) or smaller.

Mechanical ventilation shall be provided in accordance with Section M1505 of the*International Residential Code* or Section 403.3.2 of the *International Mechanical Code*, as applicable, or with other*approved* means of ventilation.

R402.4.1.3 (N1102.4.1.3) <u>Prescriptive air l</u>~~L~~eakage rate. When complying with Section R401.2.1, the building or dwelling unit shall have an air leakage rate not exceeding <u>4.0</u> ~~5.0~~ air changes per hour in Climate Zones 0, 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.

TABLE R405.4.2(1) (TABLE N1105.4.2(1)) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS
Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 4.05.0 air changes per hour. Climate Zones 3 through 8: 3.0 air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area, ft^2. N_{br} = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Energy recovery shall not be assumed for mechanical ventilation.	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, °C = (°F – 32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouses, the following formula shall be used to determine glazing area:

. $AF = A_S \times FA \times F$

. where:

. AF = Total glazing area.

. A_S = Standard reference design total glazing area.

. FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

. F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

. and where:

. Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

. Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

. Below-grade boundary wall is any thermal boundary wall in soil contact.

. Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the “hot water rectangle”) divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multifamily buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

Reason: The purpose of this code change proposal is to improve the efficiency and resiliency of homes in climate zones 0 through 2 through improved building air tightness. Specifically, the proposal modifies the prescriptive air tightness requirement and the performance path baseline from ≤5.0 ACH50 to ≤4.0 ACH50. The proposal still retains the trade-off flexibility of the 2021 *IECC* for these climate zones, which will allow code users to trade back up to ≤5.0 ACH50 in the performance path, as long as efficiency losses are accounted for elsewhere in the building.

The envelope air tightness requirement for the southernmost climate zones has not changed since the air leakage test requirement was first incorporated into the 2012 *IECC*. In the meantime, air leakage testing has become a far more common step in new construction, and the techniques and products used to achieve tight envelopes have become more commonplace in all climate zones, including zones 0-2. According to a recent DOE Residential Field Study in Texas, nearly 1/3 of the homes in climate zone 2 sampled for air leakage testing already achieved 4.0 or lower air leakage, even though the local code requirements ranged from ≤5.0 to ≤7.0 ACH50. *See* https://www.energycodes.gov/residential-energy-code-field-studies . These homes would already be compliant with the air tightness requirement proposed above at no additional cost or effort, and the remainder of the homes would not have to undergo radical changes to achieve it.

Although a tighter envelope will have a more pronounced effect on energy conservation in climate zones with a larger difference between indoor and outdoor temperatures, reasonable envelope air tightness is still extremely important in moderate climates.

- Improving air tightness from ≤5.0 to ≤4.0 ACH50 will not substantially increase the cost of construction, but it will save homeowners money over the home's useful life;
- A significant number of counties in climate zones 0-2 are classified as warm/humid, and a tighter envelope will help cooling systems operate efficiently and manage indoor humidity, improving the long-term durability of buildings;
- A tighter building envelope, along with adequate fresh air through dedicated mechanical ventilation, will help maintain healthier indoor air quality for the home's occupants;
- More efficient building envelopes will generally help maintain occupant comfort and passive survivability in the event of extreme weather events or extended power outages, such as the recent power outage in Texas.

As building practices and materials improve, it is important to set code requirements that help optimize building operation and efficiency. Air tightness levels in homes in climate zones 0-2 have already been improved as a result of market transformation: More builders have learned how to improve air tightness as a part of quality construction, and manufacturers have tuned products to meet the growing national demand for tighter homes.

Beyond the direct energy and cost savings associated with reduced air leakage, we expect that occupants will experience improved comfort, and as a result, will be less likely to adjust the thermostat to counteract a "drafty home." Below is a summary of estimated energy use increases associated with adjusting a thermostat 1 degree higher or lower, broken out by climate zone.

[R4 table pix.png]

Increased Energy Use Resulting from Thermostat Adjustment

Measure	Nat'l Avg	1	2	3	4	5	6	7	8
+1 Degree Heating	4.1%	0.5%	3.0%	4.2%	4.4%	4.7%	4.5%	4.0%	2.9%
-1 Degree Cooling	3.2%	7.8%	5.3%	3.9%	2.6%	1.8%	1.4%	0.7%	0.4%

We believe the envelope air tightness requirement in these climate zones could be improved with little additional effort, and that homeowners will benefit from these improvements for many years.

Bibliography: (1) www.energycodes.gov/residential-energy-code-field-studies; (2) www.energycodes.gov/methodology

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

This proposal will increase the cost of construction in some cases. As noted above, many buildings that achieve ≤5.0 ACH50 already achieve ≤4.0 ACH50 as well, or would not require substantial additional cost to achieve this improvement. We believe it is reasonable to assume an average increase in construction costs of $108 per dwelling unit based on cost data from NREL's BEopt modeling software. For many builders, any incremental costs to achieve these gains will be reduced or eliminated over time as new techniques and quality assurance are adopted into standard practices. But for purposes of this code change proposal, a $108 incremental cost per dwelling unit is a reasonable and conservative estimate.

COST-EFFECTIVENESS

This proposal is clearly cost-effective to the homeowner. Based on modeling using NREL's BEopt software and following the residential building cost-effectiveness methodology developed by the U.S. DOE (*see* www.energycodes.gov/methodology), the analysis conducted by EECC found that this proposal will save homeowners significant energy cost and will result in clear life-cycle cost effectiveness for homeowners. The analysis estimated that this proposal will produce a positive net life cycle benefit of $225-836 over the first 30 years of the building's useful life (using the average $108 incremental cost from BEopt referenced above), depending on climate zone. A summary table of this cost-effectiveness analysis is below.

[R4 table pix_cost.png]

Climate Zone	ACH50	Incremental Cost Upgrade	Annual Energy Savings	Present Value Costs	Present Value Benefits	Life Cycle Net Benefit
1	4.0	$108	$8	$245	$469	$225
2	4.0	$108	$20	$245	$1080	$836

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: controlling air leakage is important in warm climates as well.

Final Hearing Results

REPI-63-21 AS

REPI-65-21
Original Proposal

IECC®: R402.4.2.1 (N1102.4.2.1) (New), ANSI Chapter 06 (New), CSA Chapter 06 (New)

Proponents: Nicholas O'Neil, Energy 350, NEEA (noneil@energy350.com); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new text as follows:

R402.4.2.1 (N1102.4.2.1) Gas fireplace efficiency. All gas fireplace heaters rated to ANSI Z21.88 shall be listed and labeled with a fireplace efficiency (FE) rating of 50 percent or greater in accordance with CSA P.4.1. Vented gas fireplaces (decorative appliances) certified to ANSI Z21.50 shall be listed and labeled, including their FE ratings, in accordance with CSA P.4.1.

Add new standard(s) as follows:

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

Z21-50-2019/CSA 2.22-19	Vented Decorative Gas Appliances
Z21.88-2019/CSA 2.23-19	Vented Gas Fireplace Heaters

CSA

CSA Group
8501 East Pleasant Valley Road
Cleveland, OH 44131-5516

P.4.1-2021	Testing method for measuring fireplace efficiency

Reason: The IECC does not currently address gas fireplace efficiency (though section 402.4.2 does reference safety standards for wood-burning fireplaces). Gas-burning fireplaces have a wide range of efficiency levels, from 28% to 90% and greater. Gas-fireplaces are most commonly used as secondary heating sources but may still be used for a significant number of hours per heating season.

This proposal establishes a minimum efficiency performance threshold for fireplaces based on the Canadian FE Standard. (https://www.nrcan.gc.ca/energy/products/energuide/label/reading/13718).

We suggest using the FE metric in lieu of AFUE because it more accurately reflects annual heating consumption of the fireplace (taking into account cycling losses, heating and non-heating season efficiency, pilot light contribution, etc.). Additionally the FE rating serves as the basis for efficiency for several utility programs throughout the US offering incentives for fireplaces with high FE ratings.The minimum performance threshold of 50% FE aligns with the BC Ministry of Energy, Mines, and Petroleum Resources regulations that mandates all vented gas fireplace heaters be listed and labeled with a minimum FE score of 50%. Decorative fireplaces, which comprise the bulk of fireplace sales, do not have an FE threshold but are required to be listed and labeled with an FE score. This proposal language is available in WA, NV, BC and in WA, NV, BC, and forthcoming legislation in CAGas Fireplace Efficiency

https://energy.cdpaccess.com/proposal/82/872/files/download/192/
https://energy.cdpaccess.com/proposal/82/872/files/download/122/

Bibliography: Z21-50-2016/CSA 2.22-16 -Vented Decorative Gas Appliances R402.4.2.1

Z21.88-2017/CSA 2.23-17 - Vented Gas Fireplace Heaters R402.4.2.1

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Market analysis has shown that the minimum efficiency level for vented gas heaters is above 50% FE currently, and this proposal would set a minimum threshold to remove the worst performers from the market. Additionally, vented gas heaters make up a smaller portion of the market compared to decorative gas fireplaces which are exempt from this efficiency requirement, even though they need to have an FE rating (which aligns with BC standards, and legislation in NV, WA and forthcoming in CA.)

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: The proposal has been approved as the IECC does not currently address gas fireplace efficiency which may still be used for a significant number of hours per heating season.

Final Hearing Results

REPI-65-21	AS

REPI-66-21

Original Proposal

IECC®: CHAPTER 4 [RE], R402.4.6

Proponents: Megan Hayes, NEMA, NEMA (Megan.Hayes@nema.org)

2021 International Energy Conservation Code

CHAPTER 4 [RE] RESIDENTIAL ENERGY EFFICIENCY

Revise as follows:

R402.4.6 (N1102.4.6) Air-Sealed Electrical and communication boxes ~~(air-sealed boxes)~~. Air-sealed ~~Electrical~~ electrical and communication boxes ~~installed in~~ that penetrate the *air barrier* of the *building thermal envelope* shall be caulked, taped, gasketed, or otherwise sealed to ~~limit air leakage between conditioned and unconditioned spaces~~the *air barrier* element being penetrated. Air-sealed ~~Electrical and communication outlet~~ boxes shall be buried in or surrounded by insulation. Air-sealed boxes shall betested and marked in accordance with NEMA OS 4.~~, *Requirements for Air-Sealed Boxes for Electrical and Communication Applications*, and shall have an air leakage rate of not greater than 2.0 cubic feet per minute (0.944 L/s) at a pressure differential of 1.57 psf (75 Pa). Electrical and communication outlet Air-sealed boxes shall be marked "NEMA OS 4" or "OS 4" in accordance with NEMA OS 4. Electrical and communication outlet~~ Air-sealed boxes shall be installed ~~per the~~ in accordance with the manufacturer's instructions.~~ and with any supplied components required to achieve compliance with NEMA OS 4.~~

Reason: This editorial revision better aligns the language being used in Table R402.1.1 by clarifying the requirements only apply where air-sealed boxes are selected as permitted by the table and applies to those boxes that penetrate the thermal envelope thus necessitating the need for an air barrier or air-sealed box.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There is no increase or decrease cost in construction as this proposal simply adds clarify to the original intent of R402.4.6.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proponent presented a modified version coordinated with REPI 53 that expands the terminology for electrical boxes and simplifies the language pertaining to the use of the referenced standard.

Final Hearing Results

REPI-66-21	AM

REPI-73-21

Original Proposal

IECC®: R403.1.2

Proponents: Ryohei Hinokuma, Daikin U.S. Corporation, Daikin U.S. Corporation (ryohei.hinokuma@daikinus.com)

2021 International Energy Conservation Code

Revise as follows:

R403.1.2 Heat pump supplementary heat (Mandatory). Heat pumps having supplementary electric-resistance heat shall have controls that~~, except during defrost,~~ are configured to prevent supplemental heat operation when thecapacity of the heat pump compressor can meet the heating load. Limit supplemental heat operation to only those times when one of the following applies:

1. The vapor compression cycle cannot provide the necessary heating energy to satisfy the thermostat setting.
2. The heat pump is operating in defrost mode.
3. The vapor compression cycle malfunctions.
4. The thermostat malfunctions.

Reason: The use of electric resistance heaters as backup heating devices can significantly increase winter energy consumption, and air source heat pumps can effectively provide heating without such devices including the cold climate regions in the United States. Also, Daikin has observed that it’s common for heat pumps to be installed with electric resistance heaters configured to operate in conditions where sufficient heating capacity is available from the heat pump alone. This results in reducing the operation hours of heat pumps and increasing the operation hours of electric-resistance heaters. Such setting of heat pump systems will fail to yield expected reduction of GHG emissions and result in higher energy consumption and longer peak demand events. Therefore, Daikin proposes to revise R403.1.2, which defines the use of electric resistance heaters as supplementary heat for heat pumps, to prevent such practice.

See attached letter for more background information justifying this modification.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Requiring the use of the switchover temperature controls will not increase nor decrease the cost of construction - however, it will result in energy savings and lower utilities costs for the end -user.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal defines the use of electric resistance heaters as supplementary heat for heat pumps.

Final Hearing Results

REPI-73-21	AM

REPI-74-21

Original Proposal

IECC®: SECTION 202 (New), R403.1.3 (New), ANSI Chapter 06 (New)

Proponents: Nicholas O'Neil, Energy 350, NEEA (noneil@energy350.com); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new definition as follows:

PILOT LIGHT, CONTINUOUSLY BURNING. A small gas flame used to ignite gas at a larger burner. Once lit, a continuously pilot light remains in operation until manually interrupted. Pilot light ignition systems with the ability to switch between intermittent and continuous mode are considered continuous.

PILOT LIGHT, INTERMITTENT. A pilot which is automatically ignited when an appliance is called on to operate and which remains continuously ignited during each period of main burner operation. The pilot is automatically extinguished when each main burner operating cycle is completed.

PILOT LIGHT, INTERRUPTED. A pilot which is automatically ignited prior to the admission of fuel to the main burner and which is automatically extinguished after the main flame is established.

PILOT LIGHT, ON-DEMAND. A pilot which, once placed into operation, is intended to remain ignited for a predetermined period of time following an automatic or manual operation of the main burner gas valve.

Add new text as follows:

R403.1.3 Continuously Burning Pilot Light. Gas fireplace systems are not permitted to be equipped with a*continuously burning pilot light*.

Exception: Any fireplace equipped with an *on-demand*, *intermittent* or *interrupted ignition pilot light* (as defined in ASNI Z21.20) is not considered to have a *continuously burning pilot light*.

Add new standard(s) as follows:

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

ANSI Z21.20-2005 (R2016)	Automatic Gas Ignition Systems And Components R403.1.3

Reason: Standing pilot lights are no longer necessary with many gas-fired appliances offering alternative ignition methods. Some models rely completely on intermittent ignition, while others allow standing pilots to operate for a few hours after shutdown and then use electronic ignition to re-start. This proposal saves energy by eliminating the wasted energy of a pilot light during the numerous hours per year when the appliance is non-operational.

With an average heat output of 946 btu/h for a continuously burning pilot light, analysis has shown an energy savings of 28 therms/yr if switching from a continuous pilot light to an intermittent pilot light. This is based on studies that looked at average fireplace use over the course of the year of 3,700 hours. Meaning, homeowners who use their fireplace less than this can stand to save more as the pilot light wastes energy as it sits idle.

Furthermore, the The Hearth, Patio & Barbecue Association (HPBA), based just outside of Washington, DC, is the North American industry association for manufacturers, retailers, distributors, representatives, service firms, and allied associates for all types of fireplace, stove, heater, barbecue, and outdoor living appliances and accessories. They also agree the continuous pilot lights are not necessary as the technology has moved on to intermittent or on-demand pilot lights that can accommodate various climates and user preferences. The HPBA shares the same position to discontinue the use of continuous pilots as demonstrated by their policy statement available on their website, as follows:Position Statement: New technologies now exist that can more adequately replace continuous pilots, which provided an important safety feature, but have required consumers to manually extinguish the pilot on their gas appliances. A phasing out of continuous pilots saves homeowners money and achieves energy conservation when appliances are not in frequent use.

https://energy.cdpaccess.com/proposal/81/871/files/download/188/

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

This prohibition is not expected to add significant cost to any gas-fired appliance listed in the proposal. Past efficiency studies have shown $100 increase in price for fireplaces in particular to move from a standard continuously lit pilot light to an intermittent ignition system.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal saves energy by eliminating the wasted energy of a pilot light during the numerous hours per year when the appliance is non-operational.

Final Hearing Results

REPI-74-21 AS

REPI-78-21

Original Proposal

IECC®: SECTION 202, SECTION 202 (New)

Proponents: David Springer, Frontier Energy Inc,, on behalf of the California Statewide Utility Codes and Standards Team (iecc-ducts2@2050partners.com); Mark Lyles, New Buildings Institute, New Buildings Institute (markl@newbuildings.org)

2021 International Energy Conservation Code

Revise 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.

Add new definition as follows:

DISTRIBUTION SYSTEM EFFICIENCY (DSE). A system efficiency factor that adjusts for the energy losses associated with delivery of energy from the equipment to the source of the load.

Reason: Thermal Distribution System Efficiency (TDSE) defined in Section R202 is inconsistent with the term (DSE) used in Table R405.4.2(1). The change to Distribution System Efficiency (DSE) is to provide consistency. This definition is from the ASHRAE Standard 152, a consensus standard titled "Method of Test for Determining the Design and Seasonal Efficiencies of Residential Thermal Distribution Systems."

Bibliography: *ANSI/ASHRAE Standard 152-2014: Method Of Test For Determining The Design And Seasonal Efficiencies Of Residential Thermal Distribution Systems*, ASHRAE, https://webstore.ansi.org/standards/ashrae/ansiashraestandard1522014.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not increase the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The original proponents of having TDE in the IECC reached out to the WG to explain the reason why the term was added to the code. Underground ducts are tested in accordance with NSF P374. The term, thermal distribution efficiency (TDE), comes from this testing protocol. Underground ducts are listed in accordance with ICC ES LC1014, which also refers to NSF P374. While neither of these are ANSI standards, they are the only methods currently available for testing, listing and labeling underground ducts. There are several manufacturers of underground ducts that certify to these methods. To be consistent and to facilitate enforcement, thermal distribution efficiency (TDE) needs to remain in the IECC. Separately, the WG learned that ANSI/RESNET/IECC Standard 301 has a different, but similar definition for DSE. Since Standard 301 is already referenced in the IECC, it makes sense to use this definition. DSE is used in Table R405.4.2(1).

Final Hearing Results

REPI-78-21	AM

REPI-79-21

Original Proposal

IECC®: R403.3.2

Proponents: Craig Conner, Building Quality, self (craig.conner@mac.com); Joseph Lstiburek, Building Science Corporation (joe@buildingscience.com)

2021 International Energy Conservation Code

Revise as follows:

R403.3.2 Ducts located in conditioned space. For ductwork to be considered inside a *conditioned space,* it shall comply with one of the following:

1. The duct system shall be located completely within the *continuous air barrier* and within the building thermal envelope.
2. Ductwork in ventilated attic spaces <u>or unvented attic with vapor diffusion port</u> shall be buried within ceiling insulation in accordance with Section R403.3.3 and all of the following conditions shall exist:
   2.1. The air handler is located completely within the *continuous air barrier* and within the *building thermal envelope*.
   2.2. The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the *building thermal envelope* in accordance with Section R403.3.6, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area* served by the duct system.
   2.3. The ceiling insulation *R*-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the duct.
3. Ductwork in floor cavities located over unconditioned space shall comply with all of the following:
   3.1. A *continuous air barrier* installed between unconditioned space and the duct.
   3.2. Insulation installed in accordance with Section R402.2.7.
   3.3. A minimum R-19 insulation installed in the cavity width separating the duct from unconditioned space.
4. Ductwork located within *exterior walls* of the *building thermal envelope* shall comply with the following:
   4.1. A *continuous air barrier* installed between unconditioned space and the duct.
   4.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing.
   4.3. The remainder of the cavity insulation shall be fully insulated to the drywall side.

Reason: Research done by the Department of Energy through the Building America Program shows that sealed attics with vapor diffusion ports significantly reduce the risk of condensation on ductwork. The existing IRC language allows sealed attics with vapor diffusion ports. This language makes it clear that the buried duct language for vented attics also applies to sealed attics with vapor diffusion ports.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This allows another option. It does not add costs.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: improved language with modification to replace the term sealed with unvented to correlate with I codes

Final Hearing Results	
REPI-79-21	AM

REPI-80-21

Original Proposal

IECC®: R403.3.2

Proponents: Vladimir Kochkin, NAHB, NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Revise as follows:

R403.3.2 Ducts located in conditioned space. For ductwork to be considered inside a *conditioned space,* it shall comply with one of the following:

1. The duct system shall be located completely within the *continuous air barrier* and within the building thermal envelope.
2. Ductwork in ventilated attic spaces shall be buried within ceiling insulation in accordance with Section R403.3.3 and all of the following conditions shall exist:

   ~~2.1.~~ The air handler is located completely within the *continuous air barrier* and within the *building thermal envelope*.

   ~~2.2.~~ The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the *building thermal envelope* in accordance with Section R403.3.6, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area* served by the duct system.

   ~~2.3.~~ The ceiling insulation *R*-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the duct.

3. ~~Ductwork in floor cavities located over unconditioned space shall comply with all of the following~~: Ductwork located in wall or floor building assemblies separating unconditioned from conditioned space shall comply with the following:

   ~~3.1.~~ A *continuous air barrier* ~~installed between unconditioned space and the duct~~. shall be installed as part of the building assembly between the *duct* and the *unconditioned space*.

   ~~3.2. Insulation installed in accordance with Section R402.2.7~~. Ducts shall be installed in accordance with Section R403.3.1.

   Exception: Where the building assembly cavities containing *ducts* have been air sealed in accordance with Section R402.4.1, *duct* insulation is not required.

   ~~3.3. A minimum R-19R-10 insulation installed in the cavity width separating the duct from unconditioned space~~. Not less than R-10 insulation, and not less than 50 percent of the required R-value specified in Table R402.1.3, shall be located between the *duct* and the *unconditioned space*.

   3.4 For *ducts* in these building assemblies to be considered within *conditioned space*, the air handling equipment shall be installed within *conditioned space*.

4. ~~Ductwork located within *exterior walls* of the *building thermal envelope* shall comply with the following~~:

   ~~4.1. A *continuous air barrier* installed between unconditioned space and the duct~~.

   ~~4.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing~~.

   ~~4.3. The remainder of the cavity insulation shall be fully insulated to the drywall side~~.

Reason: The provision for R19 insulation was added in the 2021 IECC without justification. Apparently, the requirement was copied from a drawing intended for CZ 3 applications where R-19 floor insulation is a requirement. There is no basis for having a separate requirement for insulation at duct locations in floor cavities that is more restrictive than the floor insulation R-value requirement (CZ 0, 1, 2 require R13 floor insulation). Furthermore, duct insulation requirement for ducts in unconditioned space is R6 or R8 depending on the duct diameter. The proposed modification aligns the requirement for ducts in floors with a similar requirement for ducts in exterior walls where ducts must be separated by R-10 (see R403.3.2(4) of 2021 IECC). It is noted that floor insulation installation is always required to be in compliance with Section R402.2.7 and the floor is required to include an air barrier between unconditioned space and the duct.

There are no energy use implications associated with this change. The R19 requirement can add cost for constructing a bulkhead to accommodate the added insulation in the floor.

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

In certain floor assembly configurations in Climate Zones 0, 1, and 2, this change will reduce costs by avoiding the need for bulkhead construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The original proposal to revise the minimum insulation value for 3.3 was accepted, and further modified to combine Items 3 and 4 as a single Item 3.

Final Hearing Results

REPI-80-21	AM

REPI-82-21

Original Proposal

IECC®: R403.3.3

Proponents: Craig Conner, Building Quality, self (craig.conner@mac.com); Joseph Lstiburek, Building Science Corporation (joe@buildingscience.com)

2021 International Energy Conservation Code

Revise as follows:

R403.3.3 (N1103.3.3) Ducts buried within ceiling insulation. Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

1. The supply and return ducts shall have an insulation *R*-value not less than R-8.
2. At all points along each duct, the sum of the ceiling insulation *R*-value against and above the top of the duct, and against and below the bottom of the duct, shall be not less than R-19, excluding the *R*-value of the duct insulation.
3. In Climate Zones 0A, 1A, 2A and 3A, the supply ducts shall be completely buried within ceiling insulation, insulated to an *R*-value of not less than R-13 and in compliance with the vapor retarder requirements of Section 604.11 of the International Mechanical Code or Section M1601.4.6 of the International Residential Code, as applicable.

   Exception: Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

4. In Climate Zones 0A, 1A, 2A and 3A when installed in an unvented attic with vapor diffusion port, the supply ducts shall be completely buried within ceiling insulation, insulated to an R-value of not less than R-8 and in compliance with the vapor retarder requirements of Section 604.11 of the International Mechanical Code or Section M1601.4.6 of the International Residential Code, as applicable..

   Exception: Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

   4.1. Air permeable insulation installed in unvented attics shall be in compliance with the requirements of Section R806.5.2 of the International Residential Code.

Reason: Additional research done by the Department of Energy through the Building America Program has shown that Climate Zone 3A should not have been included in this section. Some condensation has been noted in some instances in Climate Zone 3A. However, with a sealed attic with vapor diffusion ports the issue of condensation is resolved. The additional language in 4. Makes it clear that this also applies to Climate Zones 0A, 1A, 2A and 3A.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is a correction to the code. It will not increase costs.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal modified to Restore 3A in item 3 and add item 4 also provide further modification to replace the term sealed with unvented to align with I codes. Discussion on removing partially or completely will be done under separate proposal.

Final Hearing Results

REPI-82-21	AM

REPI-83-21

Original Proposal

IECC®: R403.3.3.1

Proponents: Craig Conner, Building Quality, self (craig.conner@mac.com); Joseph Lstiburek, Building Science Corporation (joe@buildingscience.com)

2021 International Energy Conservation Code

Revise as follows:

R403.3.3.1 (N1103.3.3.1) Effective R-value of deeply buried ducts. Where using the Total Building Performance Compliance Option in accordance with Section R401.2.2 , sections of ducts that are installed in accordance with Section R403.3.3~~, located directly on or within~~ 5. ~~5 inches (140 mm) of the ceiling,~~ surrounded with blown-in attic insulation having an*R*-value of R-30 or greater and located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation *R*-value of R-25.

Reason: There are many cases with stick framed attics where 2x10 and 2x12 framing is used and ducts may be laying over framing that is higher than 5.5 inches of the ceiling. The remaining language is sufficient as it addresses R403.3.3 language for installation, states the ducts must be surrounded with insulation and can't have less than 3.5" of insulation above the duct. If that duct is higher than 5.5" from the ceiling, there will be no negative temperature or condensation impact.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This clarifies the effective R-value of deeply buried ducts. It does not add costs.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: provides clarification for requirements

Final Hearing Results

REPI-83-21	AS

REPI-85-21

Original Proposal

IECC®: R403.3.5, R403.3.6, R403.3.7 (New), R403.3.7

Proponents: Aaron Gary, Tempo, Inc., Seft (aaron.gary@texenergy.org)

2021 International Energy Conservation Code

Revise as follows:

R403.3.5 Duct testing. Each ~~Ducts~~ ducts system shall be pressure tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554 to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.

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

Exceptions: ~~A duct air-leakage test shall not be required for ducts serving ventilation systems that are not integrated with ducts serving heating or cooling systems.~~

1. A duct air-leakage test shall not be required for ducts serving ventilation systems that are not integrated with ducts serving heating or cooling systems.
2. Where tested in accordance with R403.3.7 testing of each duct system is not required.

R403.3.6 Duct leakage . The total leakage of the ducts, where measured in accordance with Section R403.3.5, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 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 3.0 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 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area*.
3. Test for ducts within thermal envelope: Where all ducts and air handlers are located entirely within the *building thermal envelope*, total leakage shall be less than or equal to 8.0 cubic feet per minute (226.6 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area*.

Add new text as follows:

R403.3.7 Dwelling unit sampling. For buildings with eight or more*dwelling units* the *duct systems* in the greater of seven, or 20 percent of the *dwelling units* in the building shall be tested, including a top floor unit, a ground floor unit, a middle floor unit, and the unit with the largest *conditioned floor area*. Where buildings have fewer than eight*dwelling units*, the *duct systems* in each unit shall be tested. Where the leakage rate of a *duct system* is greater than the maximum permitted leakage rate, corrective actions shall be made to the system and the system retested until it passes. For each tested *dwelling unit* that has a greater duct leakage rate than the maximum permitted leakage rate, an additional three *dwelling units*, including the corrected unit, shall be tested.

Revise as follows:

R403.3.8 ~~R303.3.7~~ **Building cavities.** *Building* framing cavities shall not be used as ducts or plenums.

Reason: The concept of using a sample of tested apartment units to demonstrate compliance for the whole of the multifamily apartment building was approved as part of the Commercial provisions of the 2021 IECC. This proposals applies that previously approved concept to multifamily apartment buildings that fall under the Residential provisions of the IECC. It also slightly updates the sampling method specified in the Commercial provisions of the 2021 IECC to better align with the updated RESNET multifamily sampling guidelines.

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

For multifamily projects that are built and test well, sampling provisions such as those approved in the Commercial provisions of the 2021 IECC will reduce the cost and time required for testing and verification. Projects that do not meet their testing thresholds will understandably be tested as a higher rate, potentially test each, until they too are meeting the required standards consistently and as such will may not see a reduction in testing and verification costs or timelines.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: to provide guidance on sampling for testing.

Final Hearing Results

REPI-85-21 AM

REPI-86-21

Original Proposal

IECC®: R403.3, R403.3.5, R403.3.6, TABLE R403.3.6 (New), TABLE R405.2, TABLE R405.4.2(1), TABLE R405.4.2(2), TABLE R406.2

Proponents: David Springer, Frontier Energy Inc,, on behalf of the California Statewide Utility Codes and Standards Team (iecc-ducts2@2050partners.com); Mark Lyles, New Buildings Institute, New Buildings Institute (markl@newbuildings.org); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

R403.3 Duct~~s~~ systems. Ducts and air handlers shall be installed in accordance with Sections R403.3.1 through R403.3.7.

R403.3.5 Duct system testing. Each ducts ~~*Ducts*~~ *system* shall be ~~pressure~~ tested for air leakage in accordance with ANSI/RESNET/ICC 380 or ASTM E1554 ~~to determine air leakage by one of the following methods:~~. Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system. Registers shall be sealed during the test. A written report of the test results shall be signed by the party conducting the test and provided to the *code official*. *Duct system* leakage testing at either rough-in or post-construction shall be permitted.

1. ~~Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.~~
2. ~~Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.~~

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

Exception: ~~A duct air-leakage testing~~ Testing shall not be required for *duct* ~~*ducts*~~ *systems* serving ventilation systems that are not integrated with *duct* ~~*ducts*~~ *systems* serving heating or cooling systems.

R403.3.6 Duct system leakage. ~~The total leakage of the ducts, where measured in accordance with Section R403.3.5, shall be as follows~~: The total measured *ducts system* leakage shall not be greater than the values in Table R403.3.6. For buildings complying with Section R405 or R406, where *ducts system* leakage to outside is tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554, the leakage to outside value shall not be used for compliance with this section, but shall be permitted to be used in the calculation procedures of Section R405 and R406.

1. ~~Rough-in test: The total leakage shall be less than or equal to 4.0 cubic feet per minute (113.385 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 3.02.0 cubic feet per minute (8557 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 4.03.0 cubic feet per minute (113.385 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area*.~~
3. ~~Test for ducts within thermal envelope: Where all ducts and air handlers are located entirely within the *building thermal envelope*, total leakage shall be less than or equal to 8.0 cubic feet per minute (226.6 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area*.~~

Add new text as follows:

TABLE R403.3.6 MAXIMUM TOTAL DUCT SYSTEM LEAKAGE

-	Rough In	Post Construction
Duct systems serving more than 1,000 ft^2 of conditioned floor area	cfm/100 ft^2 (LPM/9.29 m^2)	cfm/100 ft^2 (LPM/9.29 m^2)
Air handler is not installed	3 (85)	NA
Air handler is installed	4 (113.3)	4 (113.3)
Duct systems located in conditioned space, with air handler installed	8 (226.6)	8 (226.6)
Duct systems serving less than or equal to 1,000 ft^2 of conditioned floor area	**cfm (LPM)**	**cfm (LPM)**
Air handler is not installed	30 (849.5)	NA
Air handler is installed	40 (1132.7)	40 (1132.7)
Duct systems located in conditioned space, with air handler installed	80 (2265.4)	80 (2265.4)

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3~~, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6~~	Duct~~s~~ Systems
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment

R404.2	Interior lighting controls

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

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN	
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed	
	Gross area: same as proposed.	As proposed	
	U-factor: as specified in Table R402.1.2.	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: as specified in Table R402.1.2 , with the insulation layer on the interior side of the walls.	As proposed	
Above-grade floors	Type: wood frame.	As proposed	
	Gross area: same as proposed.	As proposed	
	U-factor: as specified in Table R402.1.2.	As proposed	
Ceilings	Type: wood frame.	As proposed	
	Gross area: same as proposed.	As proposed	
	U-factor: as specified in Table R402.1.2.	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 an aperture of 1 ft^2 per 300 ft^2 of 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 as specified in Table R402.1.2 .	As proposed	
Vertical fenestration other than opaque doors	Total area[h] = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. (b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed	
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed	
	U-factor: as specified in Table R402.1.2.	As proposed	
	SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed	
	Interior shade fraction: 0.92 – (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 – (0.21 × SHGC as proposed)	

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 5.0 air changes per hour. Climate Zones 3 through 8: 3.0 air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area, ft^2. N_{br} = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Energy recovery shall not be assumed for mechanical ventilation.	The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal $(1/e_f) \times [0.0876 \times CFA + 65.7 \times (N_{br}+1)]$ where: e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of $0.01 \times CFA + 7.5 \times (N_{br}+1)$ CFA = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed
Internal gains	IGain, in units of Btu/day per dwelling unit, shall equal $17{,}900 + 23.8 \times CFA + 4{,}104 \times N_{br}$ where: CFA = conditioned floor area, ft^2. N_{br} = number of bedrooms.	Same as standard reference design.
Internal mass	Internal mass for furniture and contents: 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.3, located on the interior side of the walls.	As proposed
	For other walls, ceilings, floors, and interior walls: wood frame construction.	As proposed
Heating systems[d, e]	For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC–Commercial Provisions. Capacity: sized in accordance with Section R403.7.	As proposed
Cooling systems[d, f]	As proposed. Capacity: sized in accordance with Section R403.7.	As proposed
Service water heating[d, g]	As proposed. Use, in units of gal/day = $25.5 + (8.5 \times N_{br})$ where: N_{br} = number of bedrooms.	As proposed Use, in units of gal/day = $25.5 + (8.5 \times N_{br}) \times (1 - HWDS)$ where: N_{br} = number of bedrooms. $HWDS$ = factor for the compactness of the hot water distribution system.

Compactness ratio[i] factor		HWDS
1 story	2 or more stories	
> 60%	> 30%	0

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN			
		> 30% to ≤ 60%	> 15% to ≤ 30%	0.05	
		> 15% to ≤ 30%	> 7.5% to ≤ 15%	0.10	
		< 15%	< 7.5%	0.15	
Thermal distribution systems	Duct insulation: in accordance with Section R403.3.1.	Duct insulation: as proposed.			
	Duct location: same as proposed	Duct location: as proposed.			
	Duct system leakage to outside: For *duct systems* serving≤ 1,000 ft^2 of *conditioned floor area*, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min). For *duct systems* serving>1,000 ft^2 of *conditioned floor area*, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100ft^2 (9.29 m^2) of *conditioned floor area*.	Duct system leakage to outside: The measured total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate. Exceptions: 1. Where duct system leakage to outside is tested in accordance with ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered. 2. Where total duct system leakage is measured without the air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditioned floor area*.			
	Distribution System Efficiency (DSE): For hydronic systems and ductless sytems, a ~~A~~ thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies ~~for all systems other than tested duct systems~~. Duct location: same as proposed design. **Exception:** For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditioned floorarea* at a pressure of differential of 0.1 inch w.g. (25 Pa).	Distribution System Efficiency (DSE): For hydronic systems and ductless systems as specified in Table R405.4.2(2). ~~Duct location: as proposed~~. ~~Duct insulation: as proposed~~. ~~As tested or, where not tested, as specified in Table R405.4.2(2).~~			
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F.	Same as standard reference design.			
Dehumidistat	Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None. Where the proposed design utilizes a mechanical ventilation system with latent heat recovery: Dehumidistat type: manual, setpoint = 60% relative humidity. Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.	Same as standard reference design.			

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, °C = (°F – 32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouses, the following formula shall be used to determine glazing area:

. $AF = A_S \times FA \times F$

. where:

. AF = Total glazing area.

. A_S = Standard reference design total glazing area.

. FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

. F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

. and where:

. Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

. Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

. Below-grade boundary wall is any thermal boundary wall in soil contact.

. Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multifamily buildings with central water heating systems, circulation loops or electric heat traced pipes.

2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.

3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.

4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.

5. The basement or attic shall be counted as a story when it contains the water heater.

6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

TABLE R405.4.2(2) DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS[b]
Distribution system components located in unconditioned space	—NA	0.95
Untested dDistribution systems~~s~~ components entirely located in conditioned space[c]	0.88NA	1
Ductlesssystems[d]	1	—NA

a. Default values in this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.

b. Hydronic systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed-loop piping and that do not depend on ducted, forced airflow to maintain space temperatures.

c. Entire system in conditioned space shall mean that no component of the distribution system~~, including the air-handler unit~~, is located outside of the conditioned space.

d. Ductless systems shall be allowed to have forced airflow across a coil but shall not have any ducted airflow external to the manufacturer's air-handler enclosure.

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle

R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Duct~~s~~ systems
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Reason: IECC Section R403.3.6 limits total leakage to 4.0 cfm per 100 ft^2 of conditioned space for ducts outside the thermal envelope and 8.0 cfm per 100 ft^2 for ducts inside the thermal envelope. The proposed change would reduce allowable duct leakage from 4 to 3 cfm per 100 square feet of conditioned floor area if an air handler is installed, and from 3 to 2 cfm per 100 square feet if no air handler is installed at the time of testing.

IECC Table R405.2 is poorly written making it unclear whether Section R403.3.6 is excluded from Total Building Performance requirements. This amendment clarifies this requirement.

When ducts are located in unconditioned space, return duct leakage effectively draws air from attic spaces or outdoors, increasing heating and cooling load. Supply duct leakage creates a pressure deficit which increases infiltration and heating and cooling load, and reduces system capacity, resulting in longer run times.

Proper practices of duct sealing include use of UL 181, UL 181A, and UL 181B approved pressure sensitive tapes and mastic to seal sheet metal seams and joints and flex duct connections to collars and boots in accordance with ANSI/SMACNA-006-2006. In addition to sealing, drawbands or clamps should be used to secure flexible duct connections.

The proposed leakage rate is readily achievable and has been demonstrated by California Title 24 compliance experience. Since the 2005 version of Title 24 was implemented, residential ducts have been required to be verified by HERS raters to have leakage rates at 25 Pa pressurization of no greater than 6 percent of total fan flow (as measured or using a 400 cfm per ton default). Test results are required to be recorded in HERS registries. The 2019 Title 24 standards reduced the maximum leakage rate to 5 percent of fan flow. Relating Title 24 leakage requirements to the IECC requirements, for an 1800 square foot home with a two-ton air conditioner, the maximum leakage rate at

5 percent is 40 cfm, or 2.2 cfm per 100 square feet, which is 27% more stringent than this proposal.

Bibliography: 2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings. California Title 24, Part 6. https://www.energy.ca.gov/publications/2008/2019-building-energy-efficiency-standards-residential-and-nonresidential

Hoeschele, M., R. Chitwood, et al. 2015. "High Performance Ducts in Hot-Dry Climates". Department of Energy Building America report. https://www.nrel.gov/docs/fy15osti/64366.pdf

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Based on field studies and computer simulations completed in a hot-dry climate, the proposed code change would result in annual site energy savings of approximately 2% depending on fuel source. Savings are highly dependent on heating and cooling system operating hours, climates, and duct leakage impacts on infiltration.

If industry standard practices for duct installation are followed there should be no additional cost for duct sealing to achieve the proposed leakage rate.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: provides clarity to existing language and removes redundant language. Also provides a table to better identify requirements.

Final Hearing Results

REPI-86-21	AM

REPI-87-21

Original Proposal

IECC®: R403.4.1

Proponents: Howard Ahern, Airex Manufacturing, Airex Manufacturing (howard.ahern@airexmfg.com)

2021 International Energy Conservation Code

Revise as follows:

R403.4.1 Protection of piping insulation.

Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture~~, equipment maintenance~~ physical damage, and wind. The protection shall provide shielding from solar radiation that can cause degradation of the materialand shall be removable no less than 6 feet (1828 mm) from the equipment for maintenance. Adhesive tape shall be prohibited

Reason: Reason:

Purpose of code change:

This proposal will clarify the intent of Section R403.4.1 The intent of these sections is not only protection of pipe insulation from weather but to insure the insulations thermal conductivity energy savings integrity lasts the life of the mechanical system as

per the intent of the code. To remove the opportunity for misunderstanding so that the code has will have its intended result, the term “equipment maintenance” must be clarified that it is for physical damage. The 2012,2015, & 2018 IECC Code and Commentary both state that Equipment maintenance is to protect from physical damage to the pipe insulation.

“The piping insulation should be protected from sunlight, moisture, wind and solar

radiation but also from personal who may step on it, run in to it with equipment, etc. and cause it to be damaged. “

Protective covering must also protect from physical damage so if the protection covering does get

damaged from stepping on it, dropping tools on it, birds, lawn trimmers etc.it can be repaired or replaced.

Keeping the insulations thermal conductivity integrity and insuring the insulation system last the

life of the mechanical system and avoiding the costly replacement of the insulation. Repairing pipe insulation is

done with adhesives and then adhesive seams are left to weather exposure leading to degradation. The seams

open sun and moisture damage the insulation system.

Removable protection is vital to ensure insulation can retard heat and condensation to provide energy savings and safety.

Some insulation manufactures are now stating that gel coated or plastic coated insulation while it may be UV resistance , it will only protect for about a year without additional protection, or stating for protection longevity the coated insulation must have additional protection. Cracks in the protection , seams splitting or unprotected ends allow moisture to damage the insulation and It only takes a 1% moisture gain to equal to a 7.5 % loss in thermal efficiency.

Pipe insulation is sold in minimum 6 foot sections at Contractor supply Distributors

This proposal states that protection be removable no less than 6 feet from the equipment to allow equipment maintenance without having to destroy the insulation or purchase additional pipe insulation to replace.

Removable protection comes in many forms and from many manufactures it can be as simple as bent sheet metal, piping covers, jackets, pre fit channel systems & gutter systems, preformed covers, cladding, pipe , etc.

The intent is in the original 2012 IECC code proposal, the proponent's reason statement of this requirement EC207-09/10 stated this was to Harmonize the IECC with ASHRAE 90.1 the 2012 code the reason statement also stated -"All AC

units require periodic maintenance. The frequency varies with how hard the unit operates, exterior temperature,

preventive maintenance program, and many others. On every occasion, every maintenance provides an excuse for the

Freon line insulation to be touched and removed." The intent is clear that the protection be removable and independent

of the pipe insulation for maintenance without damaging the pipe insulation.

Removing protection without damaging the insulation is stated in EC207-09/10 "Adhesives Tape is not

permitted as it will limit maintenance and damage insulations permeability characteristics. Removal

of tape damages the integrity of the original insulation into pieces, specially, if the insulation

has reached thermo set state.

The main reason for pitting and corrosion of the piping in refrigerant lines is moisture intrusion into the pipe insulationfrom the termination point that are not protected. The gap between the piping and insulation creates a pathway formoisture to run the length and damage the system. "The most likely area of intrusion is at the insulation system penetration Points,gauges, attachments etc. If the integrity or exterior o the insulation system is not

installed correctly and moisture sources are present, moisture will more than likely penetrate the

insulation system. Moisture intrusion can negatively affect all aspects of the insulation system such as

thermal values, which can have a direct impact on process control, energy cost, condensation,

control, safety, the potential of mold development etc. Not to mention the potential of corrosion

under the insulation (CUI)." Insulation, the Forgotten Technology for Energy Conservation 2007 ACEE

https://energy.cdpaccess.com/proposal/36/624/files/download/210/

Bibliography: Howard Ahern
Airex Manufacturing

760-250-1625

howard.ahern@airexmfg.com

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This change will not increase the cost of construction as removable protection has been used before and snice the IECC2012 when protection was required. In fact this will decrease the cost of construction on future equipment replacement and maintenance by not having to replace pipe insulation.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The proposal indicates that protection be removable without having to destroy the insulation or purchase additional pipe insulation to replace.

Final Hearing Results

REPI-87-21	AM

REPI-89-21

Original Proposal

IECC®: R403.5.2, TABLE C403.12.3, TABLE R405.2, TABLE R406.2

Proponents: Gary Klein, on behalf of the California Statewide Utility Codes and Standards Team (iecc-pipe-insulation@2050partners.com); Mark Lyles, New Buildings Institute, New Buildings Institute (markl@newbuildings.org); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

R403.5.2 Hot water pipe insulation. Insulation for service hot water piping~~with a thermal resistance, *R*-value, of not less than R-3~~ shall comply with Table R403.5.1 and be applied to the following:

1. Piping $^{3}/_{4}$ inch (19.1 mm) and larger in nominal diameter located inside the *conditioned space*.
2. ~~Piping serving more than one dwelling unit~~.

2. ~~3.~~ Piping located outside the *conditioned space*.

3. ~~4.~~ Piping from the water heater to a distribution manifold.

4. ~~5.~~ Piping located under a floor slab.

5. ~~6.~~ Buried piping.

6. ~~7.~~ Supply and return piping in ~~circulation and recirculation systems~~ *circulating hot water systems.* ~~other than cold water pipe return demand recirculation systems.~~

    Exception: Cold water returns in *demand recirculation water systems.*

TABLE R403.5.2 MINIMUM PIPE INSULATION THICKNESS

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		MINIMUM PIPE INSULATION THICKNESS (in inches)	
	Conductivity Btu × in./(h × ft^2 × °F)[a]	Mean Rating Temperature, °F		
141-200	0.25-0.29	125	1.0	
105-140	0.21-0.28	100	1.0	

For SI: 1 inch = 25.4 mm, °C = [(°F) – 32]/1.8.

a For insulation outside the stated conductivity range listed in Table R403.5.2, the minimum thickness (T) listed in Table R403.5.2, shall be determined as follows:

$T = r\,[(1 + t/r)^{K/k} - 1]$

where:

T = Minimum insulation thickness.

r = Actual outside radius of pipe.

t = Insulation thickness listed in the table for applicable fluid temperature and pipe size; 1-inch.

K = Conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu × in/h × f~~t~~^{2} × °F).

k = The upper value of the conductivity range listed in Table R403.5.2 for the applicable fluid temperature.

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
Mechanical	
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.2	Hot water pipe insulation
R403.5.3	Drain water heat recovery units

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
Mechanical	
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.2	Hot water pipe insulation
R403.5.3	Drain water heat recovery units

Reason: The proposal will update the requirements for the hot water pipe insulation from insulation level R-3 to a thickness of 1 inch. The proposal will apply to service hot water pipes of all diameter sizes, though most distribution pipes are unlikely to exceed 1 ½ inch in diameter. At service hot water temperatures, a 1-inch insulation thickness on a 1-inch diameter pipe translates to an R-value level of R-7.7. The proposed 1-inch insulation thickness is consistent with pipe insulation requirements in Table C403.12.3 *Minimum Pipe Insulation Thickness (in inches)*, applicable to systems serving multiple dwelling units. This is the case for the 105 and 140°F temperature and the "<1" and "1 to < 1½" nominal pipe size (inch) ranges.

Both the IECC commercial section and ASHRAE standards specify pipe insulation requirements in terms of pipe insulation thickness. California's Title 24, Part 6 specifies both the insulation R-value and thickness, allowing buildings to show compliance using either requirement. The proposal team recommends changing the requirement to insulation thickness, to be consistent with the IECC commercial section, ASHRAE, and California's requirements. Table 1 summarizes pipe insulation requirement formats across energy standards. The team further recommends defining how insulation thickness shall be determined for alternative materials, the same method as described under C403.12.3 and for Table C403.12.3.

Table 1: Pipe Insulation Requirement Formats across Energy Standards

Energy Standards	IECC Residential	IECC Commercial	ASHRAE	CA Title 24 Part 6
Specifies Insulation R-value	Current	No	No	Yes
Specifies Insulation Thickness	As Proposed	Yes	Yes	Yes

Currently text in both IEEC sections R403.5.2 and R403.8 imply applicability for piping serving "more than one dwelling unit" (or "multiple dwelling units"). The proposal team recommends clarifying language such that service hot water systems serving anything other than a one single-family home or one dwelling unit would follow R403.8 and comply with commercial sections C403 and C404. This raises concerns that two-dwelling unit buildings covered by the IRC will now be directed to commercial sections.

Bibliography: Statewide CASE Initative. (2020, September). *2022 Title 24 Final CASE Report - Multifamily Domestic Hot Water Distribution.* Retrieved from Title24Stakeholders: https://title24stakeholders.com/wp-content/uploads/2020/09/2022_T24_Final-CASE-Report-MF-DHW-Dist.pdf

Statewide CASE Initiative. (2011, October). *Water and Space Heating ACM Improvement.* Retrieved from Title24Stakeholders: http://title24stakeholders.com/wp-content/uploads/2017/10/2013_CASE-Report_Water-and-Space-Heating-ACM-Improvement.pdf

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

The pipe insulation prices shown in Table 2 were collected in support of the 2022 Title 24, Part 6 update to pipe insulation requirements and do not include pricing for 1/2 inch insulation, but demonstrate a cost trend across increasing insulation thickness (Statewide CASE Initative, 2020).

Table 2: Insulation Cost per Linear Foot at Different Pipe Sizes and Insulation Thicknesses

Pipe Size (inch)	Insulation Thickness (inches)			
	1/2	1	1 1/2	2
3/4	TBD	$14	NA	NA
1	TBD	$14.75	$15.75	NA
1 1/2	TBD	NA	$18	$21.75

The proposal team will perform detailed cost analyses on the insulation thickness proposal based on the typical pipe length found in single-family homes and multifamily dwelling units in advance of IECC committee meetings.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: based on the proponent’s reason statement.

Final Hearing Results

REPI-89-21 AM

REPI-90-21

Original Proposal

IECC®: SECTION 202 (New), R403.5.4 (New), TABLE R403.5.4 (New), TABLE R405.2, TABLE R406.2, ANSI Chapter 06 (New), ASME Chapter 06 (New)

Proponents: Kim Cheslak, NBI, NBI (kim@newbuildings.org); Josh Keeling, Cadeo Group, Cadeo Group (jkeeling@cadeogroup.com); Ben Rabe, Fresh Energy (rabe@fresh-energy.org); Bryan Bomer, Department of Permitting Services, Montgomery County MD, Department of Permitting Services (bryan.bomer@montgomerycountymd.gov); Lauren Urbanek, Natural Resources Defense Council (lurbanek@nrdc.org); Howard Calvert Wiig, Hawaii State Energy Office, Hawaii State Energy Office (howard.c.wiig@hawaii.gov); Kim Burke, State of Colorado, Colorado Energy Office (kim.burke@state.co.us); Matthew Tidwell, Portland General Electric, Portland General Electric (matthew.tidwell@pgn.com); Chris Castro, City of Orlando, City of Orlando (chris.castro@orlando.gov); Amber Wood, ACEEE, ACEEE (awood@aceee.org); Brad Smith, City of Fort Collins (brsmith@fcgov.com)

2021 International Energy Conservation Code

Add new definition as follows:

DEMAND RESPONSIVE CONTROL. A control capable of receiving and automatically responding to a demand response signal.

DEMAND RESPONSE SIGNAL. A signal that indicates a price or a request to modify electricity consumption for a limited time period.

Add new text as follows:

R403.5.4 Demand responsive water heating. Electric storage water heaters with a rated water storage volume of 40 gallons (150L) to 120 gallons (450L) and a nameplate input rating equal to or less than 12kW shall be provided with *demand responsive controls* in accordance with Table R403.5.4 or another equivalent *approved* standard.

Exceptions:

1. Water heaters that are capable of delivering water at a temperature of 180°F (82°C) or greater.
2. Water heaters that comply with Section IV, Part HLW or Section X of the ASME Boiler and Pressure Vessel Code.
3. Water heaters that use 3-phase electric power.

TABLE R403.5.4 DEMAND RESPONSIVE CONTROLS FOR WATER HEATING

Equipment Type	Controls	
	Manufactured Before 7/1/2025	Manufactured On or After 7/1/2025
Electric stoarge water heaters	ANSI/CTA-2045-B Level 1 and also capable of initiating water heating to meet the temperature set point in response to a *demand response signal*.	ANSI/CTA-2045-B Level 2, except “Price Stream Communication” functionality as defined in the standard.

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate

Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation
R403.5 except Section R403.5.2	Service hot water systems
~~R403.5.1~~	~~Heated water circulation and temperature maintenance systems~~
~~R403.5.3~~	~~Drain water heat recovery units~~
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors

R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5 except Section R403.5.2	Service hot water systems
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Add new standard(s) as follows:

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

ANSI/CTA 2045-B February 2021 Modular Communications Interface for Energy Management

ASME

American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990

BPVC *Boiler and Pressure Vessel Code*

Reason: With increasing penetrations of intermittent renewable energy, volatile wholesale power prices, and subsequent growth in dynamic rates/demand response programs, grid-interactive end uses present an opportunity to help homes manage their bills, participate in programs, and support efficient grid operations. Water heaters can provide many services to the grid, including generation, transmission, and distribution capacity, energy arbitrage, and ancillary services. In their assessment of the National Potential for Load Flexibility, Brattle estimated that across all measures these services could provide as much as $15 billion per year in value to the electric system.

As electricity systems transform to include more variable wind and solar energy, demand flexibility becomes increasingly critical to both grid operation and further transformation. Building systems that can use energy when it is abundant, clean, and low-cost not only help decarbonize the entire energy system, they also insulate their owners from future increases in demand charges and peak hour energy rates – a current and accelerating trend. Water heaters offer an unparalleled opportunity for load shifting: tanks full of hot water are inherently energy storage devices. Including the controls necessary to take advantage of this opportunity is relatively simple and affordable in new construction. Compared to other energy storage technologies such as batteries, smart, grid-integrated water heater controls can deliver substantial dispatchable (that is, reliable to the grid operator) energy flexibility. The controls specified by ANSI/CTA-2045-B ensure negligible risk of occupant disruption (that is, the hot water will not run out). Water heaters provide a particularly attractive option as they have inherent thermal storage that allows energy consumption to be shifted with little to no impact to the end user. This capability has been demonstrated in several contexts, most recently through regional demonstrations conducted by EPRI and BPA.

In their Grid-interactive and Efficient Buildings (GEBs) Roadmap, the US Department of Energy estimates that approximately 15 GW of additional load flexibility is expected to be added to the system under reference case assumptions. Combined with energy efficiency, this is expected to provide $13 billion/year of peak demand savings to the power system and its customers. Through a comprehensive literature review and interviewing dozens of national experts, the USDOE team found that one of the biggest barriers was the lack of interoperability. A key tool to solve this problem is building codes, which can help to ensure that interoperable devices and controls are installed at the time of construction. USDOE cited explicitly the use of codes and standards as one of its recommended pathways to enable greater adoption of GEBs technologies.

ANSI/CTA-2045-B standardizes the socket, and communications protocol, for electric water heaters so they can communicate with the grid, and with demand response signal providers. In addition, 2045-B adds control and communications requirements for mixing valves in water heaters, which enable them to provide greater storage capacity to support increased load shifting while eliminating scalding risk.

Versions of this standard are included in codes or other requirements in California, Oregon, and Washington and are referenced explicitly by ENERGY STAR.

Bibliography: [1] Brattle, The National Potential for Load Flexibility (2019) https://brattlefiles.blob.core.windows.net/files/16639_national_potential_for_load_flexibility_-_final.pdf

[2] BPA, CTA-2045 Water Heater Demonstration Report (2018) https://www.bpa.gov/EE/Technology/demand-response/Documents/Demand%20Response%20-%20FINAL%20REPORT%20110918.pdf

EPRI, CEA-2045 Field Demonstrations Project Description (2014) https://www.epri.com/research/products/000000003002004009

[3] USDOE, A National Roadmap for Grid-Interactive Efficient Buildings (2021) https://gebroadmap.lbl.gov/A%20National%20Roadmap%20for%20GEBs%20-%20Final.pdf

[4] Washington State Revised Code of Washington, Title 19, Chapter 19.260, Section 19.260.080, available at https://app.leg.wa.gov/RCW/default.aspx?cite=19.260.080

Oregon Department of Energy, Energy Efficiency Standards Rulemakinghttps://www.oregon.gov/energy/Get-Involved/Pages/EE-Standards-Rulemaking.aspx

U.S. EPA Energy Star Program, Connected Criteria for ENERGY STAR Products, https://www.energystar.gov/products/spec/connected_criteria_energy_star_products_pd

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

To enable grid-interactive controls, there are two sources of costs: the incremental cost to ensure that equipment is interoperable with CTA-2045-B and the cost of the control module installed in that device. The incremental manufacturing cost is in the range of a few dollars, and negligible at higher volumes. The current incremental cost to include a CTA-2045-B compliant control module ranges from about $60 (direct current, hard-wired connection) to $160 (alternating current, wireless cellular connection); this is expected to decline as manufacturing lines are brought up to larger scale (source: Advanced Water Heating Initiative). The major determinant of cost if the chosen radio pathway as chipset costs vary considerably between different frequencies/standards.

In the BPA report, manufacturers stated a range of $2-$30 for regional deployment, but noted that there would be economies of scale for a national rollout. The main cost was development of firmware/hardware to accommodate the standard, but these costs have already been incurred to meet codes/standards in OR, WA, and CA.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal adds Demand Response controls for tanked water heaters only. The proposal is for specific tanked water heaters with 3 exceptions listed in the proposal. The reason for the revision replaces a definition for “grid integrated controls”.

Final Hearing Results

REPI-90-21 AM

REPI-91-21

Original Proposal

IECC®: R403.5.4 (New), TABLE R403.5.4 (New)

Proponents: Dan Wildenhaus, Northwest Energy Efficiency Alliance (dwildenhaus@trccompanies.com); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new text as follows:

R403.5.4 Water volume determination. The water volume in the piping shall be calculated in accordance with this section. Water heaters, circulating water systems and heat trace temperature maintenance systems shall be considered to be sources of heated water. The volume shall be the sum of the internal volumes of pipe, fittings, valves, meters and manifolds between the nearest source of heated water and the termination of the fixture supply pipe. The volume in the piping shall be determined from Table R403.5.4. The volume contained within fixture shutoff valves, within flexible water supply connectors to a fixture fitting and within a fixture fitting shall not be included in the water volume determination. Where heated water is supplied by a recirculating system or heat-traced piping, the volume shall include the portion of the fitting on the branch pipe that supplies water to the fixture.

TABLE R403.5.4 INTERNAL VOLUME OF VARIOUS WATER DISTRIBUTION TUBING

OUNCES OF WATER PER FOOT OF TUBE									
NOMINAL SIZE (inches)	**COPPER TYPE M**	**COPPER TYPE L**	**COPPER TYPE K**	**CPVC CTS SDR 11**	**CPVC SCH 40**	**CPVC SCH 80**	**PE-RT SDR 9**	**COMPOSITE ASTM F1281**	**PEX CTS SDR 9**
3/8	1.06	0.97	0.84	N/A	1.17	-	0.64	0.63	0.64
1/2	1.69	1.55	1.45	1.25	1.89	1.46	1.18	1.31	1.18
3/4	3.43	3.22	2.90	2.67	3.38	2.74	2.35	3.39	2.35
1	5.81	5.49	5.19	4.43	5.53	4.57	3.91	5.56	3.91
1 1/4	8.70	8.36	8.09	6.61	9.66	8.24	5.81	8.49	5.81
1 1/2	12.18	11.83	11.45	9.22	13.20	11.38	8.09	13.88	8.09
2	21.08	20.58	20.04	15.79	21.88	19.11	13.86	21.48	13.86

For SI: 1 foot = 304.8 mm, 1 inch = 25.4 mm, 1 liquid ounce = 0.030L, 1 oz/f^{2}t = 305.15 g/m^2.

N/A = Not available.

Reason: *Language needs to be introduced into the prescriptive portion of the code's Systems section in order to be referenced in new R408 Additional Efficiency Package Options.*

Inefficient hot water distribution systems have been recognized as a problem for many years as they result in energy and water waste, and result in long hot water delay times that are the cause of a significant number of complaints by new home buyers. Recirculation systems are a solution to two of the three problems (water and wait time), but the thermal energy impact of different recirculation system options has already been addressed in section **R403.5.1.1 Circulation system**.[1]

In all non-recirculation distribution options, water heater energy consumption and hot water waste are correlated. A decrease in water heater energy consumption follows a reduction in wasted water; therefore, improving insulation and reducing the piping length and/or pipe diameter have equal benefits for energy and water waste. In recirculation systems, water heater energy consumption and wasted hot water are independent, and often have an inverse effect (when recirculation is not demand based).[2]

This distribution system problem exists for a variety of factors including:

- An outdated pipe sizing methodology in the plumbing code that results in oversized hot water distribution systems since the assumed fixture flow rates are much higher than current requirements.

- Municipalities with design recommendations that force plumbers and designers to assume low supply water pressure, resulting in larger distribution piping, which waste more water and energy.
- Increasing efforts to conserve water has resulted in the realization of water savings due to improvements in showerhead and lavatory maximum flow rates; however, reduced flow rates often result in increased wait times if the hot water distribution system is not designed to accommodate lower flows.
- Increasing popularity of gas instantaneous water heaters, which offer improved operating efficiency, but can result in increased water waste when starting from a "cold start up" situation.
- Inefficient plumbing installations that are not focused on minimizing pipe length or pipe diameters.

The IECC has already addressed pipe insulation and Circulation systems in the 2021 IECC Residential provisions.

1

Residential Compact Domestic Hot Water Distribution Design: Balancing Energy Savings, Water Savings, and Architectural Flexibility Farhad Farahmand, TRC Companies Yanda Zhang, ZYD Energy

[2]*Evaluating Domestic Hot Water Distribution System Options With Validated Analysis Models*E. Weitzel and M. Hoeschele Alliance for Residential Building Innovation

https://energy.cdpaccess.com/proposal/445/976/files/download/134/
https://energy.cdpaccess.com/proposal/445/976/files/download/133/
https://energy.cdpaccess.com/proposal/445/976/files/download/132/
https://energy.cdpaccess.com/proposal/445/976/files/download/131/
https://energy.cdpaccess.com/proposal/445/976/files/download/130/

Bibliography: · *Residential Compact Domestic Hot Water Distribution Design: Balancing Energy Savings, Water Savings, and Architectural Flexibility* Farhad Farahmand, TRC Companie;Yanda Zhang, ZYD Energy

· *Evaluating Domestic Hot Water Distribution System Options With Validated Analysis Models*E. Weitzel and M. Hoeschele Alliance for Residential Building Innovation

· California Energy Codes & Standards Case Report for *Compact Hot Water Distribution*; Measure Number: 2019-RES-DHW1-F, Residential Plumbing

· Home Innovation Research Labs Annual Builder Practices Survey, 2021

· Department of Energy Zero Energy Ready Home National Program Requirements (Rev. 07) [footnote 15]

· Efficient hot water distribution system – USBGC LEED BD+C: Homes v4 – LEED v4

· Residential Hot Water Distribution Systems: Roundtable Session; JD Lutz, Lawrence Berkely National Laboratory; G Klein, California Energy Commission; D Springer, Davis Energy Group; BD Howard, Building Environmental Science & Technology

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Incremental first costs to builders, designers, and plumbers are design based and each builder will need to determine potential cost impacts based on existing designs and measures in use. Depending on current practices and paths taken for IECC compliance this measure may result in small incremental cost increases or decreases. These potential cost differences relative to standard practices are likely to be:

· Reduced cost of PEX or copper tubing due to less material installed.

· Reduced cost to pipe insulation due to smaller plumbing layout.

· Reduced or neutral cost in labor hours for plumber.

· Increased water heating venting costs, if a gas water heater or electric heat pump water heater is centrally located.

· Increased venting labor costs, if a gas water heater or electric heat pump water heater is located is centrally located and not on a garage wall.

This measure should not have maintenance costs associated with it compared to standard practices.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: based on the proponent's reason statement.

Final Hearing Results

REPI-91-21	AM

REPI-94-21

Original Proposal

IECC®: R403.6.1

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

R403.6.1 Heat or energy recovery ventilation . *Dwelling units* shall be provided with a heat recovery or energy recovery ventilation system in Climate Zones 7 and 8. The system shall be a *balanced ventilation system* with a ~~minimum~~ sensible ~~heat~~ recovery efficiency (SRE) of no less than 65 percent at 32°F (0°C) at ~~a~~ an airflow ~~flow~~ greater than or equal to the design airflow. The SRE shall be determined from a listed value or from interpolation of listed values.

Reason: This proposal is intended to clarify the existing requirements in this section. "Balanced ventilation system" is a term that is now defined in the 2024 IRC and IMC. The industry term for sensible heat recovery efficiency is "sensible recovery efficiency" (SRE). For any given heat or energy recovery ventilator, the SRE generally improves as airflow is reduced. By interpolating, a specifier can obtain a closer estimate of the unit's performance at the design airflow. As a point of reference, interpolation of the SRE was recently vetted by the California Energy Commission and approved for inclusion in Part 6 of Title 24-2022.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal clarifies the application of existing requirements and does not affect construction cost.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: clarifies the existing language

Final Hearing Results

REPI-94-21 AM

REPI-95-21

Original Proposal

IECC®: R403.6.2, TABLE R403.6.2, CSA Chapter 06 (New), ASHRAE Chapter 06 (New)

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

R403.6.2 Whole-dwelling mechanical ventilation system fan efficacy. Fans used to provide whole-dwelling mechanical ventilation shall meet the efficacy requirements of Table R403.6.2 at one or more rating points. Fans shall be tested in accordance with ~~HVI 916~~ the test procedure referenced by Table R403.6 and listed. The airflow shall be reported in the product listing or on the label. Fan efficacy shall be reported in the product listing or shall be derived from the input power and airflow values reported in the product listing or on the label. Fan efficacy for fully ducted HRV, ~~ERC~~ERV, balanced, and in-line fans shall be determined at a static pressure of not less than 0.2 inch w.c. (49.85 Pa). Fan efficacy for ducted range hoods, bathroom and utility room fans shall be determined at a static pressure of not less than 0.1 inch w.c. (24.91 Pa).

TABLE R403.6.2 WHOLE-DWELLING MECHANICAL VENTILATION SYSTEM FAN EFFICACY[a]

FAN LOCATION SYSTEM TYPE	AIRFLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	TEST PROCEDURE
HRV, orERV, or balanced	Any	1.2 cfm/watt	HRV or ERV: CAN/CSA 439; Balanced without heat or energy recovery: ASHRAE Standard 51 (ANSI/AMCA Standard 210)
Range hood	Any	2.8	ASHRAE 51 (ANSI/AMCA Standard 210)
In-line supply or exhaust fan	Any	3.8 cfm/watt	
Other exhaust fan	< 90	2.8 cfm/watt	
	≥ 90 and < 200	3.5 cfm/watt	
	≥ 200	4.0	
Air-handler that is integrated to tested and *listed* HVAC equipment	Any	1.2 cfm/watt	Outdoor airflow as specified. Air-handler fan power determined in accordance with the HVAC appliance's test method referenced by Section C403.3.2 of the IECC-Commercial Provisions.

For SI: 1 cubic foot per minute = ~~28.3 L/min.~~0.47 L/s.

a. Design outdoor airflow rate/watts of fan used.

Add new standard(s) as follows:

CSA

CSA Group
8501 East Pleasant Valley Road
Cleveland, OH 44131-5516

CAN/CSA-C439-18 Laboratory methods of test for rating the performance of heat/energy-recovery ventilators

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

ASHRAE Standard 51-16 / ANSI/AMCA Standard 210-16 Laboratory Methods Of Testing Fans For Certified Aerodynamic Performance Rating

Reason: Approval of this proposal and coordinating proposals submitted to the IECC-C will improve alignment of the residential fan efficacy table, the commercial fan efficacy table, the ASHRAE 90.1 fan efficacy table, and the ENERGY STAR Ventilating Fans v4.1 specification. It will also incorporate errata that are needed to the 2021 IECC based on final action on proposals RE133-19, RE137-19, and RE178-19, approved in the previous code cycle. The test procedures referenced are those referenced by ASHRAE 90.1 and the IECC-C and are those used by industry for testing and listing.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The only element of this proposal that may affect first costs is the introduction of a fan efficacy requirement for exhaust fans exceeding 200 cfm. This requirement aligns with ENERGY STAR criteria and has already been vetted by ASHRAE 90.1, which has cost effectiveness requirements. Additionally, a small sample of internet retail pricing for units that would be affected by this requirement showed that price was not heavily correlated with efficacy:

Compliant:
Model A: 300 cfm, 7.3 cfm/watt, $185
Model B: 200 cfm, 11.4 cfm/watt, $179

Not Compliant:

Model C: 200 cfm, 3.5 cfm/watt, $159
Model D: 200 cfm, 3.6 cfm/watt, $212
Pricing gathered October 2021 from airxheat, ecomfort, homedepot, and amazon.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: updated testing procedure references

Final Hearing Results

REPI-95-21 AM

REPI-96-21

Original Proposal

IECC®: R403.6.3

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

R403.6.3 Testing. Mechanical ventilation systems shall be tested and verified to provide the minimum ventilation airflow rates required by Section R403.6, in accordance with ANSI/RESNET/ICC 380~~. Testing shall be performed according to the ventilation *equipment* manufacturer's instructions, or by using a flow hood or box, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals or grilles, outlet terminals or grilles, or in the connected ventilation ducts.~~ Where required by the code official, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

Exceptions: ~~Kitchen range hoods that are ducted to the outside with 6-inch (152 mm) or larger duct and not more than one 90-degree (1.57 rad) elbows or equivalent in the duct run.~~

1. Kitchen range hoods that are ducted to the outside with ducting having a diameter of 6 inches (152 mm) or larger, a length of 10ft (3048 mm) or less, and not more than two 90° elbows or equivalent shall not require testing.
2. A third-party test shall not be required where the ventilation system has an integrated diagnostic tool used for airflow measurement, programmable airflow settings, and a user interface that communicates the installed airflow rate.

Reason: Verification of ventilation system airflow rate is critical to ensuring systems meet minimum code requirements. This modification to the original proposal is in keeping with the objective of verifying airflow rate, but it adds another option for doing so by encouraging innovation of products that are verified to modulate airflow to the user's selected rate and communicate via a user-interface whether the user's selected rate is achieved. To encourage the development and specification of such verified, self-modulating systems, this proposal waives any requirement for third-party field verification of the airflow rate when such a device is used. To verify that the device meets the criteria of Section 403.6.2.2, results from laboratory testing must be provided by a laboratory that is approved by a certification body that is accredited to ISO/IEC 17065, Conformity assessment — Requirements for Bodies Certifying Products, Processes and Services. ISO/IEC 17065 is the cornerstone for certification body accreditation; referencing it clarifies compliance requirements for manufacturers and relieves building officials from the burden of subjective approval.

This proposal also modifies the kitchen range hood testing exception to stipulate a maximum length of duct that can be used to be eligible for the exception while adding more flexibility in terms of the number of elbows. The allowance proposed for length and elbows aligns with the Home Ventilating Institute’s new airflow metric for range hoods, Nominal Installed Airflow (see HVI 920 for more information), which is intended to provide a better approximation of real-world airflow than the traditional range hood airflow rating at 0.1” w.c.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal will not increase the cost of construction. The proposal can help reduce costs by providing additional compliance options.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: adds option to verifying airflow rate and modifies the kitchen range hood testing exception

Final Hearing Results

REPI-96-21 AM

REPI-99-21

Original Proposal

IECC®: SECTION 202 (New), R403.7.1 (New), TABLE R405.2, TABLE R406.2

Proponents: David Baylon, Northwest Energy Efficiency Alliance (david@davidbaylon.com); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new definition as follows:

ZONAL HEATING. A heating system in which each *zone* or room has a separate heater with a single controller in each *zone*.

Add new text as follows:

R403.7.1 Electric resistance zone heated units. All detached one- and two-family dwellings and townhouses in Climate Zones 4-8 using electric resistance *zonal heating* as the primary heat source shall install one additional heating unit in the largest living zone. The additional unit shall have an HSPF greater than 7.4 (6.3 HSPF2). Building permit drawings shall specify the heating equipment type and location of the heating system.

Exceptions:

1. Total installed heating capacity of 2 kW per dwelling or less.
2. Dwellings that have central ducted or ductless cooling or heating systems.

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation

R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas

R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Reason: The use of a split system DHP system (less than 36,000 BTU heating) has shown itself to provide significant savings in the field trials and large-scale market evaluations in the Pacific Northwest. Savings have been demonstrated in all three climate zones in the region (4C, 5B, and 6B). These savings derive from the ability of the heat pump to perform over a wide range of outdoor temperature conditions (down to -10°F) and provide significant heating to the home with C.O.P. greater than 2.5. The unit is meant to displace the electric heat when conditions allow often in swing seasons. The savings largely depend on the unit to fully heat the zone or zones where they are installed. The primary electric heating is sized to meet the design heating requirements in accordance with R403.7 so this additional equipment is designed to provide savings when it is operating. The variable speed compressors can also provide significant cooling to the zone and typically have SEER ratings above 16. In many cases this can be the primary cooling in the dwelling and obviate the need for further zone level cooling using much less efficient equipment.

Detailed metering of about 100 electric resistance zonal homes showed a reduction of about 3000 kwh/yr. Even in homes that used supplemental stoves such as wood or propane fired average savings was almost 2000 kwh/yr in subsequent billing analysis done on almost 4000 homes throughout the region.

While this region had small cooling loads in the few areas where substantial seasonal cooling is required, savings of about 300 kwh/yr were observed. In most cases these savings were the result of replacing window air conditioners that provided zone cooling for the home.

Bibliography: Baylon, et al, 2014, *Ductless Heat Pump Impact and Process Evaluation, Billing Analysis Repor*,*t* Northwest Energy efficiency Alliance, Portland, OR

https://neea.org/resources/ductless-heat-pump-impact-process-evaluation-billing-analysis-report

Baylon, et al, 2012, *Ductless Heat Pump Impact and Process Analysis, Field Metering Report,*Northwest Energy Efficiency Alliance, Portland, OR.

https://ecotope.com/ecotope-publications-database/

Lubliner, Et al, 2016, Performance and Costs of Ductless Heat Pumps in Marine Climate High-Performance Homes–Habitat for Humanity the Woods, USDOE Building America Program, Golden, CO
http:/www.osti.gov/scitech/

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

The installation costs of DHP were documented as part of the detailed field and market evaluation in the Pacific Northwest. The cost of a DHP installation in new construction (townhouses) varied from $2500 to $3500. The installed DHPs were generally 1 nominal 1 ton. The costs for DHPs as a retrofit varied substantially. The retrofit costs were generally between $3500 and $4500 and were sized between 1 ton and 2.5 tons nominal.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: provides consensus language that follows what has been used successfully in Washington state.

Final Hearing Results

REPI-99-21	AM

REPI-101-21

Original Proposal

IECC®: R404.1

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

R404.1 (N1104.1) Lighting equipment. All permanently installed lighting fixtures~~, excluding kitchen appliance lighting fixtures~~, shall contain only high-efficacy lighting sources .

Exceptions:

1. kitchen appliance lighting.
2. antimicrobial lighting used for the sole purpose of disinfecting.

Reason: The lighting efficacy requirements of this section were only developed to apply to luminaires that provide lighting for illumination. This exception clarifies the section's intent in regard to lighting that is used for germicidal or antimicrobial purposes and is aligned with the IECC-C Section C405.3.1 exception for antimicrobial lighting.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This code change will provide clarity to code officials and designers regarding how to apply the requirements of this section to germicidal or antimicrobial lighting. No effect is expected with regard to construction costs.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: language matches the commercial side. new part in article 410, added in group A, interior environments that point to UL standards. Guidance in the IBC and NEC

Final Hearing Results

REPI-101-21	AM

REPI-102-21 Part I

Original Proposal

IECC®: SECTION 202, R404.1

Proponents: Michael Jouaneh, Lutron Electronics Co., Inc., Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

THIS IS A 2 PART PROPOSAL. PART I & II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Energy Conservation Code

Revise as follows:

~~**HIGH-EFFICACY LIGHT SOURCES.** Any lamp with an efficacy of not less than 65 lumens per watt, or luminaires with an efficacy of not less than 45 lumens per watt.~~

R404.1 Lighting equipment. All permanently installed <u>luminaires</u> ~~lighting fixtures~~, excluding kitchen appliance lighting <u>equipment</u> ~~fixtures~~, shall <u>be capable of operation with an efficacy of not less than 45 lumens per watt or shall</u> contain <u>lamps</u> ~~only high-efficacy lighting sources~~ <u>capable of operation at 65 lumens per watt or greate</u>r.

Reason: This editorial revision corrects the terminology used to describe lightning equipment and relocates the efficacy criteria from the definition of “high-efficacy light sources” to R404.1 to improve clarity for the user and proper enforcement of the code. By including the lighting efficacy requirements in R404.1, there is no need for the definition. Additionally, color tunable light sources are capable of operation outside of those used for general lighting applications (e.g., red color operation). It’s appropriate to ensure tunable sources are capable of providing white light at the efficacies shown above.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There is no increase or decrease cost in construction as this proposal is primarily editorial. It moves requirements that were in the definitions to the main body of the code. And the proposal adds clarity for new lighting technology (e.g, tunable lighting) so that this technology can also comply with the efficacy thresholds.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: per proponent's reason statement

Final Hearing Results

REPI-102-21 Part I AM

REPI-102-21 Part II

Original Proposal

IRC: SECTION 202, N1104.1

Proponents: Michael Jouaneh, Lutron Electronics Co., Inc., Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

2021 International Residential Code

Revise as follows:

~~**HIGH-EFFICACY LIGHT SOURCES.** Any lamp with an efficacy of not less than 65 lumens per watt, or luminaires with an efficacy of not less than 45 lumens per watt.~~

N1104.1 Lighting equipment. All permanently installed luminaires ~~lighting fixture~~s, excluding kitchen appliance lighting equipment ~~fixtures~~, shall be capable of operation with an efficacy of not less than 45 lumens per watt or shallcontain lamps~~only high-efficacy lighting sources~~ capable of operation at 65 lumens per watt or greater.

Reason: This editorial revision corrects the terminology used to describe lightning equipment and relocates the efficacy criteria from the definition of “high-efficacy light sources” to R404.1 to improve clarity for the user and proper enforcement of the code. By including the lighting efficacy requirements in R404.1, there is no need for the definition. Additionally, color tunable light sources are capable of operation outside of those used for general lighting applications (e.g., red color operation). It’s appropriate to ensure tunable sources are capable of providing white light at the efficacies shown above.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

There is no increase or decrease cost in construction as this proposal is primarily editorial. It moves requirements that were in the definitions to the main body of the code. And the proposal adds clarity for new lighting technology (e.g, tunable lighting) so that this technology can also comply with the efficacy thresholds.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: per proponent's reason statement

Final Hearing Results

REPI-102-21 Part II AM

REPI-105-21

Original Proposal

IECC®: TABLE R404.1 (TABLE N1104.1) (New), R404.1.1, R404.1.2 (N1104.1.1) (New), R404.1.3 (N1104.1.2) (New), R404.1.4 (N1104.1.3) (New), R404.1.5 (N1104.1.4) (New)

Proponents: Vladimir Kochkin, NAHB, NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Add new text as follows:

TABLE R404.1 (TABLE N1104.1) LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

Base site allowance	400 watts
Uncovered parking areas and drives	0.4 W/ft2
Building Grounds	
Walkways and ramps less than 10 feet wide	0.50 W/linear foot
Walkways and ramps 10 feet wide or greater, plaza areas, special feature areas	0.10 W/ft2
Dining areas	0.65 W/ft2
Stairways	0.70 W/ft2
Pedestrian tunnels	0.12 W/ft2
Landscaping	0.04 W/ft2
Building Entrances and Exits	
Pedestrian and vehicular entrances and exits	14 W/linear foot of opening
Entry canopies	0.25 W/ft2

For SI: 1 watt per square foot = 10.76 w/m2, 1 foot = 304.8 mm.

Revise as follows:

R404.1.1 Exterior lighting. Connected exterior lighting for Group R-2, R-3,and R-4 residential buildings shall comply with Section s R404.1.2 through R404.1.5. ~~C405.4.~~

Exceptions:

1. Detached one- and two- family dwellings.
2. Townhouses.
3. Group R-3 buildings that do not contain more than 2 dwelling units.

4 ~~3.~~ Solar-powered lamps not connected to any electrical service.

5 ~~4.~~ Luminaires controlled by a motion sensor.

6 ~~5.~~ Lamps and luminaires that comply with Section R404.1.

Add new text as follows:

R404.1.2 (N1104.1.1) Exterior lighting power requirements. The total exterior connected lighting power shall be not greater than the exterior lighting power allowance calculated in accordance with Section R404.1.3. The total exterior connected lighting power shall be the total maximum rated wattage of all lighting that is powered through the energy service for the building.

Exception: Lighting used for the following applications shall not be included.

1. Lighting approved because of safety considerations.
2. Exit signs.
3. Specialized signal, directional and marker lighting associated with transportation.
4. Temporary lighting.
5. Lighting for water features and swimming pools.
6. Lighting controlled from within dwelling units.

R404.1.3 (N1104.1.2) Exterior Lighting Power Allowance. The total area or length of each area type multiplied by the value for the area type in Table R404.1 shall be the lighting power (watts) allowed for each area type. For area types not listed, the area type that most closely represents the proposed use of the area shall be selected. The total exterior lighting power allowance (watts) shall be the sum of the base site allowance plus the watts from each area type.

R404.1.4 (N1104.1.3) Additional exterior lighting power. Additional exterior lighting power allowance shall be available for the building facades at 0.075 W/ft2 (0.807 w/m^2) of gross above-grade wall area. This additional power allowances shall be used only for the luminaires serving the facade and shall not be used to increase any other lighting power allowance.

R404.1.5 (N1104.1.4) Gas lighting. Gas-fired lighting appliances shall not be equipped with continuously burning pilot ignition systems.

Reason: The 2021 IECC Residential Provisions include a new section for exterior lighting that points the user to the commercial energy code. This format is counter to the framework of residential energy provisions intended to serve as a standalone set of criteria. This proposal extracts the relevant provisions applicable to residential occupancies from the commercial energy provisions and places these requirements directly within the residential provisions. The additional item under exceptions is intended to cover one- and two-unit R-2 buildings that may fall outside of the scope of the IRC for unrelated reasons and will need to be designed using the IBC but effectively are the same as the buildings already exempt under the first two items.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposal copies the relevant requirements from the commercial code.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Discussion on modifying the numbers through public comment. Should consider other zones

Final Hearing Results

REPI-105-21 AS

REPI-106-21

Original Proposal

IECC®: SECTION 202 (New), R404.2, R404.2.1 (N1104.2.1) (New), R404.2.2 (N1104.2.2) (New)
Proponents: Megan Hayes, NEMA, NEMA (Megan.Hayes@nema.org)

2021 International Energy Conservation Code

Add new definition as follows:

<u>**AUTOMATIC SHUT-OFF CONTROL**</u>**.** <u>A device capable of automatically turning loads off without manual intervention. Automatic shut-off controls include devices such as, but not limited to, occupancy sensors, vacancy sensors, door switches, programmable time switches (i.e., timeclocks), or count-down timers.</u>

Revise as follows:

R404.2 (N1104.2) Interior lighting controls. <u>All</u> permanently installed <u>luminaires</u> ~~lighting fixtures~~ shall be controlled <u>as required in Sections R404.2.1 and R404.2.2.</u> ~~with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture~~.

Exception: Lighting controls shall not be required for ~~the following:~~ <u>safety or security.</u>

1. ~~Bathrooms~~.
2. ~~Hallways.~~
3. ~~Exterior lighting fixtures~~.
4. ~~Lighting designed for safety or security.~~

Add new text as follows:

<u>**R404.2.1 (N1104.2.1) Habitable spaces**</u>**.** <u>All permanently installed luminaires in habitable spaces shall be controlled with a dimmer or an automatic shut-off control that automatically turns off lights within 20 minutes after all occupants have left the space and shall incorporate a manual control to allow occupants to turn the lights on or off.</u>

<u>**R404.2.2 (N1104.2.2) Specific locations**</u>**.** <u>All permanently installed luminaires in garages, unfinished basements, laundry rooms, and utility rooms shall be controlled by an *automatic shut-off control* that automatically turns off lights within 20 minutes after all occupants have left the space and shall incorporate a manual control to allow occupants to turn the lights on or off.</u>

Reason: This proposal extensively revises R404.2 to correct terminology and to clarify application of lighting controls in residential occupancies. The revised rule adds a separate lighting control requirement for habitable spaces that includes both automatic and non-automatic control function and adds automatic occupant sensor control only to specific, non-habitable spaces of a residence where lighting tends to remain on when no occupants are using the spaces, thus reducing energy conservation. The revised language also includes provisions to ensure the occupants can manually turn the lighting on and off independently of the occupant sensor control. Approval of this proposal will more closely align R404.2 with C405.2 of the IECC and improve enforceability of the requirement.

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

The code change proposal will increase the cost of construction by removing the four exempt spaces in the current rule but will also increase the effective use and conservation of energy consumed by lighting in residential occupancies.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: this proposal improves the requirements for interior lighting control by correcting terminology and providing different control allowances in habitable spaces versus other specific locations in residential occupancies.

Final Hearing Results	
REPI-106-21	AM

REPI-108-21

Original Proposal

IECC®: R404.2

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

2021 International Energy Conservation Code

Revise as follows:

R404.2 (N1104.2) Interior lighting controls. Permanently installed lighting fixtures shall be controlled with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture.

Exception: Lighting controls shall not be required for the followinglighting fixtures:

1. Bathrooms~~s~~ lighting.
2. Hallways~~s~~ lighting.
3. ~~Exterior lighting fixtures~~.

4 3. Lighting designed for safety or security.

Reason: As currently written, the exception in 404.2 appears that exempts lighting controls for exterior lighting fixtures appears to conflict with the requirements for exterior lighting controls in 404.3.

This proposal clarifies that the control requirements of 404.2 only apply to interior lighting fixtures and removes the language about exterior lighting fixtures to prevent any confusion.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This is an editorial correction that will have no impact on the cost of construction.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Aligns language with section title.

Final Hearing Results

REPI-108-21	AM

REPI-117-21

Original Proposal

IECC®: R405.2

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

2021 International Energy Conservation Code

Revise as follows:

R405.2 (N1105.2) Performance-based compliance. Compliance based on total building performance requires that a*proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.
3. An annual energy cost that is less than or equal to the annual energy cost of the*standard reference design*. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

    ~~Exception~~ Exceptions:

    1. The energy use based on source energy expressed in Btu or Btu per square foot of*conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.
    2. The energy use based on site energy expressed in Btu or Btu per square foot of*conditioned floor area* shall be permitted to be substituted for the energy cost for an all-electric building with on-site renewable energy installed.

Reason: A new exception is needed for those buildings that are using 100% renewable energy. When a building is using 100% renewable energy, the source multiplier has the same value for the standard reference design and the proposed design.

Under the "captured energy" approach, the source multiplier for renewable electricity is 1.0. If the standard reference design uses 100 kWh, that is equal to 341,200 site Btu's and 341,200 "source" Btu's. If the proposed design uses 70 kWh, that is equal to 238,840 site Btu's and 238,840 "source" Btu's. There is no difference in the results. Even if another value, such as 1.05 were used, the difference / percentage reduction would still be the same (30%), as the ratio would be (70 * 1.05) / (100 * 1.05) = 70/100.

Under the "infinite energy" approach, the source multiplier for renewable electricity is 0.0. In this scenario, by using the "source" value, the standard reference design uses 0.0 "source" Btu's and the proposed design uses 0.0 "source" Btu's. For this situation, it is analytically necessary to use site energy as the basis of comparison.

Bibliography: ASHRAE Standard 105-2021, *Standard Methods for Determining, Expressing, and Comparing Building Energy Performance and Greenhouse Gas Emissions*, Appendix J and Appendix K, 2021, Atlanta, GA

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposed change only adds an exception for the building performance analysis and has no impact on construction costs.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: adds exceptions to allow annualized consideration for renewables.

Final Hearing Results	
REPI-117-21	AM

REPI-118-21

Original Proposal

IECC®: R405.2

Proponents: William Fay, Energy Efficient Codes Coalition; Amy Boyce, Institute for Market Transformation, Energy Efficient Codes Coalition (amy.boyce@imt.org); Amber Wood, ACEEE, Energy Efficient Codes Coalition (awood@aceee.org); Jason Reott, Alliance to Save Energy, Energy Efficient Codes Coalition

2021 International Energy Conservation Code

Revise as follows:

R405.2 (N1105.2) Performance-based compliance. Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total building thermal envelope UA, which is the sum of *U*-factor times assembly area, shall be less ~~greater~~ than or equal to the building thermal envelope UA using the prescriptive *U*-factors from Table R402.1.2 multiplied by 1.15 in accordance with Equation 4-1. ~~levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.~~ The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be: 0.30.
$$UA_{\text{Proposed design}} \leq 1.15 \times UA_{\text{Prescriptive reference design}} \quad \text{(Equation 4-1)}$$
3. An annual energy cost that is less than or equal to the annual energy cost of the *standard reference design*. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

   Exception: The energy use based on source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

Reason: The purpose of this code change proposal is to improve the mandatory thermal envelope trade-off backstop applicable to the performance compliance path. This proposal improves the efficiency and usability of the *IECC* by combining two successful concepts incorporated into the 2021 *IECC:*

- First, it adds some flexibility to the performance path backstop by changing the thermal envelope backstop from values in the 2009 *IECC* prescriptive tables to a calculation based on a percentage (115%) of the Total UA of the current code's envelope requirements. This would make the performance path backstop consistent with the ERI backstop for projects without on-site generation in Section R406.3.1. The ERI backstop, which was originally based on the 2009 *IECC* in the 2015 and 2018 editions of the *IECC*, was changed to a Total UA-based backstop in the 2021 *IECC* as a result of Proposal No. RE150-19 (as modified by the Committee). We believe that code users would benefit from both trade-off backstops working in the same way.
- Second, this proposal will improve efficiency and streamline future code development by replacing a reference to envelope requirements from an older code edition with a reference to the current code requirements. Basing the calculation on the current code helps ensure that improvements to the code baseline each cycle will be reflected in the backstop without a need for additional code change proposals in the future. This will also simplify compliance and enforcement efforts by reducing the need to refer to other code books.

An effective thermal envelope backstop is crucial to ensure that the home retains reasonable envelope performance (U-factor and SHGC) (similar to the prescriptive path) under alternative compliance paths (such as the performance path, ERI, etc.) and that the envelope is not unduly traded-off for other measures. Trading off envelope and associated occupant comfort can have direct impacts on energy usage. For example, if the occupant responds to discomfort from a "cold" or "hot" room due to an inadequate building envelope by adjusting the thermostat, the additional energy use from the adjusted thermostat can be substantial. Below is a summary of estimated energy use increases associated with adjusting a thermostat 1 degree higher or lower, broken out by climate zone.

[R6 table pix.png]

Increased Energy Use Resulting from Thermostat Adjustment									
Measure	Nat'l Avg	1	2	3	4	5	6	7	8
+1 Degree Heating	4.1%	0.5%	3.0%	4.2%	4.4%	4.7%	4.5%	4.0%	2.9%
-1 Degree Cooling	3.2%	7.8%	5.3%	3.9%	2.6%	1.8%	1.4%	0.7%	0.4%

An effective envelope trade-off backstop can help improve occupant comfort and can save significant energy and energy cost.

As the *IECC* is improved in 2024 and future cycles to meet the nation's demand for more efficient and resilient buildings and reduced greenhouse gas production, we believe that improved and streamlined trade-off backstops play a very important role. These backstops are critical consumer protections that will maintain a minimum level of building thermal envelope efficiency across all new homes, providing long-term comfort and energy savings for homeowners, and more broadly, reducing peak demand and greenhouse gas production at the state and national level.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not increase the baseline stringency of the *IECC*, and whether the proposal results in increased or decreased costs ultimately depends on compliance choices made by the code user in each case (including the choice of compliance path). The added flexibility of moving to a UA-based backstop will allow builders to use what they conclude is the optimal combination of envelope measures to meet the building thermal envelope UA under the code, which may reduce construction costs as compared with the current backstop in some cases.

COST-EFFECTIVENESS

This proposal does not increase or otherwise affect the stringency of the prescriptive code values or necessarily result in increased costs. Instead, the performance path thermal envelope backstop only places limits on choices under an alternative compliance path (which is optional), so a cost-effectiveness analysis does not apply.

The ICC Board of Directors set the 2021 *IECC* as the baseline for future *IECC* development – and by extension made the 2021 *IECC* the basis for cost-effectiveness analyses. This means for purposes of analyzing code proposals, the existing provisions of the 2021 *IECC* are considered cost-effective and reasonable, since they are the starting point for analyses of code changes and no rollbacks are permitted. It should also be noted that US DOE found the entire 2021 *IECC* cost effective, including section R406. *See* Pacific Northwest National Laboratory, *National Cost Effectiveness of the Residential Provisions of the 2021 IECC* (June 2021). Changes to trade-off backstops like this code change proposal (which utilizes U-factors and SHGCs less stringent than the prescriptive measures of the 2021 *IECC*) do not increase the stringency of that baseline or impose any additional costs to meet specific measures. In addition, if the prescriptive values are cost-effective, then the backstop values would be cost-effective. These backstops serve only as a consumer protection against excessive trade-offs, but do not require anything more than what would be required for base code compliance. Thus, a cost-effectiveness analysis would be difficult or impossible to apply and would not be informative.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: The only modification is to adjust the equals sign to a less than or equals sign to align with REPI-004-21 previously approved by the full committee.

Final Hearing Results

REPI-118-21 AM

REPI-120-21

Original Proposal

IECC®: TABLE R405.2, TABLE R406.2

Proponents: Robby Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

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

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.8.1	Basement wall insulation installation
R402.2.9.1	Slab-on-grade floor insulation installation
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.4.2	Fireplaces
R402.4.3	Fenestration air leakage
R402.4.4	Rooms containing fuel burning appliances
R402.4.5	Recessed Lighting
R402.4.6	Electrical and communication outlet boxes(air sealed boxes)
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.2	Hot Water boiler temperature reset
R403.3, ~~including R403.3.1,~~ except ~~Sections R403.3.2, R403.3.3 and~~ R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating

R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

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

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

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.8.1	Basement wall insulation installation
R402.2.9.1	Slab-on-grade floor insulation installation
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.4.2	Fireplaces
R402.4.3	Fenetration air leakage
R402.4.4	Rooms containing fuel burning appliances
R402.4.5	Recessed lighting
R402.4.6	Electrical and communication outlet boxes (air sealed boxes)
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3 except ~~Sections R403.3.2, R403.3.3 and~~ R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation

R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Reason: Performance paths R405 and R406 really are the same in terms of how the energy model compares the as built home is modeled against a reference home. One's metric of compliance is energy cost and one is an ERI score but both have to be better than.

The objective of the different compliance paths is to offer flexibility to trade off components of the building thermal envelope. Primarily R-values and U-values. Section R405 and R406 allow some greater trade off opportunities which increases flexibility in choosing building assemblies and R-values and U-values primarily.

The intent how ever is that how the IECC calls out for things to be installed is consistent throughout the compliance path options. The pre 2021 IECC prescriptive and mandatory approach did not make this clear enough so the word requirements was adopted and these tables were created to demonstrate that the requirements pertained to all compliance approach choices.

This proposal fills out the table to better ensure parity between the different compliance approaches. Eave baffles was the main example used in the 2021 code development cycle. Just because one can trade off the R-value if attic insulation does not mean that you don't have to install attic eave baffles in a ventilated attic assembly. In the same way the requirements added to the tables in this proposal all have to do with an installation requirement not an R-value or U-value that can be traded. These types of requirements need to be the same regardless of the compliance path chosen.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not increase cost but rather ensures that requirements of the IECC are equally required regardless of the compliance path option chosen.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal initially included changes to R402.2.8 in both portions. After discussion motion was as modified with removal of R402.2.8 in both portions, and correction of missing 'e' in recessed lighting for both tables.

Final Hearing Results

REPI-120-21	AM

REPI-121-21

Original Proposal

IECC®: R405.2, CHAPTER 6 [RE], ASHRAE Chapter 06 (New)

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

2021 International Energy Conservation Code

Revise as follows:

R405.2 (N1105.2) Performance-based compliance. Compliance based on total building performance requires that a*proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.
3. An annual energy cost that is less than or equal to the annual energy cost of the*standard reference design*. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration’s State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

    Exception: The energy use based on source energy expressed in Btu or Btu per square foot of*conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multipliers for ~~electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1~~ all energy sources shall be obtained from ASHRAE Standard 105 (Tables K2, K4, or K8) or from another data source *approved* by the *code official*.

CHAPTER 6 [RE]
REFERENCED STANDARDS

Add new standard(s) as follows:

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

ASHRAE - 2021	ASHRAE 105 - 2021 Standard Methods for Determining, Expressing, and Comparing Building Energy Performance and Greenhouse Gas Emissions

Reason: The current values in the code are not correct, as they have not been updated and do not account for regional or international differences and different key inputs. ASHRAE has updated these estimates on a regular basis, with explanations of how the estimates were derived. This proposal provides the locations of the updated estimates without reprinting the large tables into the IECC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This only affects estimates of source energy used for total building performance analysis, and does not have any impact on construction costs.

Staff Note: Proponent unable to provide required copies prior to printing of monograph.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proposal initially offered 2 reference points for source energy factors: IGCC and ASHRAE, after discussion motion was as modified with IGCC reference stricken

Final Hearing Results	
REPI-121-21	AM

REPI-124-21

Original Proposal

IECC®: TABLE R405.4.2(1)

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

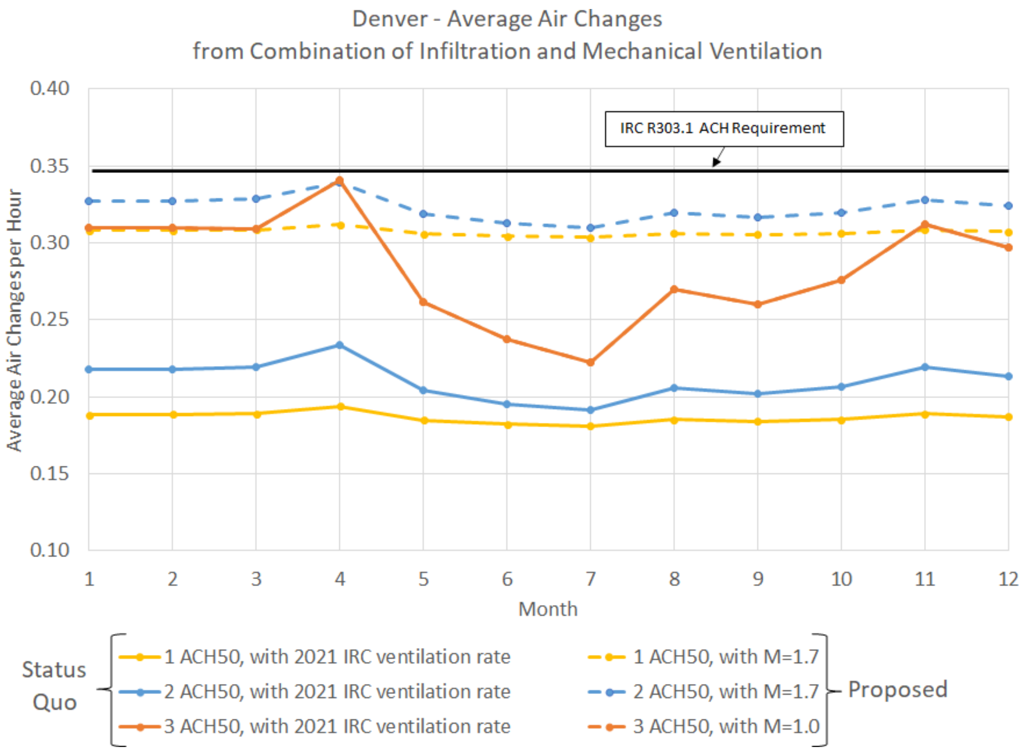
Revise as follows:

TABLE R405.4.2(1) (TABLE N1105.4.2(1)) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN	
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 5.0 air changes per hour. Climate Zones 3 through 8: 3.0 air changes per hour.	The measured air exchange rate.[a]	
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M0.01 × *CFA* + 7.5 × (N_{br} + 1) where: B = 0.01 × *CFA* + 7.5 × (N_{br} + 1), cfm. *M = 1.0 where the measured air exchange rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B)* *Q = the proposed mechanical ventilation rate, cfm.* *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Energy recovery shall not be assumed for mechanical ventilation.	The mechanical ventilation rate[b], Q, shall be in addition to the air leakage rate and shall be as proposed.	
Mechanical ventilation	Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (1/e_f) × [0.0876 × *CFA* + 65.7 × (N_{br}+1)] (8.76 × B × M)/e_f where: B and M are determined in accordance with the Air Exchange Rate row of this table. e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate ofB × M(0.01 × *CFA* + 7.5 × (N_{br}+1)). *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed	

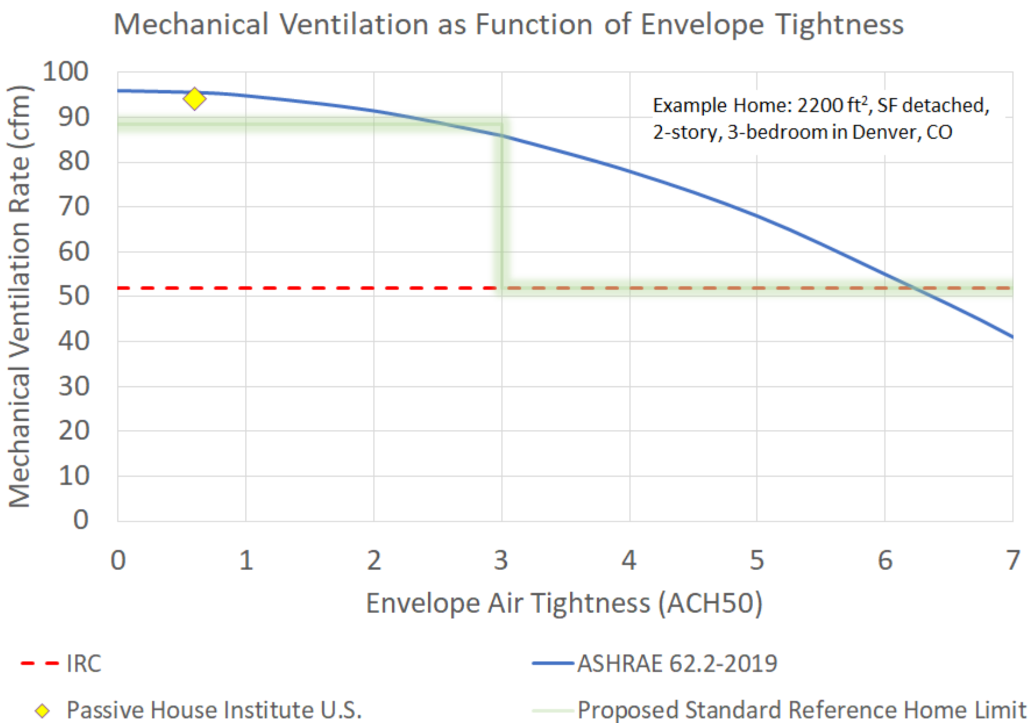
Reason: Within very tight homes, this proposal would permit builders and homeowners to increase mechanical ventilation rates to a more reasonable level without imposing an IECC performance path penalty. The IECC incentivizes builders to build as tightly as possible, which is good. However, the IECC penalizes builders for providing mechanical ventilation at rates that are minimally compliant with consensus standards (ASHRAE 62.2-2019), minimally compliant with IRC R303.1, and that are above the minimum required by IRC M1505.4.3; this is bad. Because the IRC M1505.4.3 mechanical ventilation rate is not calculated as a function of the building envelope air tightness, the combination of the IECC and IRC requirements encourages builders to build homes with air changes that can be ~50% lower than the 0.35 air changes per hour (ACH) that has traditionally been the target for minimum acceptable indoor air quality (see IRC Section R303.1).

The following graph shows monthly average air changes rates (i.e., total air changes resulting from mechanical ventilation combined with infiltration from building envelope leakage) in Denver, CO for a typical 2200 ft^2 single-family dwelling unit, calculated using the ASHRAE Handbook of Fundamentals.[1] The solid lines show the monthly average air changes resulting from a builder tightening a home without increasing the minimum IRC M1505.4.3 mechanical ventilation rate. At 3.0 ACH50, the home is expected to have an annual average air change rate of 0.28 ACH, which is 20% lower than the 0.35 ACH target. However, if the same home is tightened to 1.0 ACH50 without increasing the mechanical ventilation rate, the annual average air change rate decreases to 0.18 ACH, which is almost 50% lower than the 0.35 ACH target! To incentivize builders to build tight without penalizing them for providing reasonable number of air changes, the performance path's standard reference mechanical ventilation rate should permit higher ventilation rates for very tight construction (i.e., < 3.0 ACH50). In the example chart below, the dashed lines show the maximum air change rate (combined infiltration and mechanical ventilation rate) for the standard reference home that would be permitted by this proposal. These rates are still lower than the traditional 0.35 ACH target and strike a more reasonable balance between health and energy concerns than Table R405.4.2(1)'s current language.



Why did the ASHRAE Ventilation Rates and IRC Ventilation Rates Diverge?

The IRC M1505.4.3 ventilation rate was developed based on the ASHRAE 62.2-2010 ventilation rate equation, which was built around the assumption of the ventilation system being installed in a fairly leaky building that was typical practice at the time (i.e., ~6 - 7 ACH50). In 2012, the IECC required building air sealing to be verified by a blower door test for the first time. In 2013, ASHRAE 62.2 responded to the IECC building air sealing requirements by changing the ventilation rate equation to be a function of the building envelope air tightness level. This change by ASHRAE was intended to provide an occupant with the same amount of fresh air (on an annual basis), regardless of how tightly the occupant's home is constructed. Unfortunately, the IRC M1505.4.3 ventilation rates have not kept pace with improvements in building air sealing. The chart below illustrates how ASHRAE 62.2-2019 rates change as a function of envelope air tightness, which results in comparable fresh air regardless of building tightness. This proposal would permit tight homes (i.e., those with an air tightness below 3 ACH50) to step up their mechanical ventilation rate to a rate comparable to the ASHRAE 62.2-2019 and the IRC R303.1 minimum ventilation rate without penalty.



Why is it Important to have the OPTION to Specify Higher, Reasonable Ventilation Rates without Penalty?

The total ventilation rates promulgated by ASHRAE 62.2-2019 and IRC R303.1 have long been referenced as rates needed to provide minimum acceptable indoor air quality. It is expected that occupants seeking improved IAQ may elect to use these rates that are higher than the IRC M1505.4.3 minimum to reduce pollutant concentration and support better productivity and health outcomes, which have also been linked to increases in wages. Studies that have shown better health outcomes or improved performance for building occupants as a function of higher ventilation rates include:

- Sundell[2]: Sick building syndrome declines as ventilation rate increases.
- Milton[3]: Sick leave decreases as ventilation rate increases.
- Bornehag[4]: Risk of asthma for children increases with decreasing ventilation rate in homes.
- Seppänen[5] : Productivity decreases with decreasing ventilation rate.
- Tejsen[6]: Productivity increases with increasing residential ventilation rate.

While some of these studies were conducted in commercial buildings, LBNL's[7] analysis of residential studies concluded that, "Just over half of (residential) studies report one or more statistically significant health benefits of increased ventilation rates." LBNL noted that, "The findings of research on how ventilation rates in homes affect health are mixed," but that "overall… the number of reported statistically significant improvements in health with increased ventilation rates far exceeded the anticipated chance improvements in health."

Additional Q&A

Q1: What happens if the proposed building envelope is 3 ACH50 or greater?

A1: There is no change to current requirements.

Q2: What happens if the builder doesn't increase the proposed design mechanical ventilation rate beyond the IRC Section M1505.4.3 minimum?

A2: In this case, Q/B = 1, M = 1 (i.e., minimum(1.7, Q/B) = 1), BxM = B, and there is no change to the current requirements.

Q3: What if the builder triples the proposed design mechanical ventilation rate beyond the IRC Section M1505.4.3 minimum?

A3: In this case, Q/B = 3, M = 1.7 (i.e., minimum(1.7, Q/B), and BxM = 1.7B, meaning the mechanical ventilation rate of the standard reference home increases to 1.7 times the IRC Section M1505.4.3 minimum. The builder would be penalized for the energy use associated with the difference between the proposed design mechanical ventilation rate of 3B and the standard reference home's ventilation rate of 1.7B.

Bibliography:

1. ASHRAE Handbook of Fundamentals. 2017. Chapter 17 Enhanced Model.
2. Sundell et al. 1994. Sick Building Syndrome (SBS) in Office Workers and Facial Skin Symptoms among VDT-Workers in Relation to Building and Room Characteristics: Two Case-Referent Studies. Indoor Air, 4: 83-94.
3. Milton et al. 2000. Risk of Sick Leave Associated with Outdoor Air Supply Rate, Humidification, and Occupant Complaints. Indoor Air, 10:212-221.
4. Bornehag, C & Sundell, Jan & Hägerhed, Linda. (2003). Asthma and allergy among children and the association to ventilation rate at home, a case control study. Epidemiology. 14. 10.1097/00001648-200309001-00224.
5. Seppänen, O. A., and W. Fisk. 2006. Some quantitative relations between indoor environmental quality and work performance or health. HVAC&R Research 12 (4):957-73. doi:10.1080/10789669.2006.10391446.
6. Tejsen et al. 2016. The effects of bedroom air quality on sleep and next-day performance. Indoor Air, 26:679-686.
7. LBNL. Indoor Air Quality Scientific Findings Resource Bank. Building Ventilation. Accessed May 6, 2021. https://iaqscience.lbl.gov/ventsummary#:~:text=Just%20over%20half%20of%20studies,improve%20with%20increased%20ventilation

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

In some cases, this proposal could increase the estimated savings associated with mechanical ventilation systems in very tight construction. This could help to reduce construction costs.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: this proposal would permit builders and homeowners to increase mechanical ventilation rates to a more reasonable level without imposing an IECC performance path penalty.

Final Hearing Results

REPI-124-21	AS

REPI-126-21

Original Proposal

IECC®: R406.2, R406.3, R406.3.1, R406.3.2, R406.4, R406.5, TABLE R406.5
Proponents: Robby Schwarz, BUILDTank, Inc., BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

R406.2 (N1106.2) ERI compliance. Compliance based on the Energy Rating Index (ERI) requires that the rated design meets all of the following:

1. The requirements of the sections indicated within Table R406.2.
2. Maximum ERI values indicated in ~~of~~ Table R406.5.

~~**R406.3 Building thermal envelope.**~~ ~~Building and portions thereof shall comply with Section R406.3.1 or R406.3.2~~.

R406.3~~.1 On-site renewables are not included~~ Building thermal envelope. ~~Where on-site renewable energy is not included for compliance using the ERI analysis of Section R406.4, t~~The proposed total building thermal envelope UA, which is sum of *U*-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive *U*-factors from Table R402.1.2 multiplied by 1.15 in accordance with Equation 4-1. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

$UA_{\text{Proposed design}} \leq 1.15 \times UA_{\text{Prescriptive reference design}}$ **(Equation 4-1)**

~~**R406.3.2 On-site renewables are included.**~~ ~~Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the *building thermal envelope* shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2018 *International Energy Conservation Code*~~.

R406.4 Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with ANSI/RESNET/ICC 301. ~~except for buildings covered by the *International Residential Code* , the ERI reference design ventilation rate shall be in accordance with Equation 4-2~~.
~~Ventilation rate, CFM = (0.01 x total square foot area of house) + [7.5 x (number of bedrooms + 1)]~~ ~~**(Equation 4-2)**~~

Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the building site shall not be included in the *ERI reference design* or the *rated design*. ~~For compliance purposes, any reduction in energy use of the rated design associated with on-site renewable energy shall not exceed 5 percent of the total energy use.~~

R406.5 ERI-based compliance. Compliance based on an ERI analysis requires that the *rated proposed design* and confirmed built dwelling be shown to have an ERI less than or equal to the appropriate value indicated in Table R406.5 when compared to the *ERI reference design,* as follows:~~.~~

1. Where on-site renewables are not installed, the maximum ENERGY RATING INDEX NOT INCLUDING OPP applies.
2. Where on-site renewables are installed, the maximum ENERGY RATING INDEX INCLUDING OPP applies.

    Exception: Where the ERI analysis excludes OPP, the maximum ENERGY RATING INDEX NOT INCLUDING OPP shall be permitted.

TABLE R406.5 MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP	ENERGY RATING INDEX INCLUDING OPP
0-1	5251	40
2	5251	40
3	5150	40
4	5453	40
5	5554	40
6	5453	40
7	5352	40
8	5352	40

Reason: The current ERI compliance alternative is overly complicated due to a lack of understanding of the energy modeling that produces an ERI index score. Because of this the Code ERI score is significantly different than other ERI system generated score which creates a lack of confidence in the compliance path, energy modeling in general, and ERI scores specifically.

Let's being with backstops. This proposal requires an ERI compliance score without onsite renewables/ onsite power production (OPP) and with OPP. It should be noted that ERI scores can only account for renewable energy that is generated on side. Offsite utility solar or wind energy, community solar gardens, and the like cannot be incorporated into the generation of an ERI score at this time.

Backstops in the current ERI compliance path complicate use of an ERI score, making the ERI compliance path the most restrictive path that is far from equal to the energy performance achieved by the other available compliance options. The objective of the current incorporated backstops is to ensure that one cannot build a poorly performing thermal envelope and then install either good mechanical systems or OPP to drive the ERI score down to a specific compliant level. This is a valid concern but one that can be handled in a much simpler way.

This proposal uses an energy modeled ERI score without OPP installed to be the backstop that protects the quality of the installed R-values and U-values of the building thermal envelope. In addition, it uses the requirement table to ensure installation of energy components in the home follow the IECC. Additions have been added to the requirement table ensuring parity of requirements across compliance paths.

An ERI score set in the 50's and calculated before OPP is installed requires that the builder install R-values and U-values in the envelope that are better than the current 2021 IECC requirements. In fact, the modeling shows that the builder is also required to install mechanical equipment that is better than federal minimums to obtain an ERI score without OPP to meet the ERI score requirements of the past and of this proposal. Therefore, it makes sense to simplify the compliance path, allow for flexibility in developing energy specifications for the house, while at the same time ensuring that the building thermal envelope cannot be less efficient than that required by the prescriptive compliance options. This is all done by setting an ERI compliance score in the 50's before OPP is installed on the home.

This proposal also requires that a score be developed with OPP. Currently the score has been set to be the same as the score without OPP meaning that the code is not mandating that renewables be installed on the home. However, a simple amendment by a progressive jurisdiction could change the two required scores to achieve climate action or other community goals they may have. For example, if the ERI score was set at 40 without OPP it would be at a about the tipping point where you can't get lower after maximizing the thermal envelope and mechanical system performance and before renewables would have to be added. So, a jurisdiction could also amend the ERI score with OPP to be zero and mandate zero energy homes. This mandate, however, allows the builder to determine what works best for them for how to achieve the ERI score of 40 without OPP.

As the Building thermal envelope is protected in this proposal by having an ERI score before OPP requirement, I am proposing that the ERI score remain the same per climate zone because they are all in the 50's. There is not a requirement to install OPP but a requirement if it is installed that the score with OPP be equal to or better than the score requirement without OPP.

Next Ventilation: The ventilation debate has been politicized in the current R406 ERI compliance option. I am not here to say that a few more or less cubic feet of air to ventilate a house is good or bad. All I know is that the primary reason for the diversion of the IECC ERI score and the true ANSI/RESNET/ICC standard 301 ERI score is the amended ventilation rate that has been implemented in the IECC adoption of the ERI compliance path. Although the average difference in ERI score is around 10 points, I have seen them differ by as much as 16. This divergence impacts not only the credibility of the ERI compliance process but of Energy Modeling as well. Since the IECC has accepted the ANSI/RESNET/ICC 301 standard as the standard by which to develop an ERI score I propose that the standard be used rather than be significantly amended. The biggest issue we need to keep at the forefront is that all IECC compliant homes are built tight to a specific IECC requirement and are ventilated. This proposal does not change that. All homes will be mechanically ventilated. The upside is more use of a compliance path.

Continuous maintenance standards vs. IECC code development. I know that it is not the norm, but this proposal seeks to use the most recent version of the ANSI/RESNET/ICC 301 standard starting with the 2024 IECC and moving forward. The reason is that the ANSI standards are under continual maintenance and significant changes for the better are made and adopted on a regular basis. The ANSI standards are phased in with compliance dates set based on the permit date of the house, usually six months into the future. So, for example, if an updated version of ANSI 301 is release on January 1st, 2022, the implementation date for that standard would be for houses permitted on June 1st, 2022. This gives time for energy modelers and builders to coordinate any changes in construction practices that may be needed to maintain compliance while allowing homes that permitted prior to June 1st, 2022, to complete using the standard that was in place at the time of the original building permit.

This change will make the ERI compliance path dynamic based on the effective dates of the ANSI 301 standard which will also allows all ERI scores based on the ANSI 301 standard to progress in unison rather than continually being out of sync. As the public, builders, jurisdictions, and the ICC do not truly understand all these nuances and do not realize that currently Section R406 ERI is a snapshot in time where the sole audience should be local code officials only, this break from the norm makes sense in this case.

As an example of this issue is put forth in a RESNET paper that states, “homes with permits in the fall of 2020 and seeking a HERS Rating will be using ANSI/RESNET/ICC Standard 301-2019. If their state has adopted 2018 IECC, their code-compliance ERI will still be based on the much older 2014 version of Standard 301 with Addendum A and B. The result is different index scores, since the older version of Standard 301 with only Addendum A and B was before amendments like the Index Adjustment Factor or the allowance of credit for LED lighting.” Link provided in Bibliography

Bibliography: https://www.resnet.us/articles/the-iecc-energy-rating-index-and-hers-index-whats-the-difference/

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal does not change cost implications of using the ERI compliance option. Because the ERI score without OPP have not changed the path is still not as flexible as other compliance options. However, it is easier to use and is more likely to be used without significant amendments.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Proponent modified proposal based on prior meeting input. Changes allow for modest solar trade-off while maintaining envelope UA backstop, and modest change to reduce ERI values

Final Hearing Results

REPI-126-21 AM

REPI-131-21

Original Proposal

IECC®: R406.4

Proponents: Vladimir Kochkin, NAHB, NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Revise as follows:

R406.4 (N1106.4) Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with RESNET/ICC 301. ~~except for buildings covered by the *International Residential Code* , the ERI reference design ventilation rate shall be in accordance with Equation 4-2.~~

~~Ventilation rate, CFM = (0.01 × total square foot area of house) + [7.5 × (number of bedrooms + 1)]~~ **~~(Equation 4-2)~~**

The mechanical ventilation rates used for the purpose of determining the ERI shall not be construed to establish minimum ventilation requirements for compliance with this code.Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the building site shall not be included in the *ERI reference design* or the *rated design*. For compliance purposes, any reduction in energy use of the rated design associated with on-site renewable energy shall not exceed 5 percent of the total energy use.

Reason: The purpose of this proposal is to fix an inadvertent error that was introduced in the 2018 IECC during an effort to coordinate the ERI calculation procedure with the residential ventilation rates. The change in 2018 IECC resulted in a significant increase in the ERI scores. That was never the intent of the change as was confirmed by the original proponent, and it was the result of using terms that were not fully coordinated with the specific terms in Standard 301. Proposals and public comments attempted to fix this issue in 2021 IECC, but in the end none of them were approved. The proposed amendment resolves the issues in accordance with the original intent by requiring the calculation of air exchange rate in Standard 301 be aligned with IECC Table R405.4.2(1) used in the performance path calculations. This amendment will coordinate the ERI procedure with the residential mechanical code provisions on this subject. The proposed amendment also makes it clear that IECC buildings rated using the ERI are not required to meet the Standard 301 air exchange and ventilation rates -- this is added because Standard 301 uses the terms "**required** dwelling unit total exchange rate" and "total**required** ventilation rate." It's noted that the coordination between Standard 301 and this code should be done such that there is a single ERI index for buildings complying with the IECC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal fixes an error. There is no impact on construction practices. The change will allow designers to calculate correct ERI scores.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: This proposal better aligns the R406 ERI path with the ICC/RESNET standard 301 and HERS ratings

Final Hearing Results

REPI-131-21	AM

REPI-136-21

Original Proposal

IECC®: R408.2, R408.2.2

Proponents: Ryohei Hinokuma, Daikin U.S. Corporation, Daikin U.S. Corporation (ryohei.hinokuma@daikinus.com)

2021 International Energy Conservation Code

Revise as follows:

R408.2 (N1108.2) Additional efficiency package options. Buildings meeting the requirements ~~Additional efficiency package options~~ for compliance with Section R401.2.1 are set forth in Sections R408.2.1 through R408.2.5.

R408.2.2 (N1108.2.2) More efficient HVAC equipment performance option. Heating and cooling *equipment* shall meet one of the following efficiencies: Centrally Ducted Systems

1. Greater than or equal to 95 AFUE natural gas furnace and ~~16 SEER~~ 15.2 SEER2 in Climate Zones 5, 6, and 7 and 16.0 SEER2 in the other Climate Zones for air conditioner.
2. Greater than or equal to 95 AFUE natural gas furnace and 8.5 HSPF2/16.0 SEER2 air source heat pump.

~~2.~~ 3. Greater than or equal to ~~10 HSPF/16 SEER~~ 8.5 HSPF2/16.0 SEER2 air source heat pump.

~~3.~~ 4. Greater than or equal to 3.5 COP ground source heat pump.

Ductless Systems

1. Single Zone: 8.5 HSPF2/16.9 SEER2 variable speed air source heat pump
2. Multi Zone: 8.5 HSPF2/16.9 SEER2 variable speed air source heat pump (Non-Ducted Indoor Units)
3. Multi Zone: 8.5 HSPF2/15.2 SEER2 variable speed air source heat pump (Ducted or Mixed Indoor Units)

For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the cooling design load. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the heating design load.

Reason: The 2021 IECC has implemented a new section, R408 Additional Efficiency Package Options, which defines requirements to achieve additional energy efficiency to be selected from one of the following five options: 1. Enhanced envelope performance option., 2. More efficient HVAC equipment performance option., 3. Reduced energy use in servicing water-heating option., 4. More efficient duct thermal distribution system option., and 5. Improved air sealing and efficient ventilation system option. Daikin requests that the 2024 version of IECC retains the section to continue effectively driving builders and users to optimize the energy performance of their homes.

As mentioned in our Introduction (see attached letter), variable speed heat pumps provide superior energy performance over single and two-stage equipment due to their higher efficiency attained during partial load operation. Also, ductless systems with variable speed compressors provide~~s~~ homeowners opportunities to further save energy consumption by turning off individual indoor units in unoccupied zones. For the 2024 IECC, Daikin proposes changes to R408.2 and R408.2.2 to accurately capture the energy performance superiority of variable speed air source heat pumps in both centrally ducted and ductless systems.

The metrics of HSPF and SEER are being updated to the new metrics of HSPF2 and SEER2 that will be in effect when the 2024 IECC is adopted by jurisdictions (see 10 CFR 430.32).

DAIKIN

DA/KIN U..S, CORPORATION
6☐1 13THSTREET NW, SUITE 200 SOUTH
WASHIflG'fOfl, OC 20005
PI-IONE: (201) 383--8740

October 12, 2021

The International Code Council
500 **New** Jersey Ave NW 6th floor
Washington, DC 20001
Re: 2024 International Energy Conservation Code 11ECCJ Code Change Proposal

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Daikin U.S. Corporation I"Daiikin") hereby submits the followil'lg code change proposal in response to the development process of 2024 lInternational Ene:rgy Conservation Code (IECC). Daikin U.S. Corporation i.s a subsidiary of Daikin Industries, Ltd., tlile world's largest air conditioning equipment manufacturer. The Daikin Group includes Daikin Applied, Daikin North America LLC, and Goodman Manufacturing Company, L.P.

I. <u>Introduction</u>

Buildings account for 40 percent of all US energy consumption and 24 percent of its greenhou,se gas (GHG) emissiions[1]. Out of those, 22 percent of the comumption and 12 percent of the emissions come from residential buildings[1]. Under the Biden Administration, the United State5 targets to reduce its GHG emission by 50-52 percent by 2030. To achieve the decarbonization go.al, energy efficiency as well as building electrification will need to play a critical role.

Replacement of lower efficiency or carbon intensive HV/'\C equipment with heat pumps are an effecti11e solution to drive energy efficiency and building electrification and thus building decarbonization. Within heat pumps, variable speed heat pump5 have demonstrated 511perior energy performance over single and two-stage equipment. For instance, the Uniited States Environmental! Protection Agency (U.S. EPA] notes that variable speed equipment alild modulating systems specifically pro11ide additional customer comfort advantages by following load, provide

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[1] Use ofenerg;J in.explained- U..S. Energy Informatiion Administrrcition https:/wwwei:a e:gv/eneCSYS>."Qlaineril1.t5e-of-enewy'

' Fast Faas on Transportation Gr€€nhoccse Gas Emissions I US EPA. Jmps:(I- •r•-Bov(greenvehicl€s/f3 -f:ag§-tr-anr-e-wtion-sreenhrn se-s.aii:emi@i2ns capacitie,s (i.e., lessthan 100% capaci'ly). When operating at part-load, it can be significantly more efficient. As shown in Figure 1, variable speed equipment's efficiency increases s.ignificantly as its load reduces below 100%. This.exceeds the performance olf both single and two-stage equipment as. load reduces. According to computer simulations, validated by the Electric Power Research Institute [EPRI), when variable speed HVAC equipment reducesits.cooling capacity by 25% it results in a 4-3% reduction in power consumption while for single-speed equipment it would yield only a 25% reduction in power consumption[4]. However, according to National Resource Delfense Council (NRDC), "currentte.s.t procedures do not adequately capture the impact of a variable [speed] unit's control logic, which can have a large impact on efficiency ." Lastly, Daikin would like to point out that ductless systems can !further improve energy performance of HVAC systems by allowing homeowners to turn off indoor units.in unoccupied zones.

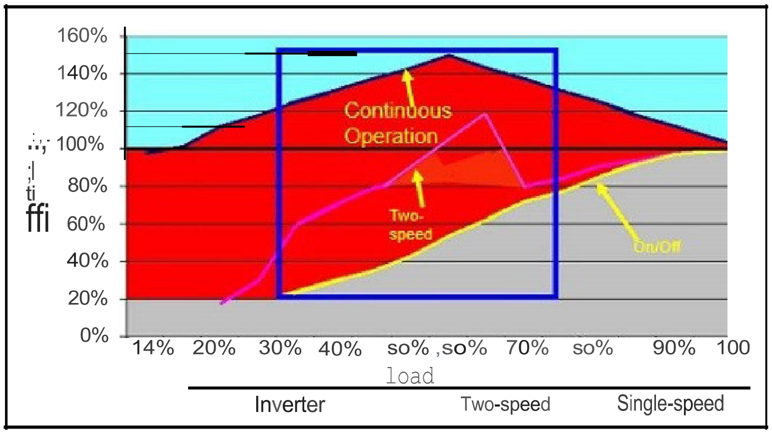

Figure 1; HVACEquipment Efficiency at Various Part-Loads

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8 U.S. EPA, ENERGY STARResidential **Air** Source Heat Pump and Central Air Conditioning Equipment Version 6.0 Discussion Guide dated August 3, 201S, https:1/IYIYl'laenergystar.gov/sites/default/files/

4 HRAl and AHRI, Letter to U.S. EPA Regarding ENERGY STARResidential Air Source Heat Pump and Central Air Conditioning Equipment Version 6.0 Discussion Guide dated September 21, 2018. https://'.vww.energystar.gov/sites/defaultfliles/AHRI_HRAI_Comments_CAC_ASHP_Discussion%20Guide_0.9%-2021%20201S.pdf

5 NRDC. NRDC Comments on ENERGY STAR Progr m Requirements for **Air** Source Heat Pump **end** Central Air Conditioner Equipment Version 6a0, **Draft** 1 dated May 23, 2019, htt ps://w.::w.energysta r. gov/sites/defa ult/files/NRDC%20Comments%20on%20CACAstI_P%20Draft%201%20V6.0_odf

However, heat pumps c,urrently account for only 12 percent of the space heating installl base in the United States, whilst a significant portion of space heating installed consists of combustion equipment such as furnac@s and boilers (76 p@rcent of tota1)5.To significa,ntly boost th@ proportiOli of heat pumps, @speciallly variabl@ sp@ed heat pumps including the ones in ductless configuration, eff@ctiv@and aggressive market transformation will be r@quir@d. Daikin believes that building codes should play a critical role in accelerating the adoption oi such technologies in the United States.

Hereby, to exec,ute the forementioned market transformation, Daikiin would like to make the following code change proposalls for the development proces,s,o,f 2024 IECC:

II. <u>Code Change P,roposal to R403.I.2 Heat Purnp Supplementary Heat</u>

The use of electric r@sistance heat@r.s as backup heating d@vic@s can significantly incr@ase winter energy ronsumptiion; and air source heat pumps can eff;:activ@ly provide heating without such devices including the cold climate regions in the United States. Also, O,aikin has observed t:hat it's common for heat pumps to be installed with electric resistance heaters configured to operate in conditions where suffident heat,ing capacity is available from the heat pump alone. This results in reducing the operation hours of heat pumps and increasing theoperation hours of electric heaters. Such setting of heat pump systems will fail to yield expected reduction of GHG emissions and result in higher@n@rgy consumption and longer p@ak demand events. Th@,efore, Daikin proposes to revise R403.1.2, which d@fines the use of electric r@sistanc@ h@at@rs a,s supplementary heat for heat pumps, to prev@nt such practice as following:

> R403.1.2 Heat pump supplementary heat <u>{Mandatory).</u>
> Heat pumps having suppilementary @lectric-resistance heat sha,11 have controls that, <u>e110eflt d1.1riAg defi:o.t,</u> prev@nt supplemental heat op@,ation wh@n th@ <u>capacity of the</u> heat pump <u>s1:1rar.iFess.ir</u> can meet the heating load'. <u>The controls shall permit supplemental heat operation only during heat pump capacity shortage, defrost operation, or for emergency use when heat pump is not operational. To ensure the use</u>

' Statistics Offic<l

<u>of electric-resistance heat for supplementary use only, the space heating design ambient temperature shall be used to switch operation from heat pumps to the resistance heat.</u>

III. Code Change Proposal to R408.2 Additional Efficiency Package Options

The 2021 IECC has implemented a new section, R408 Additional Efficiency Package Options, which defines requirements to achieve additional energy efficiency to be selected from one of the following five options: 1. Enhanced envelope performance option., 2. More efficient HVAC equipment performance option., 3. Reduced energy use in servicing water-heating option., 4. More efficient duct thermal distribution system option., and S. Improved air sealing and e·fficient ventilation system option. Daikin requests that the 2024 version of IECC retains the section 1o continue e·ffectively driving builders and users to optimize the energy performance of their homes.

As mentioned in our Introduction, variable speed heat pumps provide superior energy performance over single and two-stage equipment due to their higher efficiency attained during partial load operation. Also, ductless systems with variable speed compressors provide homeowners opportunities to 'further save energy consumption by turning off individual indoor units in unoccupied zones. For the 2024 IECC, Daikin proposes the·followingchangesto R408.2 to accurately capture the energy performance superiority of variable speed air source heat pumps in both centrally ducted and ductless systems.

DAIKIN U.S. CORPORATION
601 13TH STREET NW, SUITE 200 SOUTH
WASHINGTON, DC 20005
PHONE: (202) 383-8740

R408.2 Additional efficiency package options.

Buildings meeting the requirements Additional efficiency package options for compliance with Section 401.2.1 are set forth in Sections R408.2.1 through R408.2.

R408.2.2 More efficient HVAC equipment performance option.

Heating and cooling equipment shall meet one of the following efficiencies:

Centrally Ducted Systems

1. Greater than or equal to 95 AFUE natural gas furnace and ~~16 SEER~~ 16.9 SEER2[7] air conditioners.
2. Greater than or equal to 95 AFUE natural gas furnace and 8.5 HSPF2/16.9 SEER2 air source heat pump.
3. ~~2.~~ 3. Greater than or equal to ~~10 HSPF/16 SEER~~ 8.5 HSPF2[8]/16.9 SEER2 air source heat pump.
4. ~~3.~~ 4. Greater than or equal to 3.5 COP ground source heat pump.

Ductless Systems

1. Single Zone: 8.5 HSPF2/16.9 SEER2 variable speed air source heat pump.
2. Multi Zone: 8.5 HSPF2/16.9 SEER2 variable speed air source heat pump (Non-Ducted Indoor Units).
3. Multi Zone: 8.5 HSPF2/15.2 SEER2 variable speed air source heat pump (Ducted or Mixed Indoor Units)

For multiple cooling system, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the cooling design load. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the heating design load.

[7] SEER2 per 10CFR 430.32 (effective 1/1/2023)

[8] HSPF2 per 10CFR 430.32 (effective 1/1/2023)

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

This proposal may increase the cost of construction when utilizing variable speed air source heat pumps, but it will result in energy savings and lower utility costs for the end-user.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: proponent worked with industry to provide a proposal that is clear and provides cost benefit.

Final Hearing Results

REPI-136-21 AM

REPI-140-21

Original Proposal

IECC®: R408.2.5

Proponents: Mike Moore, Stator LLC, Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

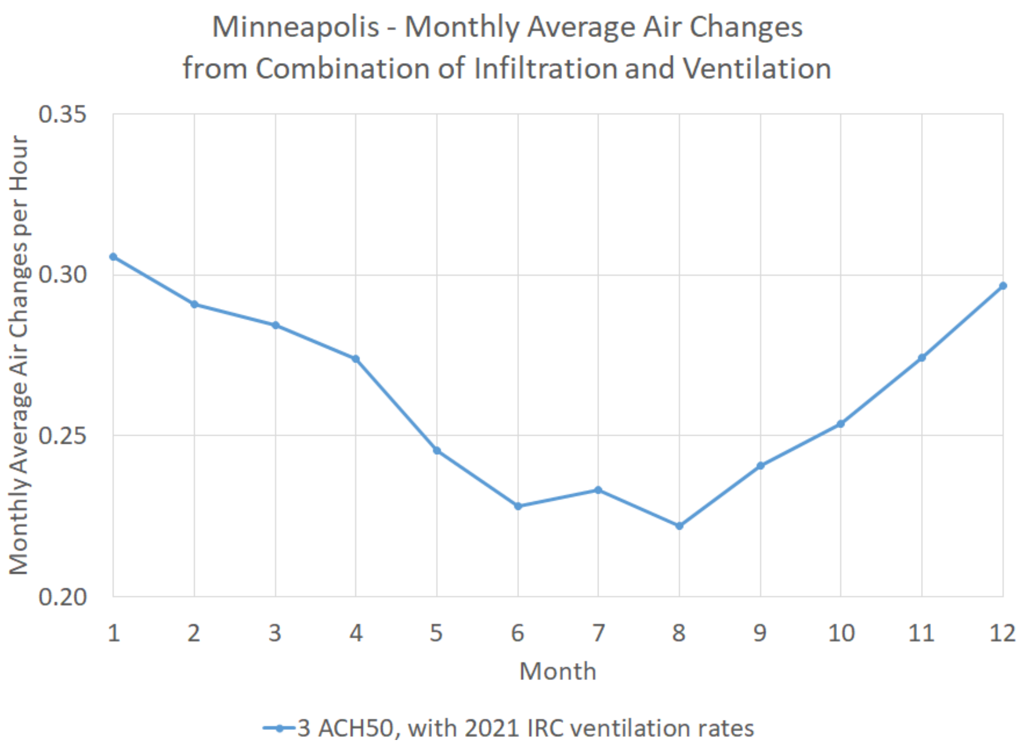
R408.2.5 (N1108.2.5) Improved air sealing and efficient ventilation system option. The measured air leakage rate shall be less than or equal to 3.0 ACH50, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed. ~~Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent~~ HRV and ERV Sensible Recovery Efficiency (SRE)~~,~~ shall be no less than 75 percent at 32°F (0°C), at the lowest listed net airflow~~less than or equal to 1.1 cubic feet per minute per watt (0.03 m^3/min/watt) and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent~~ ERV Latent Recovery/Moisture Transfer (LRMT) shall be no less than 50 percent, at the lowest listed net airflow. In Climate Zone 8, recirculation shall not be used as a defrost strategy.

Reason: This proposal removes a conflict between the H/ERV fan efficacy of this section and that of Table R403.6.2 (removing the requirement here to ensure that the higher fan efficacy of R403.6.2 takes precedent), clarifies that performance values should be *listed* values (and for SRE, uses the same reference temperature as is required in Section R403.6.1), permits recirculation defrost to be used in all climate zones but Climate Zone 8, and improves readability of the section.

Recirculation defrost draws a fraction of the electrical load of an H/ERV that uses electric resistance defrost, which is a strategy that designers may specify to meet the current Section R408.2.5 requirements. In fact, electric resistance defrost can draw over 900 Watts in a typical unit. A common criticism of recirculation defrost is that it reduces air exchange when installed in cold climates that require frequent operation of the defrost cycle – leaving occupants without access to fresh air. However, by overlaying a typical recirculation defrost control strategy on a TMY3 weather data for each climate zone, we can see that recirculation defrost cycles are very limited on an annual basis, even in cold climates:

Climate Zone	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Annual Recirc Defrost Run Time (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	3%	2%	4%	7%

In all but climate zone 8, a typical reduction in annual run time is less than 5%. Also, that reduction happens during the coldest time of the year, when infiltration of outdoor air through leaks within the building envelope is at its peak and is offsetting the reduction in mechanical ventilation (see the chart below for an illustration of total ventilation rates for a typical code compliant home). For these reasons, permitting recirculation defrost in all but climate zone 8 strikes a good balance between IAQ and energy demand.



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

The proposal can help reduce costs by providing additional, energy efficient compliance options.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: proposal removes a conflict between the H/ERV fan efficacy of this section and Table R403.6.2.

Final Hearing Results

REPI-140-21 AM

REPI-142-21

Original Proposal

IECC®: 408.2.6 (New)

Proponents: Dan Wildenhaus, Northwest Energy Efficiency Alliance (dwildenhaus@trccompanies.com); Kevin Rose, Northwest Energy Efficiency Alliance (NEEA), Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new text as follows:

408.2.6 Compact hot water distribution. For Compact Hot Water Distribution system credit, the volume shall store not more than 16 ounces (473 mL) of water between the nearest source of heated water and the termination of the fixture supply pipe where calculated using Section R403.5.4 *Construction documents* shall indicate the ounces of water in piping between the hot water source and the termination of the fixture supply.

Reason: Inefficient hot water distribution systems have been recognized as a problem for many years as they result in energy and water waste, and result in long hot water delay times that are the cause of a significant number of complaints by new home buyers. Recirculation systems are a solution to two of the three problems (water and wait time), but the thermal energy impact of different recirculation system options has already been addressed in section **R403.5.1.1 Circulation system**.[1]

In all non-recirculation distribution options, water heater energy consumption and hot water waste are correlated. A decrease in water heater energy consumption follows a reduction in wasted water; therefore, improving insulation and reducing the piping length and/or pipe diameter have equal benefits for energy and water waste. In recirculation systems, water heater energy consumption and wasted hot water are independent, and often have an inverse effect (when recirculation is not demand based).[2]

This distribution system problem exists for a variety of factors including:

- An outdated pipe sizing methodology in the plumbing code that results in oversized hot water distribution systems since the assumed fixture flow rates are much higher than current requirements.
- Municipalities with design recommendations that force plumbers and designers to assume low supply water pressure, resulting in larger distribution piping, which waste more water and energy.
- Increasing efforts to conserve water has resulted in the realization of water savings due to improvements in showerhead and lavatory maximum flow rates; however, reduced flow rates often result in increased wait times if the hot water distribution system is not designed to accommodate lower flows.
- Increasing popularity of gas instantaneous water heaters, which offer improved operating efficiency, but can result in increased water waste when starting from a “cold start up” situation.
- Inefficient plumbing installations that are not focused on minimizing pipe length or pipe diameters.

The IECC has already addressed pipe insulation and Circulation systems in the 2021 IECC Residential provisions.

[1] *Residential Compact Domestic Hot Water Distribution Design: Balancing Energy Savings, Water Savings, and Architectural Flexibility*

Farhad Farahmand, TRC Companies and Yanda Zhang, ZYD Energy

[2] *Evaluating Domestic Hot Water Distribution System Options With Validated Analysis Models*E. Weitzel and M. Hoeschele Alliance for Residential Building Innovation

Savings:

The following savings have been calculated for compact domestic hot water distribution only, as Drain Water Heat Recovery has already been included in the 2021 IECC. The California Energy Codes & Standards Case Report for *Compact Hot Water Distribution*; Measure Number: 2019-RES-DHW1-F, Residential Plumbing[3] performed savings analysis using 16 California climate zones. This analysis focused on Therm and Water Savings as it's estimated that over 75% of Residential New Construction Water Heaters installed are gas tankless systems. Nationally, ~68% of Residential New Construction Domestic Hot Water systems are gas fueled, according to the *Home Innovation Research Lab's Annual Builder Practices Survey, 2021*[4]. California's climate zones correlate approximately to IECC Climate Zones 2, 3b, 3c, 4c, 5b, and 6. Savings estimated should be conservative for climate zones 4c and higher as ground temperatures and therefore incoming water temperatures in California homes may be 1 to 3^{o}F higher than in these cooler climates.

Energy Savings Compact Hot Water Distribution Design:In climate zones 3b and lower, first year weighted average residential energy savings (translated from Therms/yr to Mmbtu/yr) are estimated to be per Single Family Home: Climate ZoneSavings in ThermsSavings in Mmbtu2 and 3b4.480.4483c and higher5.570.557 These estimates come from assumption of a 2,430 sq ft home with 3.5 bedrooms.

3

California Energy Codes & Standards Case Report for *Compact Hot Water Distribution*; Measure Number: 2019-RES-DHW1-F, Residential Plumbing

[4]Home Innovation Research Labs Annual Builder Practices Survey, 2021

Water Savings

:

Estimated impacts on water use are presented in the table below. Water use savings estimates are challenging given that hot water usage behaviors among individuals and households are highly variable and can depend strongly on the demographics of the household (Parker, D.; Fairey, P.; and Lutz, J.; 2015). In addition, the proposed compliance option approach ensures that compliant hot water distribution systems will be smaller than a conventional non-compact system but cannot precisely specify the design and configuration and hence the impacts on water waste. To provide a best approximation of water savings impacts, the Statewide CASE Team relied on detailed distribution simulation study completed under the U.S. Department of Energy's Building America program (Weitzel, E.; Hoeschele, M. 2014). In these estimates, it was assumed that all water savings occur indoors.

Impacts on Water Use Table On-Site Indoor Water Savings (gal/yr) Per Dwelling Unit Impacts (single family) 962

Per Dwelling Unit Impacts (multifamily) 321

Drain Water Heat Recovery Savings:

Using the most conservative Department of Energy savings estimates of 800kWh per year, with an U.S. Energy Information Agency hybrid electricity rate for the nation of 13.5 cents per kWh show an annual savings estimate for electric water heating at: $108/yr

https://energy.cdpaccess.com/proposal/446/975/files/download/139/
https://energy.cdpaccess.com/proposal/446/975/files/download/138/
https://energy.cdpaccess.com/proposal/446/975/files/download/137/
https://energy.cdpaccess.com/proposal/446/975/files/download/136/
https://energy.cdpaccess.com/proposal/446/975/files/download/135/

Bibliography:

- *Residential Compact Domestic Hot Water Distribution Design: Balancing Energy Savings, Water Savings, and Architectural Flexibility* Farhad Farahmand, TRC Companie;Yanda Zhang, ZYD Energy

- *Evaluating Domestic Hot Water Distribution System Options With Validated Analysis Models* E. Weitzel and M. Hoeschele Alliance for Residential Building Innovation
- California Energy Codes & Standards Case Report for *Compact Hot Water Distribution*; Measure Number: 2019-RES-DHW1-F, Residential Plumbing
- Home Innovation Research Labs Annual Builder Practices Survey, 2021
- Department of Energy Zero Energy Ready Home National Program Requirements (Rev. 07) [footnote 15]
- Efficient hot water distribution system – USBGC LEED BD+C: Homes v4 – LEED v4
- Residential Hot Water Distribution Systems: Roundtable Session; JD Lutz, Lawrence Berkely National Laboratory; G Klein, California Energy Commission; D Springer, Davis Energy Group; BD Howard, Building Environmental Science & Technology

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

Incremental first costs to builders, designers, and plumbers are design based and each builder will need to determine potential cost impacts based on existing designs and measures in use. Depending on current practices and paths taken for IECC compliance this measure may result in small incremental cost increases or decreases. These potential cost differences relative to standard practices are likely to be:

- Reduced cost of PEX or copper tubing due to less material installed.
- Reduced cost to pipe insulation due to smaller plumbing layout.
- Reduced or neutral cost in labor hours for plumber.
- Increased water heating venting costs, if a gas water heater or electric heat pump water heater is centrally located.
- Increased venting labor costs, if a gas water heater or electric heat pump water heater is located is centrally located and not on a garage wall.

This measure should not have maintenance costs associated with it compared to standard practices.

Energy Savings and Cost Impact for Drain Water Heat Recovery: Using the most conservative Department of Energy savings estimates of 800kWh per year savings, with an U.S. Energy Information Agency hybrid electricity rate for the nation of 13.5 cents per kWh, and an increased cost of $1,000 per unit due to increase copper prices; these systems provide an 11 year simple payback.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: based on the proponent's reason statement and will need to coordinate with REPI-18-21.

Final Hearing Results

REPI-142-21	AM

REPI-143-21

Original Proposal

IECC®: R501.7 (New), R502.1, R502.2, R502.3.1, R502.3.2, R502.3.3, R502.3.4, R502.3

Proponents: Robby Schwarz, BUILDTank, Inc., Colorado Chapter of the ICC (robby@btankinc.com)

2021 International Energy Conservation Code

Add new text as follows:

R501.7 Change in space conditioning. Any unconditioned or low-energy space that is altered to become *conditioned space* shall be required to be brought into full compliance with this code.

Exception: Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the *proposed design* is permitted to be 110 percent of the annual energycost otherwise allowed by Section R405.2.

Revise as follows:

R502.1 General. *Additions* to an existing *building*, *building* system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction. ~~without requiring the unaltered portion of the existing *building* or *building* system to comply with this code.~~ *Additions* shall not create an unsafe or hazardous condition or overload existing*building* systems. ~~An *addition* shall be deemed to comply with this code where the *addition* alone complies, where the existing *building* and *addition* comply with this code as a single building, or where the *building* with the *addition* does not use more energy than the existing*building*. *Additions* shall be in accordance with Section R502.2 or R502.3.~~

~~**R502.2 (N1110.2) Change in space conditioning. Any unconditioned or low-energy space that is altered to become*conditioned space* shall be required to be brought into full compliance with this code.**~~

~~**Exceptions:**~~

1. ~~**Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the *proposed design* is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.2.**~~
2. ~~**Where the Total UA, as determined in Section R402.1.5, of the existing building and the*addition*, and any *alterations* that are part of the project, is less than or equal to the Total UA generated for the existing *building*.**~~
3. ~~**Where complying in accordance with Section R405 and the annual energy cost or energy use of the*addition* and the existing *building*, and any *alterations* that are part of the project, is less than or equal to the annual energy cost of the existing *building*. The *addition* and any *alterations* that are part of the project shall comply with Section R405 in its entirety.**~~

~~**R502.3.1**~~**R502.2.1 Building envelope.** New *building* envelope assemblies that are part of the *addition* shall comply with Sections R402.1, R402.2, R402.3.1 through R402.3.5, and R402.4.

Exception: New envelope assemblies are exempt from the requirements of Section R402.4.1.2.

~~**R502.3.2**~~**R502.2.2 Heating and cooling systems.** HVAC ducts newly installed as part of an *addition* shall comply with Section R403.

Exception: Where ducts from an existing heating and cooling system are extended to an*addition.*

~~**R502.3.3**~~ **R502.2.3 Service hot water systems.** New service hot water systems that are part of the *addition* shall comply with Section R403.5.

~~**R502.3.4**~~**R502.2.4 Lighting.** New lighting systems that are part of the *addition* shall comply with Section R404.1.

~~**R502.3**~~**R502.2 Prescriptive compliance.** *Additions* shall comply with Sections R502.3.1 through R502.3.4.

Reason: The existing Section **R502.2 Change in space conditioning** in the additions chapter 5 Existing homes has not reference to additions. Is speaks to a general condition of changing a low energy space during an alteration to become a conditioned space. This is not an addition, so it was moved to a new section in R501 General as an overarching general requirement rather than one specific to additions.

The additions section R502 struggle with how to determine compliance with the requirements of the IECC as they relate to existing home additions. The existing section R502.1 general spoke loosely to demonstrating compliance but it is not specific enough to guide enforcemen well. We therefore stuck language from this section and created a true compliance section for additions on Section R502.2. This new section leverages an existing compliance option and states that the *addition* shall be deemed to comply with this code wherethe existing building with the addition complies prescriptively (using Total UA) or does not use more energy than the existing building and demonstrates compliance using either Building Performance energy cost, or Energy Rating Index compliance option listed below. In this way a prescriptive nonenergy compliance base compliance path can be used, and two energy-based compliance paths are options. All of the compliance paths require that the building plus the addition be compared to the building before the addition to quantify that the building plus the addition is equal to or better than the building before the addition was added.

This approach requires benchmarking the existing structure before construction begins so a comparison can be made using one of the three compliance approaches. ANSI/RESNET/ICC 301-2019 or ANSI/BPI 1200-S-2017 standards have been referenced as guidelines for how to evaluate insulation levels and other energy features needed to benchmark an existing building through computer modeling.

All compliance approaches compare the building plus addition to itself without the addition, so parity is achieved. The two performance approaches should be more flexible as they are whole house approaches meaning, for example, that a leaky house before an addition, is compared with a leaky house plus a tighter addition with more volume which can offset (trade) to be equal to or better than. In addition, the existing house could add LED lighting or do other low hanging, low cost, energy upgrades to ensure compliance.

This approach is new and forces us to consider and offer opportunity to upgrade existing homes at the time that an addition is added to the structure. New Homes become existing homes and they last a really long time. Jurisdictions around the country are struggling with how to encourage energy upgrades to help meet climate action and other goals they may have for their housing stock. This proposal offers a starting point by which a community grow from. It requires a look at the existing structure to consider if some level of upgrade must happen when an addition is added. Communities could go further and require that the existing structure plus the addition be x percentage better than the existing structure was before. This is the direction that communities are looking to go. If we want jurisdictions to continue to use the IECC this proposal needs to be considered. Otherwise community goals will outpace the what the IECC can offer to meet their climate goals.

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

Cost of construction will increase with this proposal primarily due to the cost of demonstrating compliance. However, there was no true means developed in the past existing home additions section to demonstrate compliance other than a vague visual inspection. This approach truly quantifies compliance while offering an opportunity to address issues with the existing structure.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Changes in space conditioning was confusing in the additions section. As additions are new construction would be required to comply with the code. The original language remains with exceptions 2 and 3 removed.

Final Hearing Results

REPI-143-21	AM

REPI-144-21

Original Proposal

IECC®: SECTION 202 (New), R502.3, R502.3.5 (N1110.3.5) (New), R503.1, R503.1.5 (N1111.1.5) (New), SECTION R506 (N1114) (New), R506.1 (N1114.1) (New)

Proponents: Sean Denniston, New Buildings Institute, New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Add new definition as follows:

EXTERIOR WALL ENVELOPE. A system or assembly of exterior wall components, including exterior wall finish materials, that provides protection of the building structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment.

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.

Revise as follows:

R502.3 (N1110.3) Prescriptive compliance. *Additions* shall comply with Sections R502.3.1 through ~~R502.3.4~~ R502.3.5.

Add new text as follows:

R502.3.5 (N1110.3.5) Additional Efficiency Packages. *Additions* shall comply with Section R506. *Alterations* to the existing building that are not part of the *addition*, but permitted with the *addition*, shall be permitted to be used to achieve this requirement.

Exceptions:

1. *Additions* that increase the *building*'s total *conditioned floor area* by less than 25 percent.
2. *Additions* that do not include the addition or replacement of equipment covered in Sections R403.5 or R403.7.
3. *Additions* that do not contain *conditioned space*.
4. Where the *addition* alone or the existing building and *addition* together comply with Section R405 or R406.

Revise as follows:

R503.1 (N1111.1) General. *Alterations* to any building or structure shall comply with the requirements of the code for new construction, without requiring the unaltered portions of the existing building or building system to comply with this code. *Alterations* shall be such that the existing building or structure is not less conforming to the provisions of this code than the existing *building* or structure was prior to the *alteration*.*Alterations* shall not create an unsafe or hazardous condition or overload*existing* building systems. *Alterations* shall be such that the existing *building* or structure does not use more energy than the existing building or structure prior to the*alteration*. *Alterations* to existing *buildings* shall comply with Sections R503.1.1 through ~~R503.1.4~~ R503.1.5.

Add new text as follows:

R503.1.5 (N1111.1.5) Additional Efficiency Packages. *Alterations* shall comply with Section R506 where the *alteration* contains replacement of two or more of the following:

1. HVAC unitary systems or HVAC central heating or cooling equipment serving the*work area* of the *alteration*.

2. Water heating equipment serving the *work area* of the *alteration*.
3. 50 percent or more of the lighting fixtures in the *work area* of the *alteration*.
4. 50 percent or more of the area of interior surfaces of the *thermal envelope* in the *work area* of the *alteration*.
5. 50 percent or more the area of the *building's exterior wall envelope*.

Exceptions:

1. *Alterations* that are permitted with an addition complying with Section R502.3.5.
2. *Alterations* that comply with Section R405 or R406.

SECTION R506 (N1114) ADDITIONAL EFFICIENCY PACKAGE OPTIONS

R506.1 (N1114.1) General. Where required in Section R502 or R503, the *building* shall comply with one or more additional efficiency package options in accordance with the following:

1. Enhanced envelope performance in accordance with Section R408.2.1.
2. More efficient HVAC equipment performance in accordance with Section R408.2.2.
3. Reduced energy use in service water-heating in accordance with Section R408.2.3.
4. More efficient duct thermal distribution system in accordance with Section R408.2.4.
5. Improved air sealing and efficient ventilation system in accordance with Section R408.2.5.

Reason:

Section R408 was added to the IECC in 2021. R408 requires homes to include an additional efficiency option to achieve greater efficiency. R408 was a residential version of section C406 that had been in the commercial code since 2012. This allowed the IECC to achieve additional efficiency in a highly flexible way. However, there is one significant gap in R408, it does not apply to additions or alterations. R502 and R503 do not reference R408 in the sections with which additions and alterations must comply. The exclusion from R408 is a significant loophole. Additions and substantial alterations are prime opportunities for achieving greater energy efficiency utilizing R408.This proposal creates a framework to apply R408 to additions and substantial alterations. It creates a new Section R506 that provides guidance for how to utilize R408 for existing buildings. R506.1 takes the place of the charging language in R401.2.5, R408.1 and R408.2 for existing buildings. This section R506 is referenced by new sections in R502 and R503 that set which additions and alterations need to meet the additional efficiency option requirement in R506.The new Section R502.3.5 establishes which additions must comply with C506. It also allows alterations and additions that are part of the same permit to meet C506 together. The section includes certain exemptions in order to ensure that C506 is only getting triggered by larger additions that have enough new systems included to enable flexible application of the package options:

1. Smaller additions that add less than 25% conditioned area
2. Additions that don’t include new water heating or space conditioning systems
3. Additions that don’t include conditioned space
4. Additions that will comply with R405 or R406.

The new section C503.3.5 requires that large alterations comply with the new R506. The section includes important exceptions:

1. The first exception ensures that the requirements only apply to substantial additions with significant scope. The exemption is worded

to address small alterations that only impact one of the main buildings systems: envelope (R402), HVAC (R403.5) and water heating (C403.7). Alterations that impact two or more of these systems – and must therefore comply with two or more of these sections – will have a larger scope with more opportunities to choose from among the available package options.

2. An exception that reflects the allowance for alterations and additions to comply together under C502.
3. An exception for buildings that comply with R405 or R406.By limiting requirement to substantial alterations, the proposal ensures that projects will likely have sufficient package options within the existing scope of the project. The project team will be able to pick a package option that applies to building elements that are already within the project scope.

The savings for this proposal will vary based on which project is chosen. However, the savings should be higher for alterations in particular since the baselines for alterations include many below-code existing building features. Depending on how inefficient the rest of the building is, the impact of this proposal could be substantially higher without any greater cost than new construction R408 measures.

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

This proposal is crafted so that it will only impact major renovations / large-scope alterations that are already impacting the major systems that serve as the basis for packages under R408. This means that these projects are already undertaking the cost of bringing two or more of these major systems up to current code requirements, and the incremental cost is therefore only the cost from code rather than the cost of a standalone retrofit. Therefore, the costs for this proposal are the same as the costs for R408 requirements for new construction. However, savings for each package will generally be much higher since the rest of the building will nearly always have specifications that fall short of the latest energy code and each package will deliver greater savings. As a result, any package that is cost effective for new construction will be even more cost effective for major alterations.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: a good step forward ultimately to provide a foundation to go forward and grow from in the existing building space.

Final Hearing Results

REPI-144-21	AM

REPI-145-21
Original Proposal

IECC®: R502.3.2, R503.1.2, R503.1.2.1 (N1111.1.2.1) (New)

Proponents: Sean Denniston, New Buildings Institute, New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

R502.3.2 (N1110.3.2) Heating and cooling systems. HVAC ducts newly installed as part of an *addition* shall comply with Section R403 **.**

Exception: Where ducts from an existing heating and cooling system are extended ~~to~~ into an addition Sections R403.3.5 and Section R403.3.6 shall not be required.

R503.1.2 (N1111.1.2) Heating and cooling systems. New heating and cooling and duct systems~~HVAC ducts newly~~ installed as part of an alteration shall comply with Section R403. Alterations to heating, cooling and duct systems shall comply with this section.

Exception: Where ducts from an existing heating and cooling system are extended to an*addition*.

Add new text as follows:

R503.1.2.1 (N1111.1.2.1) Duct Leakage. Where an *alteration* includes any of the following, ducts shall be tested in accordance with Section R403.3.5 and shall have a total leakage less than or equal to 12.0 cubic feet per minute (339.9 L/min) per 100 square feet (9.29 m^2) of conditioned floor area:

1. Where 25 percent or more of the registers that are part of the duct system are relocated.
2. Where 25 percent or more of the total length of all ducts in the system are relocated.
3. Where the total length of all ducts in the system is increased by 25 percent or more.

Exception: Duct systems located entirely inside a *conditioned space* in accordance with Section R403.3.2.

Reason: This proposal requires that existing ductwork serving new equipment in additions and alterations is tested. In an alteration, all ductwork serving new equipment will need to be tested. In additions, the ductwork serving the addition, both existing and new ductwork, will need to be tested if it increases the total volume of the ductwork serving the addition by more than 20%. The proposal does not include a performance criterion for the testing; the testing is informational.

The requirements for duct construction and sealing in the IECC have developed substantially over recent code cycles. Fiberboard materials, cloth tape, un-sealed duct joints, cavity plenum returns and other materials and approaches that can lead to very leaky ducts were once commonplace but are not now allowed by the IECC. The result is that the ductwork in many existing buildings fall far below modern standards.

Duct tightening can be a very cost-effective energy retrofit. The replacement of equipment or substantial expansion of existing ductwork present prime opportunities to undertake this testing and will provide project teams and building owners important information about the relative need and savings opportunity that could come from duct tightening projects. It will also give project teams important information for configuring new equipment and ductwork to ensure the whole system performs effectively.

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

The cost will depend on the size of the duct system serving the alteration or addition.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: this helps clarify when duct testing is needed and not needed in existing homes and duct installation remains important no matter when it was installed.

Final Hearing Results

REPI-145-21	AM

REPI-150-21

Original Proposal

IECC®: R503.1.1, R503.1.1.1, R503.1.1.2 (N1111.1.1.2) (New), 503.1.1.3 (N1111.1.1.3) (New), R503.1.1.4 (N1111.1.1.4) (New), R503.1.1.5 (N1111.1.1.5) (New), R503.1.1.6 (N1111.1.1.6) (New), SECTION 202 (New), SECTION 202, TABLE R402.1.2, TABLE R402.1.3

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2021 International Energy Conservation Code

Revise as follows:

R503.1.1 (N1111.1.1) Building thermal envelope. Alterations of existing *building thermal envelope* assemblies shall comply with this section. New ~~*Building*~~ *building thermal envelope* assemblies that are part of the *alteration* shall comply with Section R402 ~~R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.12, R402.3.1, R402.3.2, R402.4.3 and R402.4.5~~. In no case shall the *R*-value of insulation be reduced or the *U*-factor of a *building thermal envelope* assembly be increased as part of a *building thermal envelope* alteration.

Exception: The following alterations shall not be required to comply with the requirements for new construction provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. ~~Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation~~.
3. ~~Construction where the existing roof, wall or floor cavity is not exposed~~.

2. ~~4.~~ Roof recover.

~~5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.~~

3. ~~6.~~ Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided that the code does not require the glazing or fenestration assembly to be replaced.
4. An existing building undergoing alterations that is demonstrated to be in compliance with Section R405 or Section R406.

R503.1.1.1 (N1111.1.1.1) ~~Replacement fenestration~~ Fenestration alterations. Where new fenestration area is added to an existing building, the new fenestration shall comply with Section R402.3. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for *U*-factor and SHGC as specified in Table R402.1.3. Where more than one replacement fenestration unit is to be installed, an area-weighted average of the *U*-factor, SHGC or both of all replacement fenestration units shall be an alternative that can be used to show compliance.

Add new text as follows:

R503.1.1.2 (N1111.1.1.2) Roof alterations. Roof insulation complying with Section R402.1 or an *approved* design shall be provided for the following roof alteration conditions as applicable:

1. An *alteration* to roof-ceiling construction where there is no insulation above *conditioned space*.

2. *Roof replacements* for roofs with insulation entirely above deck,

   Exception: Where compliance with Section R402.1 cannot be met due to limiting conditions on an existing roof, the following shall be permitted to demonstrate compliance with the insulation requirements:

   1. *Construction documents* that include a report by a registered design professional or other*approved source* documenting details of the limiting conditions affecting compliance with the insulation requirements.
   2. *Construction documents* that include a roof design by a registered design professional or other*approved source* that minimize deviation from the insulation requirements.

3. Conversion of an unconditioned attic space into*conditioned space*, and
4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling construction to which insulation can be applied.

503.1.1.3 (N1111.1.1.3) Above-grade wall alterations. *Above-grade wall* alterations shall comply with the following requirements as applicable:

1. Where interior finishes are removed exposing wall cavities, the existing cavity shall be filled with existing or new insulation complying with Section R303.1.4;
2. Where exterior wall coverings and fenestration are removed and replaced for the full extent of any exterior wall assembly, *continuous insulation* shall be provided where required in accordance with Section R402.1 or an*approved* design;
3. Where Items 1 and 2 apply, the entire wall assembly shall be insulated in accordance with Section R402.1; and,
4. Where new interior finishes or exterior wall coverings are applied to the full extent of any exterior wall assembly of mass construction, insulation shall be provided where required in accordance with Section R402.1 or an *approved* design.

Where any of the above requirements are applicable, the a*bove-grade wall* alteration shall comply with the insulation and water vapor retarder requirements of Section R702.7 of the *International Residential Code*. Where the exterior wall coverings are removed and replaced, the *above-grade wall* alteration shall comply with the water and wind resistance requirements of Section R703.1.1 of the *International Residential Code*.

R503.1.1.4 (N1111.1.1.4) Floor alterations. Where an alteration to a floor or floor overhang exposes cavities or surfaces to which insulation can be applied and the floor or floor overhang is part of the building thermal envelope, the floor or floor overhang shall be brought into compliance with Section R402.1 or an *approved* design. This requirement shall apply to floor alterations where the floor cavities or surfaces are exposed and accessible prior to construction.

R503.1.1.5 (N1111.1.1.5) Below-grade wall alterations. Where a blow-grade space is changed to *conditioned space*, the *below-grade walls* shall be insulated where required in accordance with Section R402.1. Where the below-grade space is*conditioned space* and a *below-grade wall* is altered by removing or adding interior finishes, it shall be insulated where required in accordance with Section R402.1.

R503.1.1.6 (N1111.1.1.6) Air barrier. *Building thermal envelope* assemblies altered in accordance with Section R503.1.1 shall be provided with an *air barrier* in accordance with Section R402.4. The*air barrier* shall not be required to be made continuous with unaltered portions of the *building thermal envelope*. Testing requirements of Section R402.4.1.2 shall not be required.

Add new definition as follows:

APPROVED SOURCE. An independent person, firm or corporation, approved by the*code official*, who is competent and experienced in the application of engineering principles to materials, methods or system analyses.

CONSTRUCTION DOCUMENTS. Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a building *permit*.

Revise as follows:

ROOF REPLACEMENT. ~~The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.~~An alteration that includes the removal of all existing layers of roof assembly materials down to the roof deck and installing replacement materials above the existing roof deck.

TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

CLIMATE ZONE	FENESTRATION *U*-FACTOR[f]	SKYLIGHT *U*-FACTOR	GLAZED FENESTRATION SHGC[d, e]	CEILING *U*-FACTOR[g]	WOOD FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
0	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
1	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.25	0.026	0.084	0.165	0.064	0.360	0.477
3	0.30	0.55	0.25	0.026	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.30	0.55	0.40	0.024	0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.40	0.024	0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	0.024	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	0.024	0.045	0.057	0.028	0.050	0.055

For SI: 1 foot = 304.8 mm.

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

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

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

d. The SHGC column applies to all glazed fenestration.

   Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

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

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

   1. Above 4,000 feet in elevation above sea level, or

   2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

g. Roofs with insulation entirely above deck shall comply with Section C402.2.1 and the Group R *U-factors* of Table C402.1.4.

TABLE R402.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b, i]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE[j]	WOOD FRAME WALL *R*-VALUE[g]	MASS WALL *R*-VALUE[h]	FLOOR *R*-VALUE	BASEMENT[c,g] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c,g] WALL *R*-VALUE
0	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	0	0	0
1	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	0	0	0
2	0.40	0.65	0.25	49	13 or 0 & 10ci	4/6	13	0	0	0
3	.30	0.55	0.25	49	20 or 13 & 5ci[h] or 0 & 15ci[h]	8/13	19	5ci or 13[f]	10ci, 2 ft	5ci or 13[f]
4 except Marine	.30	0.55	0.40	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	8/13	19	10ci or 13	10ci, 4 ft	10ci or 13

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	GLAZED FENESTRATION SHGC	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE	FLOOR *R*-VALUE	BASEMENT WALL *R*-VALUE	SLAB *R*-VALUE & DEPTH	CRAWL SPACE WALL *R*-VALUE
5 and Marine 4	0.30[i]	0.55	0.40	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	13/17	30	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci
6	0.30[i]	0.55	NR	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	15/20	30	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci
7 and 8	0.30[i]	0.55	NR	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	19/21	38	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

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

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

   Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "5ci or 13” means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13 & 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

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

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

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

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

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

i. A maximum *U*-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

   1. Above 4,000 feet in elevation, or

   2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

j. <u>Roofs with insulation entirely above deck shall comply with Section C402.2.1 and the Group R*R-values* of Table C402.1.3</u>.

Reason: Existing building alterations are perhaps one of the primary opportunities to reduce national energy consumption, yet Chapter 5 does little to address this need. There are many opportunities to cost-effectively improve energy efficiency of the existing building stock by use of reasonable criteria to trigger (or avoid) requirements with flexibility in the manner or extent of compliance where needed. This proposal attempts to strike that balance in a practical and cost-effective manner for building envelope assemblies of existing buildings that are undergoing specific types of alterations. Consequently, this proposal will help to address the 40% of national energy use that is attributed to the existing building stock and will only apply where alterations are proposed that provide opportunity to improve the performance of the existing building stock. A similar coordinated proposal was also submitted for the IECC-C committee.

Key changes made in this proposal are summarized as follows:

1. The revisions to charging language in Section R503.1.1 are made to be consistent with commercial building provisions in C503.2.

2. A clause is added to Section R503.1.1 to prevent reduction in existing building thermal envelope insulation levels as is included in the IECC provisions.

3. Exceptions 2 and 3 of Section R503.1.1 are deleted as they are now addressed and preserved within requirements in new subsections for above-grade walls, floors, and roofs.

4. Existing exception 5 of Section R503.1.1 is deleted because it is a requirement (not an exception) that is now moved to new Section R503.1.1.2 for roof alterations.

5. New exception 4 is added to Section R503.1.1 to provide the flexibility of a “whole” existing building compliance path using the existing total building performance and ERI paths in Sections R405 and R406. This would be most applicable to extensive or multiple alterations as may occur in a building renovation.

6. Section 503.1.1.1 for fenestration replacements is modified to address fenestration alterations including both added fenestration and fenestration replacements as both are also addressed in the IECC-C provisions for existing buildings and are relevant to existing residential building alterations.

7. A new Section R503.1.1.2 is provided to address multiple types of roof alterations to identify conditions where it is appropriate to provide insulation (if not already present).

8. A new Section R503.1.1.3 is provided for above-grade wall alterations which identifies conditions where it is appropriate and practical to provide insulation (if not already present). Language is also provided to ensure coordination with building code moisture control requirements which require integration with and can influence the method of complying with the insulation requirements.

9. A new Section R503.1.1.4 is provided for floor alterations and takes an approach similar to that done for above-grade walls (although with fewer conditional requirements).

10. A new Section R503.1.1.5 is provided for below-grade wall alterations. This captures the cases where a below-grade space (e.g., basement) is being converted to conditioned space and where basement walls are altered and the basement is already conditioned.

11. Finally, new Section R503.1.1.6 is provided to address air barrier installations in altered building thermal envelope assemblies. However, it is made clear that continuity of the air barrier is not required with unaltered portions of the building thermal envelope as that would cause the alteration to extend beyond its intended scope. It also is made clear that whole building air leakage testing is not required.

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

Where requirements are triggered and where upgrades in energy efficiency were not already planned for an alteration, this proposal will increase cost for a limited set of envelope alteration activities for existing buildings. Some existing requirements such as roof replacements and filling of exposed stud cavities remain unchanged. For those existing buildings with deficient insulation levels (or no insulation) and where planned alterations allow that deficiency to be addressed efficiently, the cost-benefits are expected to closely align with that for new buildings. However, it is not possible to conduct a simple cost-benefit analysis for existing buildings because of the multitude of variables involved and the flexibility provided in this proposal that make it nearly impossible to quantify with any reasonable level of certainty. Thus, we consider these proposed provisions to be cost-effective by judgment as these types of existing building thermal envelope upgrades are currently being used in the existing building/remodeling/renovation market, although not consistently or in an enforceable manner. In addition, the current charging language in Section R503.1.1 requires compliance with insulation requirements for new buildings for all alterations, barring only those few excepted. Now, this proposal provides requirements that also provide flexibility in means of compliance for the many alterations that are currently not included in exceptions to Section 503.1.1. For these cases, this proposal could be considered to reduce cost.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Existing building alterations are perhaps one of the primary opportunities to reduce national energy consumption, yet Chapter 5 does little to address this need. There are many opportunities to cost-effectively improve energy efficiency of the existing building stock by use of reasonable criteria to trigger (or avoid) requirements with flexibility in the manner or extent of compliance where needed. This proposal attempts to strike that balance in a practical and cost-effective manner for building envelope assemblies of existing buildings that are undergoing specific types of alterations. Consequently, this proposal will help to address the 40% of national energy use that is attributed to the existing building stock and will only apply where alterations are proposed that provide opportunity to improve the performance of the existing building stock. A similar coordinated proposal was also submitted for the IECC-C committee

Final Hearing Results

REPI-150-21	AM

REPI-151-21

Original Proposal

IECC®: R503.1.2, R503.1.2.2 (N1111.1.2.2) (New), R503.1.2.1 (N1111.1.2.1) (New)

Proponents: Sean Denniston, New Buildings Institute, New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

R503.1.2 (N1111.1.2) Heating and cooling systems. ~~HVAC ducts newly installed as part of an alteration shall comply with section R403~~ <u>New heating and cooling and duct systems that are part of the *alteration* shall comply with Section R403 and this section</u>.

Add new text as follows:

<u>**R503.1.2.2 (N1111.1.2.2) System Sizing**</u>**.** <u>New heating and cooling equipment that is part of an *alteration* shall be sized in accordance with Section R403.7 based on the existing *building* features as modified by the *alteration.*</u>

<u>**Exception:** Where it has been demonstrated to the *code official* that compliance with this section would result in heating or cooling equipment that is incompatible with the remaining portions of the existing heating or cooling system.</u>

<u>**R503.1.2.1 (N1111.1.2.1) Ducts**</u>**.** <u>HVAC ducts newly installed as part of an *alteration* shall comply with Section R403</u>.

<u>**Exception:** Where ducts from an existing heating and cooling system are extended to an *addition*.</u>

Reason:

Historically, HVAC equipment has been routinely oversized. Studies have found very high rates of equipment oversizing; for example, 60% of RTU units in CA were found to be oversized.[1] Oversized equipment results in increased energy use, decreased occupant comfort and increased wear-and-tear on equipment.[2] Oversized equipment is also less effective at dehumidification. Like-for-like equipment replacement are particularly vulnerable to oversizing. The original equipment may have been installed when code requirements for "right-sizing" equipment did not exist or was not enforced. The materials markups that are common practice among contractors disincentivize them to install smaller, right-sized equipment. Changes to building use could have occurred since the original equipment was installed, creating a mismatch between current design loads and the original equipment. The building may have modified, particularly by energy efficiency programs, altering the design loads of the building. Lighting especially stands out here. Fluorescent and LED lighting is ubiquitous, but many HVAC systems were designed to account for incandescent lamps that convert over 75% of the energy they consume into heat.

With all of these considerations, it is reasonable to assume that the existing equipment sizing is more likely to be wrong than right, yet many equipment replacements use existing system sizing to size new equipment. This proposal explicitly requires that new equipment installed as part of an alteration be sized based on current building characteristics and loads, using current sizing standards. The resulting installations will be more efficient and more effective and many will be less costly to install as owners stop paying for more equipment than they need.

Savings will vary based on the amount that existing equipment is oversized. "Right-sizing" has been found to result in about 0.2% energy savings for every 1% reduction in oversizing.[3]

[1] D.R. Felts, P. Bailey, The State of Affairs – Packaged Cooling Equipment in California, 2000.

[2] Ery Djunaedy, Kevin van den Wymelenberg, Brad Acker, Harshana Thimmana, *Oversizing of HVAC system: Signatures and penalties.* "Energy and Buildings," Volume 43, Issues 2-3, 2011,

[3] H.McLain,D.Goldberg. “Benefits of Replacing Residential Central Air Conditioning Systems.” American Council for an Energy-Efficient Economy, WashingtonDC, USA, 1984.

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

As “wrong-sized” equipment is generally oversized, this proposal will generally decrease the cost of installation. Smaller, right-sized equipment will generally be less costly to install.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Committee generally agreed that oversizing of heating and cooling appliances in existing homes was an issue. The proposed exception does allow the HVAC contractor to evaluate the existing system and propose an appliance that is compatible with the existing system components.

Final Hearing Results

REPI-151-21	AS

REPI-152-21

Original Proposal

IECC®: R503.1.2.1(N1111.1.2.1) (New)
Proponents: Sean Denniston, New Buildings Institute, New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

R503.1.2.1(N1111.1.2.1) Controls. New heating and cooling equipment that are part of the*alteration* shall be provided with controls that comply with Section R403.1.

Reason: The IECC only requires that new portions of HVAC systems comply with the requirements for new construction. This leaves unaltered portions of the HVAC system unaffected, including controls. Controls are a vital component of effective and efficient operation of heating and cooling systems and older controls that do not meet current code requirements significantly hamper efficiency in buildings. Obsolete controls also increase the operational costs for building owners and tenants. The IECC has relied on HVAC controls as a cost-effective means of delivering energy efficiency in buildings, so this is a significant missed opportunity. Equipment replacement is an ideal time to also upgrade controls. Contractors are onsite, operation of the HVAC system is already disrupted, and the cost of controls would generally be a small line-item cost in the project.

This proposal requires that thermostats be brought into compliance with current control requirements when equipment is replaced. The proposal does not require the installation of new controls, so if the existing controls already meet current code requirements, they would already be in compliance with this new section.

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

Cost will vary depending on the type of control and how obsolete existing controls are. In most systems subject to this requirement, compliance would require replacing one thermostat with another. Modern, wireless thermostats can be used to control costs when existing control wiring is insufficient to support modern controls. Utilities have consistently found thermostat retrofits to be cost effective efficiency incentive measures.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: Change title of Section to Thermostat also added reference to R403.2.

Final Hearing Results

REPI-152-21 AM

REPI-153-21

Original Proposal

IECC®: SECTION RC101, RC101.1

Proponents: Patricia Chawla, Austin Energy, Austin Energy (patricia.chawla@austinenergy.com)

2021 International Energy Conservation Code

Revise as follows:

SECTION RC101(AX101) ~~COMPLIANCE~~GENERAL

RC101.1(AX101.1) ~~Compliance~~ Scope. ~~Existing residential buildings shall comply with Chapter 5. New residential buildings shall comply with Section RC102.~~ This appendix applies to new *residential buildings.*

Reason: This proposal seeks to simplify the scope statement of this appendix.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed code change deletes redundant text from the existing code language and will not affect the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: proposal simplifies the scope statement of the appendix

Final Hearing Results

REPI-153-21 AS

REPEI-154-21

Original Proposal

IECC®: APPENDIX RC, SECTION RC102, RC102.2

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

2021 International Energy Conservation Code

Revise as follows:

APPENDIX RC (APPENDIX AX)
ZERO NET ENERGY RESIDENTIAL BUILDING PROVISIONS

SECTION RC102 (AX102)
ZERO NET ENERGY RESIDENTIAL BUILDINGS

RC102.2 (AX102.2) Energy Rating Index zero net energy score. Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RC102.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:

1. ERI value not including on-site power production (OPP) calculated in accordance with RESNET/ICC 301.
2. ERI value including on-site power production calculated in accordance with RESNET/ICC 301 with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.

$$\text{Adjusted OPP} = \text{OPP} + \text{CREF} + \text{REPC} \qquad \textbf{(Equation RC-1)}$$

where:

CREF = Community Renewable Energy Facility power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from a community renewable energy facility that is qualified under applicable state and local utility statutes and rules, and that allocates bill credits to the rated home.

REPC = Renewable Energy Purchase Contract power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from an energy facility that generates energy with photovoltaic, solar thermal, geothermal energy or wind systems, and that is demonstrated by an energy purchase contract or lease with a duration of not less than 15 years.

Reason: The term "zero energy" is more suited for a marketing brochure, rather than an IECC Appendix or an ICC code. All buildings use energy, and the use of a term like "zero energy", while appealing, is not accurate and will mislead and misinform consumers and businesses and policy makers.

The term that should be used is "zero net energy", which is the technically correct way to describe such buildings.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Using the more accurate term will have no impact on the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This adds the word “net” to the term “zero energy”. Zero Net Energy (ZNE) is the term most commonly used and is more accurate. All building use energy – there are no “zero energy” buildings.

Final Hearing Results	
REPI-154-21	AS

REPI-155-21
Original Proposal

IECC®: RC102 (AX102) (New), SECTION 202 (New), Appendix RX requires the installation of all-electric equipment and appliances in new construction in order to reduce carbon emissions and improve the safety and health of residential buildings. Where adopted as a requirement, Section RX102.1 is intended to replace R401.2. RX (New), Section RX101 (New), RX101.1 (New), RX101.2 (New), Section RX102 (New), RX102.1 (New)

Proponents: Kim Cheslak, NBI, NBI (kim@newbuildings.org); Ben Rabe, Fresh Energy (rabe@fresh-energy.org); Bryan Bomer, Department of Permitting Services, Montgomery County MD, Department of Permitting Services (bryan.bomer@montgomerycountymd.gov); Lauren Urbanek, Natural Resources Defense Council (lurbanek@nrdc.org); Howard Calvert Wiig, Hawaii State Energy Office, Hawaii State Energy Office (howard.c.wiig@hawaii.gov); Kim Burke, State of Colorado, Colorado Energy Office (kim.burke@state.co.us); Chris Castro, City of Orlando, City of Orlando (chris.castro@orlando.gov); Brad Smith, City of Fort Collins (brsmith@fcgov.com)

2021 International Energy Conservation Code

Add new text as follows:

RC102 (AX102)
GENERAL DEFINITIONS

Add new definition as follows:

ALL-ELECTRIC BUILDING. A *building* that contains no combustion equipment, or plumbing for combustion equipment, installed within the *building*, or *building site*.

APPLIANCE. A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements.

COMBUSTION EQUIPMENT. Any *equipment* or *appliance* used for space heating, *service water heating*, cooking, clothes drying and/or lighting that uses *fuel gas* or *fuel oil.*

EQUIPMENT. Piping, ducts, vents, control devices and other components of systems other than appliances that are permanently installed and integrated to provide control of environmental conditions for buildings. This definition shall also include other systems specifically regulated in this code.

-

FUEL GAS. A natural gas, manufactured gas, liquified petroleum gas or a mixture of these.

FUEL OIL. Kerosene or any hydrocarbon oil having a flash point not less than 100°F (38°C).

Add new text as follows:

Appendix RX requires the installation of all-electric equipment and appliances in new construction in order to reduce carbon emissions and improve the safety and health of residential buildings. Where adopted as a requirement, Section RX102.1 is intended to replace R401.2. RX ALL-ELECTIC RESIDENTIAL BUILDINGS

Section RX101

GENERAL

RX101.1 Intent. The intent of this Appendix is to amend the *International Energy Conservation Code* to reduce greenhouse gas emissions and improve the safety and health of buildings by not permitting *combustion equipment* in buildings.

RX101.2 Scope. This appendix applies to new residential buildings.

Section RX102
ALL-ELECTRIC RESIDENTIAL BUILDINGS

RX102.1 Application. Residential buildings shall be *all-electric buildings* and comply with Section R401.2.5 and either Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4.

Reason: The adoption of the Zero Home Appendix into the 2021 IECC has garnered a lot of attention and questions from cities and states looking to understand its energy impact and alignment with energy reduction and climate goals. The 2021 IECC version of the appendix does not address onsite carbon emissions, a request that has been made by jurisdictions seeking to set carbon targets in addition to energy reductions via energy code and stretch codes. This amendment would place the Appendix in line with the ICC's stated goals on carbon and energy reductions by requiring buildings be all-electric in addition to energy efficient. Since the Appendix is structured to be used as an optional stretch code, it presents opportunities for jurisdictions to begin to move residential construction toward full decarbonization in line with climate goals.

In order to meet President Biden's 2050 goal of reducing greenhouse gas emissions in half by 2030 and achieving net zero carbon emissions by 2050, the United States must not only reduce energy use through energy efficiency and move to utility scale and on-site renewable energy, but also transition away from using combustion equipment in buildings that runs on fossil fuels to electric equipment. In 2020, combustion equipment in commercial and residential buildings accounted for 36% of the United States energy-related greenhouse gas emissions. To meet President Biden's goal, it is crucial that new homes built today are all-electric so that emissions from these buildings are not "locked-in" by gas-dependent building infrastructure. Reduced carbon emissions was also recently cited as a priority of energy code development by the ICC in their Leading the Way to Energy Efficiency: A Path Forward on Energy and Sustainability to Confront a Changing Climate in 2021.

Fortunately, heat pump technology has dramatically improved over the last few decades, giving contractors and building owners access to highly efficient electric heating and cooling, and water heating technologies. An Ecotope study of the 2017 Oregon Residential code found that homes heated by electric heat pumps use 40 percent less energy than homes heated with gas (including water heating). Even accounting for reduced efficiency in extreme cold weather, according to a study by RMI, modern air source heat pumps are more than twice as efficient as gas furnaces and can save families up to 9 percent on their utility bills in Climate Zone 6. This is one reason why the U.S. EPA just announced that standards for the most efficient appliances in 2022 certified under the ENERGY STAR program will be all-electric.

All-electric homes are also healthier homes. Gas appliances release harmful pollutants like nitrogen dioxide (NO2) and carbon monoxide (CO) either indoors because of gas stoves or outdoors because of space-heating and water heating equipment. A recent study from the Harvard Chang School of Public Health and RMI shows that in 2017, air pollution from burning fuels in buildings led to an estimated 48,000 to 64,000 early deaths and $615 billion in health impact costs. These emissions can particularly affect children. In a meta-analysis analyzing the connections between gas stoves and childhood asthma, children in homes with gas stoves were 42% more likely to experience asthma symptoms, and 32% more likely to being diagnosed with asthma.

All-electric new construction is also less expensive to build than a home with gas appliances and in the long term will result in fewer retrofit costs for homeowners to meet future policy goals to eliminate all carbon emissions in the U.S. by 2050.

Therefore, building all-electric buildings is critical to reducing air pollution, protecting public health, reducing utility and construction costs, and meeting climate goals. NBI is submitting this amendment along with amendments that address on-site renewables, electric vehicles, and grid integration techniques. These proposed changes to the 2021 IECC, working together, will put the U.S. on the path to a decarbonized, resilient, and healthier future.

Bibliography: Fact Sheet: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies, The White House, 22 Apr. 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/.

"U.S. Energy Information Administration." What are U.S. energy-related carbon dioxide emissions by source and sector?, https://www.eia.gov/tools/faqs/faq.php?id=75&t=11

Leading the Way to Energy Efficiency: A Path Forward on Energy and Sustainability to Confront a Changing Climate, ICC, https://www.iccsafe.org/wp-content/uploads/ICC_Leading_Way_to_Energy_Efficiency.pdf.

Oregon Residential Specialty Code: 2005 Baseline and Code Roadmap to Achieve the 2030 Goal; Ecotope (2020) https://neea.org/resources/oregon-residential-specialty-code-2005-baseline-and-code-roadmap-to-achieve-the-2030-goal

The New Economics of Electrifying Buildings. RMI, 12 Feb. 2021, rmi.org/insight/the-new-economics-of-electrifying-buildings.

Uncovering the Deadly Toll of Air Pollution from Buildings. RMI, 5 May 2021, https://rmi.org/uncovering-the-deadly-toll-of-air-pollution-from-buildings/

Gas Stoves: Health and Air Quality Impacts and Solutions. RMI, 1 Feb. 2021, rmi.org/insight/gas-stoves-pollution-health/.

ENERGY STAR Most Efficient 2022 Criteria Development, U.S. EPA, https://www.energystar.gov/products/spec/energy_star_most_efficient_2022_criteria_development_pd.

Dinulescu, Cristina, Cost to Replace Electrical Panel: Factors & Prices. Penna Electric, 27, July 2020, https://pennaelectric.com/electrician-blog/cost-to-replace-electrical-panel-factors-prices/

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

Electric appliances and equipment cost less than gas appliances. Installing all-electric appliances also reduces natural gas infrastructure costs such as gas mains, services and meters. Using data from RSMeans, Grainger, Home Depot, NBI estimates that an all-electric home costs $8,735 less than a home built with natural gas appliances and equipment. A recent analysis by RMI which examined the cost effectiveness of all-electric homes in seven cities across the country from Climate Zone 2A to 6A, found that installing efficient heat pumps in water heating and space-heating compared to standard equipment installed in a mixed-fuel home resulted in life cycle cost savings in every city. Including the cost of more efficient electric equipment, the all-electric home cost on average $2,700 less than a code compliant mixed-fuel home. All-electric homes with efficient heat pumps exhibited on average $107 in lower annual utility costs. The analysis concluded that a homeowner with an all-electric home would save $3,700 over a 15-year analysis period. In addition, all electric homes with efficient heat pumps resulted in carbon emissions savings of between fifty to ninety-three percent in all climate zones. Accounting for the societal benefit carbon emissions would result in increased life cycle cost savings across all climate zones.

NBI also analyzed the cost effectiveness of an all-electric home in New York City (Climate Zone 4A) that met the requirements in NBI's Decarbonization code compared to a code compliant mixed-fuel home that met the requirements of the 2021 IECC. NBI's decarbonization code all-electric home analyzed was solar-ready, EV-ready, utilized a heat pump water heater, demand responsive controls and minimum code compliant HVAC system. These features resulted in reduced cost of $8,357 for a single-family home. Utilizing local time-of-use rates, the all-electric home resulted in equivalent utility costs as the baseline mixed fuel home and positive life cycle cost savings of $14,828 for the consumer over a 30-year analysis period. Life cycle cost savings doubled to $23,934 if the social cost of carbon is included in the analysis.

Finally, neither analysis cited includes the cost of electrical retrofits that will be required of homes that are not all-electric to meet future policy goals of achieving net zero carbon emissions by 2050. Simply upgrading the electrical panel itself to add electrical capacity for new electric appliances can cost a homeowner between $2,650 to $4,500. Adding electrical outlets that can service major appliances so that homeowners can replace a natural gas appliance with an all-electric appliance will also add significant additional costs especially if those appliances are in areas where dry wall must be removed and repaired.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: provides optional appendix for jurisdictions wanting to put this regulation in place and provides consistent language.

Final Hearing Results

REPI-155-21	AM

REPI-156-21
Original Proposal

IECC®: SECTION RC102, SECTION 202 (New), SECTION RC103 (AX103) (New), RC102.1, RC102.2, TABLE RC102.2

Proponents: Patricia Chawla, Austin Energy, Austin Energy (patricia.chawla@austinenergy.com)

2021 International Energy Conservation Code

Revise as follows:

SECTION RC102 (AX102)
~~ZERO ENERGY RESIDENTIAL BUILDINGS~~
GENERAL DEFINITIONS

Add new definition as follows:

COMMUNITY RENEWABLE ENERGY FACILITY (CREF)POWER PRODUCTION. The yearly energy, in kilowatt hour equivalent (kWheq), contracted from a community renewable energy facility that is qualified under applicable state and local utility statutes and rules, and that allocates bill credits to the rated home.

RENEWABLE ENERGY PURCHASE CONTRACT (REPC)POWER PRODUCTION. The yearly energy, in kilowatt hour equivalent (kWheq), contracted from an energy facility that generates energy with photovoltaic, solar thermal, geothermal energy or wind systems, and that is demonstrated by an energy purchase contract or lease with a duration of not less than 15 years.

Add new text as follows:

SECTION RC103 (AX103)
ZERO ENERGY RESIDENTIAL BUILDINGS

Revise as follows:

~~RC102.1~~ RC103.1 (AX103.1) General. New *residential buildings* shall comply with Section ~~RC102.2~~ RC103.2.

~~RC102.2~~ RC103.2 (AX103.2) Energy Rating Index zero energy score. Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table ~~RC102.2~~ RC103.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:

1. ERI value not including on-site power production (OPP) calculated in accordance with RESNET/ICC 301.
2. ERI value including on-site power production calculated in accordance with RESNET/ICC 301 with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.

$$\text{Adjusted OPP} = \text{OPP} + \text{CREF} + \text{REPC} \qquad \textbf{(Equation RC-1)}$$

~~where:~~

CREF = Community Renewable Energy Facility power production—~~the yearly energy, in kilowatt hour equivalent (kWheq), contracted from a community renewable energy facility that is qualified under applicable state and local utility statutes and rules, and that allocates bill credits to the rated home.~~

REPC = Renewable Energy Purchase Contract power production—~~the yearly energy, in kilowatt hour equivalent (kWheq), contracted from an energy facility that generates energy with photovoltaic, solar thermal, geothermal energy or wind systems,~~

~~**and that is demonstrated by an energy purchase contract or lease with a duration of not less than 15 years.**~~

TABLE ~~RC102.2~~ RC103.2 (TABLE AX103.2) MAXIMUM ENERGY RATING INDEX[a]

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP	ENERGY RATING INDEX INCLUDING ADJUSTED OPP (as proposed)
1	43	0
2	45	0
3	47	0
4	47	0
5	47	0
6	46	0
7	46	0
8	46	0

a. The building shall meet the requirements of Table R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or R402.1.3 of the *2015 International Energy Conservation Code*.

Reason: This proposal seeks to improve readability and structure of the language by moving defined words to a definitions portion of the Appendix. No changes were made to the content of the definitions. All other changes are renumbering changes.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

The proposed code reorganizes and restructures the existing code only and will not affect the cost of construction. No changes were made to the content of the definitions. The reorganization and restructuring increase the flexibility of the code for future code proposals.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: proposal simplifies the scope statement of the appendix

Final Hearing Results

REPI-156-21 AM

REPI-157-21

Original Proposal

IECC®: RC102.2 (AX102.2) (New), TABLE RC102.2, RC102.2.1 (AX102.2.1) (New), ASHRAE Chapter 06 (New)
Proponents: Emily Toto, ASHRAE, ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Add new text as follows:

RC102.2 (AX102.2) Requirements. New residential buildings shall comply with one of the following:

1. The Energy Rating Index (ERI) not including OPP calculated in accordance with RESNET/ICC 301 for the rated design shall be not more than the values listed in Table RC102.2 and the requirements of Sections R406.3, R406.6 and R406.7 and Table R406.2 shall be met, or
2. The requirements of ASHRAE/IES Standard 90.2, including the ERI requirements of ASHRAE/IES 90.2 Table 6-1 without the use of on-site power production (OPP), and the requirements of Sections R402.4.1.1, R402.4.1.2, R406.3, R404.4 (Electric Readiness), and R404.4 (Electric Vehicle Power Transfer Infrastructure) shall be met.

Revise as follows:

TABLE RC102.2 (TABLE AX102.2) MAXIMUM ENERGY RATING INDEX[a]

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP	ENERGY RATING INDEX INCLUDING ADJUSTED OPP (as proposed)
1	43	0
2	45	0
3	47	0
4	47	0
5	47	0
6	46	0
7	46	0
8	46	0

~~a. The building shall meet the requirements of Table R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or R402.1.3 of the *2015 International Energy Conservation Code*.~~

Add new text as follows:

RC102.2.1 (AX102.2.1) On-site power production. New residential buildings shall achieve an Energy Rating Index (ERI) value including onsite power production not more than the values in Table RC 102.2. The ERI shall be calculated in accordance with RESNET/ICC 301 with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.

Adjusted OPP = OPP + CREF + REPC **(Equation RC-1)**

where:CREF = Community Renewable Energy Facility power production–the yearly energy, in kilowatt hour equivalent (kWheq), contracted from a community renewable energy facility that is qualified under applicable state and local utility statutes and rules, and that allocates bill credits to the rated home.REPC = Renewable Energy Purchase Contract power production–the yearly energy, in kilowatt hour equivalent (kWheq), contracted from an energy facility that generates energy with photovoltaic, solar thermal, geothermal energy or wind systems, and that is demonstrated by an energy purchase contract or lease with a duration of not less than 15 years.

Add new standard(s) as follows:

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

ASHRAE/IES 90.2-2018: Energy-Efficient Design of Low-Rise Residential Buildings

Reason: The modifications in this proposal aim to standardize the method of achieving Net Zero for residential buildings. The modifications do not change the ERI values or the fact that you must meet the requirements of Table R406.2. By adding a reference to ASHRAE 90.2 users, software developers, and code officials will have the added guidance of a well vetted ASHRAE standard. The previously referenced standard RESNET 301 does not set ERI targets like that of ASHRAE 90.2. The targets in the existing appendix were taken from ASHRAE 90.2. At the time 90.2 was just being finalized and therefore was not referenced in the existing appendix. Modifications include:

- Adding the word "Net" Zero. Although there is some debate over the inclusion of the word "Net" in the industry to describe buildings achieving this degree of efficiency and reliance on renewable energy sources it is widely accepted and adequately describes the intent of this section.
- Replacing then text of RC102.2 with a new "Requirements" section that clearly outlines the requirements of this section:
- #1 points users to the "mandatory requirements" of the code. This is consistent with the current appendix.
- #2 points users to the newly referenced ASHRAE 90.2 standard vs. RESNET 301.
- #3 lets users know they must comply with Table 6-1 of 90.1 without using renewable energy in the calculation. This is consistent with the existing appendix language.
- #4 makes it clear that users must also achieve and ERI of 0 and that they can use renewable energy to achieve this calculation. This is also consistent with the current appendix.
- Section RC102.2.1 is added to address the existing allowance to use Community Renewable Energy Facility power production and Renewable Energy Purchase Contract power production in OPP calculations in a way that is more meaningful in light of the reference to ASHRAE 90.2.
- Table RC102.2 is deleted as it is no longer needed because these exact ERI values are contained in the ASHRAE 90.2 standard.
- Added ASHRAE/IES 90.2 to Chapter 6 Referenced Standards.

Bibliography: ASHRAE/IES 90.2-2018: Energy-Efficient Design of Low-Rise Residential Buildings

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This code change does not impact the cost of construction. Modifications do not change the stringency of this voluntary appendix.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: adds a reference to ASHRAE 90.2 to the appendix as an additional reference standard.

Final Hearing Results

REPI-157-21 AM

REPI-158-21

Original Proposal

IECC®: SECTION 202, SECTION R404, R404.4 (N1104.4) (New), R406.7.3, RC102.3 (AX102.3) (New)
Proponents: Diana Burk, New Buildings Institute, New Buildings Institute (diana@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

RENEWABLE ENERGY CERTIFICATE (REC). A~~n~~ market-based instrument that represents and conveys the environmental, attributes of one megawatt hour of renewable electricity generation and could be sold separately from the underlying physical electricity associated with renewable energy resources ~~energy~~; also known as anenergy attribute and energy attribute certificate (EAC).

SECTION R404 (N1104) ELECTRICAL POWER, ~~AND~~ LIGHTING, AND RENEWABLE ENERGY SYSTEMS

Add new text as follows:

R404.4 (N1104.4) Renewable energy certificate (REC) documentation. Where renewable energy generation is used to comply with this code, the documentation shall be provided to the *code official* bythe property owner or owner's authorized agent which demonstrates that where RECs or EACs are associated with that portion of renewable energy used to comply with this code, the RECs or EACs shall be retained, or retired, on behalf of the property owner.

Revise as follows:

R406.7.3 (N1106.7.3) Renewable energy certificate (REC) documentation. Where ~~on-site~~ renewable energy power production is included in the calculation of an ERI, documentation shall comply with Section R404.5. ~~one of the following forms of documentation shall be provided to the code official:~~

1. ~~Substantiation that the RECs associated with the on-site renewable energy are owned by, or retired on behalf of, the homeowner~~.
2. ~~A contract that conveys to the homeowner the RECs associated with the on-site renewable energy, or conveys to the homeowner an equivalent quantity of RECs associated with other renewable energy.~~

Add new text as follows:

RC102.3 (AX102.3) Renewable energy certificate (REC) documentation. Where *RECs* are associated with *renewable energy* power production included in the calculation of ERI zero energy score, documentation shall comply with Section R404.5.

Reason: During the 2021 IECC process the original proposal was revised during the public comment period. Because of the rules of the public comment hearings, the original proposal and not the public comment was put up for the online vote. This proposal brings back the public comment language for consideration into the 2024 IECC.

The revised language clarifies and simplifies the original proposal. The Solar Energy Industry Association (SEIA) assisted NBI in drafting these revisions. The Comment clarifies that the owner or the owner's agent shall show that the ownership or retirement of RECs have been properly tracked to the owner. This information about the treatment of RECs is found in typical leases, contracts and incentive agreements for installed solar energy systems. A reference to the contractual provision is all that is needed to satisfy the requirements of this proposal – and this reference to the RECs provision in the plans set is all that the code official would need to examine.

As an example, the following language from Austin Energy's solar program states (emphasis added): "*Customers receiving service under* *either Non-Demand or Demand Value-Of-Solar Riders cannot combine services with the Load Shifting Voltage Discount Rider. Renewable Energy Credits (RECs) and all other renewable energy attributes for generation receiving Value-of-Solar credits are aggregated by Austin Energy. All RECs for energy consumed onsite* ***will be retired on behalf of the solar customer****. "*

This is a sample bilateral contract involving the Solano (CA) Community College District: "***Environmental Attributes and Energy Credits.*** *District shall own all right, title, and interest associated with or resulting from the development, construction, installation and ownership of any facilities installed on the Project ("Generating Facilities")"*

This proposal also seeks to clarify the term renewable energy certificate. The proposal more closely aligns the definition with language under consideration both in ASHRAE Standard 228P, The Standard Method of Evaluating Zero Energy Building Performance, and in ASHRAE Standard 189.1, which will be the basis of the IgCC.

Finally, the proposal adds the term "renewable energy" in the title of Section R404 and documentation for REC requirements in this section to ensure REC documentation requirements apply if renewable energy requirements are added to this section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal simply clarifies requirements and thus will result in no additional cost for compliance with the standard.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: addresses committee concerns regarding the potential use of off site renewables and indicates that only the portion or RECs required for compliance shall be counted.

Final Hearing Results

REPI-158-21	AM

REPI-160-21

Original Proposal

IECC®: RC102.2

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

2021 International Energy Conservation Code

Revise as follows:

RC102.2 (AX102.2) Energy Rating Index zero energy score. Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RC102.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:

1. ERI value not including on-site power production (OPP) calculated in accordance with RESNET/ICC 301.
2. ERI value including on-site power production calculated in accordance with RESNET/ICC 301 with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.

$$\text{Adjusted OPP} = \text{OPP} + \text{CREF} + \text{REPC}$$ **(Equation RC-1)**

where:

CREF = Community Renewable Energy Facility power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from a community renewable energy facility that is qualified under applicable state and local utility statutes and rules, and that allocates bill credits to the rated home.

REPC = Renewable Energy Purchase Contract power production–the yearly energy, in kilowatt hour equivalent (kWheq), contracted from an energy facility that generates energy with *renewable energy resources* ~~photovoltaic, solar thermal, geothermal energy or wind systems~~, and that is demonstrated by an energy purchase contract or lease with a duration of not less than ~~15~~ 10 years.

Reason: This proposal aligns the text of RC102.2 with the definition of renewable energy resources located on page R2-3. By taking out the list and using the definition, it will prevent conflicts with state or local laws that have a longer list of eligible renewable energy resources.

In addition, it modifies the contract period to be more consistent with the typical length of time that people are in a residence.

https://ipropertymanagement.com/research/average-length-of-homeownership (data shows that the average length of home ownership is 8.17 years, and only 37% of Americans have lived in their homes for 10+ years)

https://www.nar.realtor/blogs/economists-outlook/how-long-do-homeowners-stay-in-their-homes (median length of home ownership is 13 years, with significant regional variations).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

These proposed changes will not affect the cost of construction.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: This proposal adds the more inclusive term “renewable energy resources” instead of spelling out various types of renewable energy. It would also change the terms of an energy purchase contract or lease from not less than 15 years to not less than 10 years.

Final Hearing Results

REPI-160-21	AS

REPI-161-21

Original Proposal

IECC®: SECTION 202 (New), RC102.2

Proponents: Diana Burk, New Buildings Institute, New Buildings Institute (diana@newbuildings.org)

2021 International Energy Conservation Code

Add new definition as follows:

COMMUNITY RENEWABLE ENERGY FACILITY. A facility that produces energy harvested from *renewable energy resources* and is qualified as a community energy facility under applicable jurisdictional statutes and rules.

FINANCIAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT (FPPA) . A financial arrangement between a renewable electricity generator and a purchaser wherein the purchaser pays or guarantees a price to the generator for the project's renewable generation. Also known as a "financial power purchase agreement" and "virtual power purchase agreement."

PHYSICAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT (PPPA). A contract for the purchase of renewable electricity from a specific renewable electricity generator to a purchaser of renewable electricity.

Revise as follows:

RC102.2 (AX102.2) Energy Rating Index zero energy score. Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RC102.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:

1. ERI value not including on-site power production (OPP) calculated in accordance with RESNET/ICC 301.
2. ERI value including on-site power production calculated in accordance with RESNET/ICC 301 with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.

Adjusted OPP = OPP+CREF+~~REPC~~ **(Equation RC-1)**
PPPA+FPPA
where:

CREF = Community Renewable Energy Facility power production–the yearly energy, in kilowatt hour equivalent (kWheq), contracted from a *community renewable energy facility*.~~community renewable energy facility that is qualified under applicable state and local utility statutes and rules, and that allocates bill credits to the rated home.~~
~~REPC~~ PPPA= Physical Renewable Energy Power Purchase Agreement ~~Contract~~ power production–the yearly energy, in kilowatt hour equivalent (kWheq), contracted from a *physical renewable energy power purchase agreement* ~~an energy facility that generates energy with photovoltaic, solar thermal, geothermal energy or wind systems~~, and that is demonstrated by an energy purchase contract or lease with a duration of not less than 15 years.FPPA = Financial Renewable Energy Power Purchase Agreement power production – the yearly energy, in kilowatt hour equivalent (kWheq) contracted from a *financial renewable energy power purchase agreement* with a duration of not less than 15 years.

Reason: This amendment clarifies and aligns off-site renewable energy definitions with other codes. The amendment changes the name of a "renewable energy purchase contract" to the more common name "physical renewable energy power purchase agreement." The amendment clarifies the definition of a community renewable energy facility and allows financial renewable energy power purchase agreements to be counted towards a buildings ERI zero energy score. Finally, this amendment aligns the nomenclature and definitions in this Appendix with language under consideration both in ASHRAE Standard 228P, The Standard Method of Evaluating Zero Energy Building Performance, and in ASHRAE Standard 189.1, which will be the basis of the IgCC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal simply clarifies requirements and thus will result in no additional cost for compliance with the standard.

Public Hearing Results

Committee Action	**As Submitted**

Committee Reason: There was discussion regarding definitions as well as interaction with other proposals in front of the EPLS SC and how their action would affect this proposal. It was agreed by the Econ SC that this proposal should be moved out of SC as submitted for action by the full committee.

Final Hearing Results

REPI-161-21	AS

REPI-163-21

Original Proposal

IECC®: TABLE RC102.2

Proponents: Kim Cheslak, NBI, NBI (kim@newbuildings.org); Lauren Urbanek, Natural Resources Defense Council (lurbanek@nrdc.org)

2021 International Energy Conservation Code

Revise as follows:

TABLE RC102.2 (TABLE AX102.2) MAXIMUM ENERGY RATING INDEX[a]

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP	ENERGY RATING INDEX INCLUDING ADJUSTED OPP (as proposed)
0	42	0
1	4342	0
2	4542	0
3	4742	0
4	4742	0
5	4742	0
6	4642	0
7	4642	0
8	4642	0

a. The building shall meet the requirements of Table R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or R402.1.3 of the *2015 International Energy Conservation Code*.

Reason: The adoption of the Zero Home Appendix into the 2021 IECC has garnered a lot of attention and questions from cities and states looking to understand its energy impact and alignment with energy reduction and climate goals. The 2021 IECC provided scores that are in line with ASHRAE Standard 90.2 – which is more efficient than the base 2021, but less efficient than we know can be built.

To truly embody the goal of a zero energy home, a building cannot just offset its energy, it also needs to use less energy. Targets presented for consideration here are based on a scan of PHIUS certified projects in the US.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

Because the proposal is based on a performance path, the strategies to achieve the targets are able to be optimized by the design teams to incur the smallest upfront incremental costs and the largest month over month energy, cost, and carbon savings for the life of the building.

Public Hearing Results

Committee Action **As Modified**

Committee Reason: After discussion it was determined the PHIUS values submitted by Climate Zone were overly stringent. The subcommittee felt a more realistic value to set the ERI values across all Climate Zones at 42.

Final Hearing Results

REPI-163-21 AM

REPI-165-21
Original Proposal

IECC®: TABLE R402.1.2, R402.1.3, APPENDIX RD (New), RD101 (New), RD101.1 (New), TABLE RD101.1 (New), RD101.2 (New), RD101.3 (New), RD102 (New), RD103 (New), RD104 (New), RD105 (New), RD106 (New)

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz); Joel Martell, North American Insulation Manufacturers Association (NAIMA) (joel.e.martell@gmail.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

Portions of table not shown remain unchanged.

For SI: 1 foot = 304.8 mm.

a. Nonfenestration *U*-factors shall be obtained from Appendix RD or by *approved* test data ~~measurement~~, *approved* calculation, or an *approved* source.

R402.1.3 R-value alternative. Assemblies with *R*-value of insulation materials equal to or greater than that specified in Table R402.1.3 shall be an alternative to the *U*-factor in Table R402.1.2. *R*-values of insulation materials for the assemblies specified in Appendix RD that have a *U*-factor less than or equal to the *U*-factor required by Table R402.1.2 shall be permitted.

Add new text as follows:

APPENDIX RD
ALTERNATIVE BUILDING THERMAL ENVELOPE INSULATION R-VALUE OPTIONS

RD101
ABOVE-GRADE WALL ASSEMBLIES

RD101.1 Wood frame walls. Wood frame *above-grade wall* assemblies shall comply with both the *cavity insulation* and *continuous insulation R*-values and framing conditions specified by Table RD101.1 where the tabulated *U*-factors are less than or equal to those needed for compliance with Section R402.1.2. For assemblies not addressed by the conditions of Table RD101.1, *U*-factors shall be determined by using accepted engineering practice or by testing in accordance with ASTM C1363 and shall be subject to approval by the *code official* in accordance with Section R102.1. Use of a lesser framing fraction than the indicated maximums in Table RD101.1 shall require wall framing layout details for each *above-grade wall* elevation to be included on *approved* construction documents and shall be inspected for compliance

TABLE RD101.1 ASSEMBLY U-FACTORS FOR WOOD FRAME WALLS[a,b,c,d,e,]

Woo g .stwl &. Spac .iw:	Cavity Insula .tiwl In.stall m..R.:. value	Continuous Insulation R-value																		
		.0.	1	2.	J.	i.	.5.	.6.	l	.a	.2.	1.0.	ll	12.	13.	li	1.5.	.2.0.	2..5.	J..D.
2x4 (12" .QU	.Q	0.324	0.239	.!U 90	0.158	0.136	0.119	0.106	0.096	0.087	0.080	0.074	0.069	0.064	0.060	0.057	0.054	0.042	0.035	0.030
	11	0.094	0.085	0.078	0.072	0.067	0.062	0.059	0.055	0.052	0.050	0.047	0.045	0.043	0.041	0.040	0.038	0.032	0.027	0.024
	12	0.090	0.082	0.075	0.069	0.064	0.060	0.057	0.054	0.051	0.048	0.046	0.044	0.042	0.040	0.039	0.037	0.031	0.027	0.024
	13	0.087	0.079	0.072	0.067	0.063	0.059	0.055	0.052	0.049	0.047	0.045	0.043	0.041	0.039	0.038	0.036	0.031	0.027	0.023
	14	0.084	0.076	0.070	0.065	0.061	0.057	0.054	0.0 .il	0.048	0.046	0.044	0.042	0.040	0.038	0.037	0.036	0.030	0.026	0.023
	15	0.082	0.074	0.068	0.063	0.059	0.055	0.052	0.049	0.047	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.030	0.026	0.023
	16	0.079	0.072	0.066	0.062	0.058	0.054	0.051	0.048	0.046	0.044	0.042	0.040	0.038	0.037	0.036	0.034	0.029	0.025	0.022
	17	0.077	0.070	0.065	0.060	0.056	0.053	0.050	0.047	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.029	0.025	0.022
	18	0.076	0.069	0.063	0.059	0.055	0.052	0.049	0.046	0.044	0.042	0.040	0.038	0.037	0.036	0.034	0.033	0.028	0.025	0.022
	19	0.074	0.067	0.062	0.058	0.054	0.051	0.048	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.032	0.028	0.024	0.022
	20	0.072	0.066	0.061	0.056	0.053	0.050	0.047	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.033	0.032	0.027	0.024	0.021
2x6 (12" .QU	.Q	0.313	0.230	.!U 83	0.153	0.131	0.115	0.1 0Z	0.093	0.084	0.078	0.072	0.067	0.063	0.059	0.055	0.053	0.041	0.034	0.029
	18	0.065	0.060	0.056	0.053	0.050	0.048	0.045	0.043	0.041	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.027	0.024	0.021
	19	0.063	0.059	0.055	0.052	0.049	0.047	0.044	0.042	0.040	0.039	0.037	0.036	0.035	0.033	0.032	0.031	0.027	0.024	0.021
	20	0.062	0.057	0.054	0.051	0.048	0.046	0.043	0.041	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.026	0.023	0.021
	21	0.060	0.056	0.053	0.050	0.047	0.045	0.043	0.041	0.039	0.037	0.036	0.035	0.033	0.032	0.031	0.030	0.026	0.023	0.021
	22	0.059	0.055	0.052	0.049	0.046	0.044	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.026	0.023	0.020
	23	0.058	0.054	0.0 .51.	0.048	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.025	0.022	0.020

	24	0.0 57	0.0 53	0.0 50	0.0 47	0.0 44	0.0 42	0.0 40	0.0 39	0.0 37	0.0 35	0.0 34	0.0 33	0.010.0 32 31	0.0 30	0.0 29	0.010.0 ZS 22	0.0 20
	25	0.0 56	0.0 52	0.0 49	0.0 46	0.0 44	0.0 42	0.0 40	0.0 38	0.0 36	0.0 35	0.0 34	0.0 32	0.010.0 31 30	0.0 29	0.0 28	0.0 0.0 ZS 22	0.0 20
	30	0.0 52	0.0 48	0.0 45	0.0 43	0.0 41	0.0 39	0.0 37	0.0 35	0.0 34	0.0 33	0.0 31	0.0 30	0.010.0 29 28	0.0 27	0.0 27	0.010.0 23 21	0.0 19
	35	0.0 49	0.0 46	0.0 43	0.0 40	0.0 38	0.0 36	0.0 35	0.0 33	0.0 32	0.0 31	0.0 30	0.0 29	0.010.0 28 27	0.0 26	0.0 25	0.010.0 22 20	0.0 18
2x8 (12" .Q£).	_Q	0.3 08	0.2 26	.!U 79	0.1 49	0.1 28	0.1 12	0.1 00	0.0 91	0.0 83	0.0 76	0.0 70	0.0 66	0.010.0 61 58	0.0 54	0.0 52	0.010.0 41 34	0.0 29
	20	0.0 56	0.0 53	0.0 50	0.0 47	0.0 45	0.0 43	0.0 41	0.0 39	0.0 38	0.0 36	0.0 35	0.0 34	0.010.0 33 32	0.0 31	0.0 30	0.010.0 26 23	0.0 20
	21	0.0 55	0.0 52	0.0 49	0.0 46	0.0 44	0.0 42	0.0 40	0.0 39	0.0 37	0.0 36	0.0 34	0.0 33	0.010.0 32 31	0.0 30	0.0 29	0.010.0 ZS 22	0.0 20
	22	0.0 53	0.0 50	0.0 48	0.0 45	0.0 43	0.0 41	0.0 39	0.0 38	0.0 36	0.0 35	0.0 34	0.0 33	0.010.0 32 31	0.0 30	0.0 29	0.010.0 ZS 22	0.0 20
	23	0.0 52	0.0 49	0.0 47	0.0 44	0.0 42	0.0 40	0.0 39	0.0 37	0.0 36	0.0 34	0.0 33	0.0 32	0.010.0 31 30	0.0 29	0.0 28	0.010.0 ZS 22	0.0 20
	24	0.0 51	0.0 48	0.0 46	0.0 44	0.0 42	0.0 40	0.0 38	0.0 37	0.0 35	0.0 34	0.0 33	0.0 32	0.010.0 31 30	0.0 29	0.0 28	0.010.0 24 22	0.0 19
	25	0.0 50	0.0 47	0.0 45	0.0 43	0.0 41	0.0 39	0.0 37	0.0 36	0.0 35	0.0 33	0.0 32	0.0 31	0.010.0 30 29	0.0 28	0.0 27	0.010.0 24 21	0.0 19
	30	0.0 46	0.0 44	0.0 41	0.0 39	0.0 38	0.0 36	0.0 35	0.0 33	0.0 32	0.0 31	0.0 30	0.0 29	0.010.0 28 27	0.0 26	0.0 26	0.010.0 23 20	0.0 18
	35	0.0 43	0.0 41	0.0 39	0.0 37	0.0 35	0.0 34	0.0 32	0.0 .ll	0.0 30	0.0 29	0.0 28	0.0 27	0.010.0 26 26	0.0 25	0.0 24	0.010.0 21 19	0.0 17
	40	0.0 41	0.0 39	0.0 37	0.0 35	0.0 33	0.0 32	0.0 31	0.0 30	0.0 29	0.0 28	0.0 27	0.0 26	0.010.0 ZS 24	0.0 24	0.0 23	0.010.0 20 18	0.0 17
2x4 (16" .Q£).	_Q	0.3 31	0.2 43	.!U 93	0.1 61	0.1 38	0.1 20	0.1 07	0.0 97	0.0 88	0.0 81	0.0 75	0.0 69	0.010.0 65 61	0.0 57	0.0 54	0.010.0 43 35	0.0 30
	11	0.0 92	0.0 83	0.0 76	0.0 71	0.0 66	0.0 61	0.0 58	0.0 54	0.0 52	0.0 49	0.0 47	0.0 45	0.010.0 43 41	0.0 39	0.0 38	0.010.0 32 27	0.0 24
	12	0.0 88	0.0 80	0.0 73	0.0 68	0.0 63	0.0 59	0.0 56	0.0 53	0.0 50	0.0 48	0.0 45	0.0 43	0.010.0 41 40	0.0 38	0.0 37	0.010.0 31 27	0.0 24
	13	0.0 84	0.0 77	0.0 71	0.0 66	0.0 61	0.0 57	0.0 54	0.0 .5.1	0.0 49	0.0 46	0.0 44	0.0 42	0.010.0 40 39	0.0 37	0.0 36	0.010.0 30 26	0.0 23
	14	0.0 81	0.0 74	0.0 68	0.0 64	0.0 59	0.0 56	0.0 53	0.0 50	0.0 47	0.0 45	0.0 43	0.0 41	0.010.0 39 38	0.0 37	0.0 35	0.010.0 30 26	0.0 23
	15	0.0 79	0.0 72	0.0 66	0.0 62	0.0 58	0.0 54	0.0 51	0.0 49	0.0 46	0.0 44	0.0 42	0.0 40	0.010.0 39 37	0.0 36	0.0 34	0.010.0 29 ZS	0.0 23
	16	0.0 77	0.0 70	0.0 65	0.0 60	0.0 56	0.0 53	0.0 50	0.0 47	0.0 45	0.0 43	0.0 41	0.0 39	0.010.0 38 36	0.0 35	0.0 34	0.010.0 29 ZS	0.0 22

	17	0.0 75	0.0 68	0.0 63	0.0 58	0.0 55	0.0 52	0.0 49	0.0 46	0.0 44	0.0 42	0.0 40	0.0 39	0.010.0 37 36	0.0 34	0.0 33	0.010.0 28 25	0.0 22
	18	0.0 73	0.0 66	0.0 61	0.0 57	0.0 53	0.0 50	0.0 48	0.0 45	0.0 43	0.0 41	0.0 39	0.0 38	0.010.0 36 35	0.0 34	0.0 33	0.0 0.0 28 24	0.0 22
	19	0.0 71	0.0 65	0.0 60	0.0 56	0.0 52	0.0 49	0.0 47	0.0 44	0.0 42	0.0 40	0.0 39	0.0 37	0.010.0 36 34	0.0 33	0.0 32	0.010.0 27 24	0.0 21
	20	0.0 69	0.0 63	0.0 59	0.0 55	0.0 51	0.0 48	0.0 46	0.0 43	0.0 41	0.0 39	0.0 38	0.0 36	0.010.0 35 34	0.0 32	0.0 31	0.010.0 27 24	0.0 21
2x6	_Q	0.3 22	0.2 36	.!U 87	0.1 56	0.1 33	0.1 17	0.1 04	0.0 94	0.0 86	0.0 79	0.0 73	0.0 68	0.010.0 63 59	0.0 56	0.0 53	0.010.0 42 34	0.0 29
(16" .Q£).	18	0.0 63	0.0 59	0.0 55	0.0 52	0.0 49	0.0 47	0.0 44	0.0 42	0.0 41	0.0 39	0.0 37	0.0 36	0.010.0 35 34	0.0 32	0.0 31	0.010.0 27 24	0.0 21
	19	0.0 61	0.0 57	0.0 54	0.0 51	0.0 48	0.0 46	0.0 43	0.0 42	0.0 40	0.0 38	0.0 37	0.0 35	0.010.0 34 33	0.0 32	0.0 31	0.010.0 27 23	0.0 21
	20	0.0 60	0.0 56	0.0 52	0.0 50	0.0 47	0.0 45	0.0 42	0.0 41	0.0 39	0.0 37	0.0 36	0.0 35	0.010.0 33 32	0.0 31	0.0 30	0.010.0 26 23	0.0 21
	21	0.0 58	0.0 55	0.0 .5.1	0.0 48	0.0 46	0.0 44	0.0 42	0.0 40	0.0 38	0.0 37	0.0 35	0.0 34	0.010.0 33 32	0.0 31	0.0 30	0.010.0 26 23	0.0 20
	22	0.0 57	0.0 53	0.0 50	0.0 47	0.0 45	0.0 43	0.0 41	0.0 39	0.0 37	0.0 36	0.0 35	0.0 33	0.010.0 32 31	0.0 30	0.0 29	0.010.0 25 22	0.0 20
	23	0.0 56	0.0 52	0.0 49	0.0 46	0.0 44	0.0 42	0.0 40	0.0 38	0.0 37	0.0 35	0.0 34	0.0 33	0.010.0 32 31	0.0 30	0.0 29	0.010.0 ZS 22	0.0 20
	24	0.0 55	0.0 51	0.0 48	0.0 46	0.0 43	0.0 41	0.0 39	0.0 38	0.0 36	0.0 35	0.0 33	0.0 32	0.010.0 31 30	0.0 29	0.0 28	0.010.0 ZS 22	0.0 20
	25	0.0 54	0.0 50	0.0 47	0.0 45	0.0 42	0.0 40	0.0 39	0.0 37	0.0 35	0.0 34	0.0 33	0.0 32	0.010.0 31 30	0.0 29	0.0 28	0.010.0 24 22	0.0 19
	30	0.0 50	0.0 46	0.0 44	0.0 41	0.0 39	0.0 37	0.0 36	0.0 34	0.0 33	0.0 32	0.0 31	0.0 29	0.010.0 29 28	0.0 27	0.0 26	0.010.0 23 20	0.0 18
	35	0.0 47	0.0 43	0.0 41	0.0 39	0.0 37	0.0 35	0.0 33	0.0 32	0.0 31	0.0 30	0.0 29	0.0 28	0.010.0 27 26	0.0 25	0.0 25	0.010.0 22 19	0.0 17
2x8	_Q	0.3 17	0.Z 32	.!U 84	0.1 52	0.1 31	0.1 15	0.1 0Z	0.0 92	0.0 84	0.0 77	0.0 71	0.0 66	0.010.0 62 58	0.0 55	0.0 52	0.010.0 41 34	0.0 29
(16" .Q£)_	20	0.0 55	0.0 52	0.0 49	0.0 46	0.0 44	0.0 42	0.0 40	0.0 39	0.0 37	0.0 36	0.0 35	0.0 33	0.010.0 32 31	0.0 30	0.0 29	0.010.0 26 23	0.0 20
	21	0.0 53	0.0 50	0.0 48	0.0 45	0.0 43	0.0 41	0.0 40	0.0 38	0.0 37	0.0 35	0.0 34	0.0 33	0.010.0 32 31	0.0 30	0.0 29	0.010.0 ZS 22	0.0 20
	22	0.0 52	0.0 49	0.0 47	0.0 44	0.0 42	0.0 40	0.0 39	0.0 37	0.0 36	0.0 34	0.0 33	0.0 32	0.010.0 .ll 30	0.0 29	0.0 28	0.010.0 ZS 22	0.0 20
	23	0.0 51	0.0 48	0.0 46	0.0 43	0.0 41	0.0 40	0.0 38	0.0 36	0.0 35	0.0 34	0.0 33	0.0 32	0.010.0 31 30	0.0 29	0.0 28	0.010.0 24 22	0.0 20
	24	0.0 50	0.0 47	0.0 45	0.0 43	0.0 41	0.0 39	0.0 37	0.0 36	0.0 34	0.0 33	0.0 32	0.0 31	0.010.0 30 29	0.0 28	0.0 27	0.010.0 24 21	0.0 19

	25	0.0 49	0.0 46	0.0 44	0.0 42	0.0 40	0.0 38	0.0 37	0.0 35	0.0 34	0.0 33	0.0 32	0.0 31	0.010.0 30 29	0.0 28	0.0 27	0.010.0 24 21	0.0 19
	30	0.0 45	0.0 42	0.0 40	0.0 38	0.0 37	0.0 35	0.0 34	0.0 32	0.0 31	0.0 30	0.0 29	0.0 28	0.010.0 27 27	0.0 26	0.0 25	0.0 0.0 22 20	0.0 18
	35	0.0 42	0.0 39	0.0 37	0.0 36	0.0 34	0.0 33	0.0 31	0.0 30	0.0 29	0.0 28	0.0 27	0.0 27	0.010.0 26 25	0.0 24	0.0 24	0.010.0 21 19	0.0 17
	40	0.0 39	0.0 37	0.0 35	0.0 34	0.0 32	0.0 31	0.0 30	0.0 29	0.0 28	0.0 27	0.0 26	0.0 25	0.010.0 24 24	0.0 23	0.0 22	0.010.0 20 18	0.0 16
2x4 [24" ill;).	_Q	0.3 39	0.2 48	.!U 96	0.1 63	0.1 39	0.1 22	0.1 08	0.0 98	0.0 89	0.0 81	0.0 75	0.0 70	0.010.0 65 61	0.0 58	0.0 55	0.010.0 43 35	0.0 30
	11	0.0 89	0.0 81	0.0 75	0.0 69	0.0 65	0.0 61	0.0 57	0.0 54	0.0 51	0.0 48	0.0 46	0.0 44	0.010.0 42 40	0.0 39	0.0 37	0.010.0 31 27	0.0 24
	12	0.0 85	0.0 78	0.0 72	0.0 67	0.0 62	0.0 58	0.0 55	0.0 52	0.0 49	0.0 47	0.0 45	0.0 43	0.010.0 41 39	0.0 38	0.0 36	0.010.0 31 27	0.0 23
	13	0.0 82	0.0 75	0.0 69	0.0 64	0.0 60	0.0 56	0.0 53	0.0 50	0.0 48	0.0 46	0.0 44	0.0 42	0.010.0 40 38	0.0 37	0.0 36	0.010.0 30 26	0.0 23
	14	0.0 79	0.0 72	0.0 67	0.0 62	0.0 58	0.0 55	0.0 52	0.0 49	0.0 47	0.0 44	0.0 42	0.0 41	0.010.0 39 37	0.0 36	0.0 35	0.010.0 30 26	0.0 23
	15	0.0 76	0.0 70	0.0 65	0.0 60	0.0 56	0.0 53	0.0 50	0.0 48	0.0 45	0.0 43	0.0 41	0.0 40	0.010.0 38 37	0.0 35	0.0 34	0.010.0 29 25	0.0 22
	16	0.0 74	0.0 68	0.0 63	0.0 58	0.0 55	0.0 52	0.0 49	0.0 46	0.0 44	0.0 42	0.0 40	0.0 39	0.010.0 37 36	0.0 34	0.0 33	0.010.0 28 25	0.0 22
	17	0.0 72	0.0 66	0.0 61	0.0 57	0.0 53	0.0 50	0.0 48	0.0 45	0.0 43	0.0 41	0.0 39	0.0 38	0.010.0 36 35	0.0 34	0.0 33	0.010.0 28 24	0.0 22
	18	0.0 70	0.0 64	0.0 59	0.0 55	0.0 52	0.0 49	0.0 46	0.0 44	0.0 42	0.0 40	0.0 39	0.0 37	0.010.0 36 34	0.0 33	0.0 32	0.010.0 27 24	0.0 21
	19	0.0 68	0.0 62	0.0 58	0.0 54	0.0 51	0.0 48	0.0 45	0.0 43	0.0 41	0.0 39	0.0 38	0.0 36	0.010.0 35 34	0.0 32	0.0 31	0.010.0 27 24	0.0 21
	20	0.0 66	0.0 61	0.0 56	0.0 53	0.0 50	0.0 47	0.0 44	0.0 42	0.0 40	0.0 39	0.0 37	0.0 36	0.010.0 34 33	0.0 32	0.0 31	0.010.0 27 23	0.0 21
2x6 (24" .Q£)_	_Q	0.3 30	0.2 41	.!U .2.1	0.1 59	0.1 36	0.1 19	0.1 06	0.0 95	0.0 87	0.0 80	0.0 74	0.0 68	0.010.0 64 60	0.0 57	0.0 53	0.010.0 42 35	0.0 30
	18	0.0 61	0.0 57	0.0 54	0.0 51	0.0 48	0.0 46	0.0 44	0.0 42	0.0 40	0.0 38	0.0 37	0.0 36	0.010.0 34 33	0.0 32	0.0 31	0.010.0 27 24	0.0 21
	19	0.0 60	0.0 56	0.0 52	0.0 50	0.0 47	0.0 45	0.0 43	0.0 41	0.0 39	0.0 37	0.0 36	0.0 35	0.010.0 34 32	0.0 31	0.0 30	0.010.0 26 23	0.0 21
	20	0.0 58	0.0 54	0.0 .5.1	0.0 48	0.0 46	0.0 44	0.0 42	0.0 40	0.0 38	0.0 37	0.0 35	0.0 34	0.010.0 33 32	0.0 31	0.0 30	0.010.0 26 23	0.0 20
	21	0.0 57	0.0 53	0.0 50	0.0 47	0.0 45	0.0 43	0.0 41	0.0 39	0.0 37	0.0 36	0.0 35	0.0 33	0.010.0 32 31	0.0 30	0.0 29	0.010.0 25 22	0.0 20
	22	0.0 55	0.0 52	0.0 49	0.0 46	0.0 44	0.0 42	0.0 40	0.0 38	0.0 37	0.0 35	0.0 34	0.0 33	0.010.0 32 31	0.0 30	0.0 29	0.010.0 25 22	0.0 20

	23	0.0 54	0.0 51	0.0 48	0.0 45	0.0 43	0.0 41	0.0 39	0.0 37	0.0 36	0.0 35	0.0 33	0.0 32	0.010.0 31 30	0.0 29	0.0 28	0.010.0 ZS 22	0.0 20
	24	0.0 53	0.0 49	0.0 47	0.0 44	0.0 42	0.0 40	0.0 38	0.0 37	0.0 35	0.0 34	0.0 33	0.0 32	0.010.0 31 30	0.0 29	0.0 28	0.0 0.0 24 22	0.0 19
	25	0.0 52	0.0 48	0.0 46	0.0 43	0.0 41	0.0 39	0.0 38	0.0 36	0.0 35	0.0 33	0.0 32	0.0 31	0.010.0 30 29	0.0 28	0.0 27	0.010.0 24 21	0.0 19
	30	0.0 47	0.0 44	0.0 42	0.0 40	0.0 38	0.0 36	0.0 35	0.0 33	0.0 32	0.0 31	0.0 30	0.0 29	0.010.0 28 27	0.0 26	0.0 25	0.010.0 22 20	0.0 18
	35	0.0 44	0.0 41	0.0 39	0.0 37	0.0 35	0.0 34	0.0 32	0.0 .ll	0.0 30	0.0 29	0.0 28	0.0 27	0.010.0 26 25	0.0 25	0.0 24	0.010.0 21 19	0.0 17
2x8	_Q	0.3 26	0.2 38	_Q,_1 88	0.1 56	0.1 33	0.1 17	0.1 04	0.0 94	0.0 85	0.0 78	0.0 72	0.0 67	0.010.0 63 59	0.0 56	0.0 53	0.010.0 42 34	0.0 29
(24" ill;).	20	0.0 54	0.0 51	0.0 48	0.0 46	0.0 43	0.0 42	0.0 40	0.0 38	0.0 37	0.0 35	0.0 34	0.0 33	0.010.0 32 31	0.0 30	0.0 29	0.010.0 25 22	0.0 20
	21	0.0 52	0.0 49	0.0 47	0.0 44	0.0 42	0.0 41	0.0 39	0.0 37	0.0 36	0.0 35	0.0 33	0.0 32	0.010.0 31 30	0.0 29	0.0 29	0.010.0 25 22	0.0 20
	22	0.0 51	0.0 48	0.0 46	0.0 43	0.0 41	0.0 40	0.0 38	0.0 37	0.0 35	0.0 34	0.0 33	0.0 32	0.010.0 31 30	0.0 29	0.0 28	0.010.0 24 22	0.0 20
	23	0.0 50	0.0 47	0.0 44	0.0 42	0.0 41	0.0 39	0.0 37	0.0 36	0.0 34	0.0 33	0.0 32	0.0 31	0.010.0 30 29	0.0 28	0.0 28	0.010.0 24 21	0.0 19
	24	0.0 48	0.0 46	0.0 44	0.0 41	0.0 40	0.0 38	0.0 36	0.0 35	0.0 34	0.0 33	0.0 32	0.0 31	0.010.0 30 29	0.0 28	0.0 27	0.010.0 24 21	0.0 19
	25	0.0 47	0.0 45	0.0 43	0.0 41	0.0 39	0.0 37	0.0 36	0.0 34	0.0 33	0.0 32	0.0 31	0.0 30	0.010.0 29 28	0.0 27	0.0 27	0.010.0 23 21	0.0 19
	30	0.0 43	0.0 41	0.0 39	0.0 37	0.0 35	0.0 34	0.0 33	0.0 32	0.0 30	0.0 29	0.0 29	0.0 28	0.010.0 27 26	0.0 25	0.0 25	0.010.0 22 20	0.0 18
	35	0.0 40	0.0 38	0.0 36	0.0 34	0.0 33	0.0 32	0.0 30	0.0 29	0.0 28	0.0 27	0.0 27	0.0 26	0.010.0 25 24	0.0 24	0.0 23	0.010.0 21 18	0.0 17
	40	0.0 37	0.0 35	0.0 34	0.0 32	0.0 31	0.0 30	0.0 29	0.0 28	0.0 27	0.0 26	0.0 25	0.0 24	0.010.0 24 23	0.0 22	0.0 22	0.010.0 19 18	0.0 16

For SI: 1 W/m2-K = 0.176 Btu/hr-ft2-F

a. Linear interpolation of U-factors shall be permitted between continuous insulation and cavity insulation R-values. For non-standard stud spacing, use the next lesser stud spacing shown in the table.

b. Table values are based on the parallel path calculation procedure as applicable to wood-frame assemblies and requires compliance with the following assembly conditions:

   1. Maximum framing fractions of 28% (assumed for 12"oc studs), 25% (assumed for 16"oc studs), and 22% (assumed for 24"oc studs) with 4% attributed to headers in all cases. The framing fraction is the percentage of overall opaque wall area occupied by framing members.
   2. Wood framing materials or species with a minimum thermal resistivity of R-1.25 per inch.
   3. Exterior sheathing with a minimum R-value of R-0.62 as based on wood structural panel. For walls having no exterior sheathing or sheathing of lesser R-value, footnote d shall be used to adjust the tabulated U-factor.
   4. Siding of a minimum R-0.62 as based on the assumption of vinyl siding. For walls with siding having a lower R-value, footnote d shall be used to adjust the tabulated U-factor.
   5. Interior finish of a minimum R-0.45 based on 1/2" gypsum. For walls having no interior finish or a finish of lesser R-value, footnote d shall be used to adjust the tabulated U-factor.
   6. Cavity insulation with a rated R-value installed as required by the manufacturer's installation instructions to satisfy the indicated installed R-value, considering a reduced R-value for compression in an enclosed cavity where applicable.
   7. Continuous insulation specified in accordance with the indicated rated R-value and installed continuously over all exterior wood framing, including studs, plates, headers, and rim joists.
   8. Indoor air film R-value of 0.68 and outdoor air-film R-value of 0.17.

c. Where any of the building materials that are continuous over the interior or exterior wall surface vary from those stated in footnote b, it is permissible to adjust the U-factor as follows: Uadj = 1/ [1/U + Rd] where U is the U-factor from the table and Rd is the increase (positive) or decrease (negative) in the cumulative R-value of building material layers on the outside and inside faces of the wall, excluding the continuous insulation R-value if present.

d. For a specific continuous insulation R-value not addressed in this table, the U-factor of the assembly shall be permitted to be determined as follows: Uadj = 1/[1/Unci + Rci] where Unci is the U-factor from the table for no continuous insulation (0 R-value column) and Rci is the specific rated R-value of continuous insulation added to the assembly.

e. For double wall framing, the U-factor shall be permitted to be determined by combining the U-factors for single wall framing from the table as follows: Ucombined = 1/[1/U1 + 1/U2] where U1 and U2 are the U-factors from the table for each of the adjacent parallel walls in the double wall assembly.

f. The use of insulation in accordance with this table does not supersede requirements in Section R702.7 of the International Residential Code for use of insulation and water vapor retarders to control water vapor.

RD101.2 Mass walls. *Reserved.*

RD101.3 Cold-formed steel frame walls. *Reserved.*

RD102 Roof and Ceiling Assemblies. *Reserved.*

RD103 Floor Assemblies. Reserved.

RD104 Basement Walls. *Reserved.*

RD105 Crawlspace Walls. *Reserved.*

RD106 Slabs-on-Grade. *Reserved.*

Reason: The purpose of this proposal is to provide expanded R-value options for determining compliance with the U-factor criteria prescribed in Section R402.1.2 of the IECC residential provisions. It also supplements the limited selection of common insulation conditions addressed in the R-value approach of Table R402.1.3 of the IECC. This proposal is intended to cover common wood-framed assemblies and not intended to address all assemblies at this time, but rather provides a framework for that to occur over time and address many different assembly types and options. Therefore, assembly types that are not addressed are labeled as “reserved” and those with interest in those “reserved” portions can bring forth future improvements or additions consistent with that done for Section RD101.1 for wood frame walls.

The proposal is focused on U-factor compliance options for wood frame above-grade walls (Section RD101.1) at this time because that is considered the most immediate need in the 2021 IECC residential prescriptive provisions due to the many market-available insulation methods and materials as well as different techniques to frame walls that can provide useful means to comply with the U-factors (and as supplemental alternatives to prescribed R-values). This proposal will also help to ensure that a wide-range of possible solutions are achieved in an equivalent and transparent manner. Thus, it will give support to the use of Section R102.1 by code officials often tasked with reviewing and approving alternative assemblies.

The calculations for proposed Table RD101.1 follow the same basis as used to justify the existing R-value options in Table R402.1.3. Calculations supporting this proposal can be made available to the committee upon request. However, the complete basis of the calculations are documented in footnotes to proposed Table RD101.1. Having calculations and assumptions documented in this manner will serve to make the code more transparent and compliance more consistent.

PLEASE SEE ATTACHED WORD FILE FOR PROPER FORMAT AND TABLES FOR THIS PROPOSAL.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

This proposal provides additional pre-calculated options for flexibility in prescriptive compliance. In that regard, it may actually reduce cost.

Public Hearing Results

Committee Action **As Submitted**

Committee Reason: Improves and adds flexibility in the code

Final Hearing Results

REPI-165-21 AS