IECC RESIDENTIAL COMMITTEE ACTION REPORT ON THE RESULTS ON THE 2021 PUBLIC INPUT CHANGES TO THE INTERNATIONAL ENERGY CONSERVATION CODES-UPDATED 7/26/22

Update July 26, 2022

Attached to this cover are updates to the previously issued IECC Residential Committee Action Report to properly align with the language acted on by the IECC Residential Consensus Committee. These include

REPI-33-21*Updated July 26*

REPI-57-21

REPI-61-21

REPI-64-21

REPI-86-21

REPI-96-21

REPI-120-21*Updated July 26*

REPI-126-21

The following items are updated to improve table formatting for legibility.

REPI-122-21

The following item is an update of the final vote tally

REPI-7-21 approved as modified 33 yes 6 no 1 abstain.

As per the instructions provided in the CAR your electronic ballot must submitted along with any comment/reason statement emailed to the Secretariat (kstenger@iccsafe.org) by **Friday, August 5 at 11:59 pm Pacific**. If you have further questions or issues with your ballot please contact the Secretariat.

REPI-33-21

IECC®: TABLE R402.1.2, TABLE R402.1.3, R408.2, R408.2.1 (New)

Proponents: Amanda Hickman, representing Leading Builders of America (LBA) (amanda@thehickmangroup.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (TABLE R1102.1.2) 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	0.0~~26~~ 30	0.084	0.165	0.064	0.360	0.477
3	0.30	0.55	0.25	0.0~~26~~ 30	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.30	0.55	0.40	0.0~~24~~ 26	0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.40	0.0~~24~~ 26	0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	0.0~~24~~ 26	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	0.0~~24~~ 26	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 R402.1.3 (TABLE N1102.1.3) 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~~ 38	13 or 0 & 10ci	4/6	13	0	0	0
3	.30	0.55	0.25	~~49~~ 38	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~~ 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

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*.

R408.2 (N1108.2) Additional efficiency credits ~~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 ten credits. 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.

Add new text as follows:

R408.2.1 Opaque wall 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 space heating.
2. All installed water heaters 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.

Reason: This proposal increases the overall energy savings beyond the 2021 IECC but does so in a more balanced approach. In order to achieve the increased energy savings measures that we have proposed to R408, this code change adjusts prescriptive insulation levels to be more flexible and cost-effective.
Overwhelming data shows that energy savings gains are very dependent on climate zone. What saves energy in one area of the country may actually cost energy in another. A one size approach does not work from an energy savings point of view and it can also lead to egregious financial cost that can price many American families out of homeownership. Unfortunately, that it is exactly what the 2021 IECC did - and it is critical that is corrected.

Approving this proposal will ensure that the 2024 IECC does not only save more energy, but also preserves home affordability, and promotes code adoption.

Cost Impact: The code change proposal will decrease the cost of construction.
The 2021 edition of the IECC contains provisions that were egregious in cost - some well over a 100 year paybacks. This proposal adjusts the levels for prescriptive envelope requirements, freeing up more to be spent in better cost effective measures that save more energy.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Initially considered alongside REPI-018-21 – and other R408 measures, this proposal was modified to align with the REPI-018 points-based approach to R408. This proposal weakens the ceiling insulation requirements in R402 and compensates by offering either electrification options or 3 additional points in R408.

REPI-57-21

IECC®: R402.4.1.2

Proponents: Lisa Rosenow, representing Self (lrosenow@evergreen-tech.net); Kevin Rose, representing 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 0.28 cfm/ft^2 (1.4 L/s × m^2) ~~cubic feet per minute (CFM) per square foot [0.0079 m^3/(s × m^2)]~~ of building 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.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: The proposal was intended to align residential with commercial air leakage testing standards.

REPI-61-21

IECC®: R402.4.1.4 (New), R402.4.1.2, R402.4.1.3

Proponents: Aaron Gary, representing Seft (aaron.gary@texenergy.org)

2021 International Energy Conservation Code

Add new text as follows:

R402.4.1.4 Sampling for R2 multifamily dwelling units. For buildings with eight or more testing units complying with R402.1.2 or R402.1.3, 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, a middle 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. Where buildings have fewer than eight testing units, each testing unit shall be tested.

Revise as follows:

R402.4.1.2 Testing. 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 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:** ~~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. 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.
2. Where tested in accordance with R402.4.1.4, 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.

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.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: sampling increase efficiencies

REPI-64-21

IECC®: R402.4.1.2, R402.4.1.3, TABLE R405.4.2(1), R408.2.5

Proponents: William Fay, representing Energy Efficient Codes Coalition; Amy Boyce, representing Energy Efficient Codes Coalition (amy.boyce@imt.org); Amber Wood, representing Energy Efficient Codes Coalition (awood@aceee.org); Jason Reott, representing Energy Efficient Codes Coalition

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (N1102.4.1.2) Testing and maximum air leakage rate. 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) 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, and 2.0 ~~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: 5.0 air changes per hour. Climate Zones 3 through 8: 2.0 ~~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.

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 2.0 ~~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).

Reason: The purpose of this code change proposal is to improve the energy efficiency and resiliency of homes in climate zones 3-8 through improved building envelope air tightness. Specifically, the proposal improves the prescriptive envelope air tightness requirement and performance path baseline from ≤3.0 ACH50 to ≤2.0 ACH50 for climate zones 3-8. It will also make a corresponding change to the Additional Efficiency Package Option that awards credit for reduced air leakage and the installation of an HRV/ERV. In order to maintain the level of trade-off flexibility allowed under the 2021 *IECC*, the proposal allows code users in climate zones 3-8 to trade up to ≤4.0 ACH50 in the performance path, as long as the efficiency losses are accounted for elsewhere in the home. The proposal also makes a corresponding improvement to the alternative air tightness requirement for smaller dwelling units.

The prescriptive envelope air tightness requirement of ≤3.0 ACH50 for climate zones 3-8 has not changed since the mandatory 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. Tighter building envelopes provide a range of benefits to homeowners at relatively low cost:

- Improving air tightness from ≤3.0 to ≤2.0 ACH50 will not substantially increase the cost of construction, but it will save homeowners money over the home's useful life;
- A tighter envelope will help both heating and cooling systems operate more 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.

Across the country, the envelope tightness in new buildings has improved in recent years 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. Above-code programs such as Energy Star require blower door testing, and it is a core element of energy ratings. Now that builders have had experience achieving the code requirement of ≤3.0 ACH50 under the *IECC* for nearly a decade, we believe the envelope air tightness requirement could be moderately improved with little additional effort.

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.

[R2 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%**

There is no question that homeowners will benefit from a tighter building envelope for many years, and we urge the adoption of this straightforward efficiency improvement.

Bibliography: 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. Some builders who achieve 3.0 ACH50 may already achieve 2.0 ACH50 with no additional cost. Those buildings that do not currently achieve 2.0 ACH50 should not require major additional cost to achieve this improvement. We believe it is reasonable to assume an average increase in construction costs of $198 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 $198 average 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 for EECC found that this proposal will save homeowners substantial energy cost and will result in clear life-cycle cost effectiveness. The analysis estimated that this proposal will produce a positive net life cycle benefit of $378-$5,044 over the first 30 years of the building's useful life, using the average incremental cost of $198 identified above and depending on climate zone. A summary table of this cost-effectiveness analysis is below.

[R2 table pix_cost.png]

Climate Zone	ACH50	Incremental Cost Upgrade	Annual Energy Savings	Present Value Costs	Present Value Benefits	Life Cycle Net Benefit
3	2.0	$198	$15	$448	$845	$397
4	2.0	$198	$37	$448	$827	$378
5	2.0	$198	$27	$448	$1,468	$1,020
6	2.0	$198	$34	$448	$1,831	$1,383
7	2.0	$198	$57	$448	$3,077	$2,629
8	2.0	$198	$103	$448	$5,492	$5,044

Attached Files

- **R2 table pix_cost.PNG**

https://energy.cdpaccess.com/proposal/299/1142/files/download/175/

- **R2 table pix.PNG**
  https://energy.cdpaccess.com/proposal/299/1142/files/download/174/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: air leakage tightness is essential to energy efficiency, lasts the life of the building, and is the largest contributor to errors in HVAC equipment.

REPI-86-21

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, representing on behalf of the California Statewide Utility Codes and Standards Team (iecc-ducts2@2050partners.com); Mark Lyles, representing New Buildings Institute (markl@newbuildings.org); Kevin Rose, representing Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

R403.3 Ducts~~*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 (113.3~~ 85 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 (85~~7~~ 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 (113.3 85 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	As proposed

	sheathing.	
	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		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 measured air exchange rate.[a]
		The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation		As proposed
Internal gains		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	As proposed

	area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	
	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]		As proposed
Cooling systems[d, f]		As proposed
Service water heating[d, g]		
		Compactness ratio[i] factor
		1 story
		> 60%
		> 30% to ≤ 60%
		> 15% to ≤ 30%
		< 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	Distribution System Efficiency (DSE): For hydronic systems and ductless systems as specified in Table R405.4.2(2).

	(DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies ~~for all systems other than tested duct systems~~. Duct location: same as proposed design. Exception: For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft2 (9.29 m2) of conditioned floorarea 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 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 d~~Distribution system~~s~~ components entirely located in conditioned space[c]	~~0.88~~NA	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-nonresidentialhttps://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.pdfhttps://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.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: provides clarity to existing language and removes redundant language. Also provides a table to better identify requirements.

REPI-96-21

IECC®: R403.6.3

Proponents: Mike Moore, Stator LLC, representing 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.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: adds option to verifying airflow rate and modifies the kitchen range hood testing exception

REPI-120-21

IECC®: TABLE R405.2, TABLE R406.2

Proponents: Robby Schwarz, BUILDTank, Inc., representing 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.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy 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.

REPI-122-21

IECC®: R401.2.5, R405.2, TABLE R405.4.2(1), TABLE R405.4.2(2), DOE Chapter 06 (New)

Proponents: Vladimir Kochkin, NAHB, representing NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Revise as follows:

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~~ 2. 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.

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 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 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: $UA_{\text{proposed design}} <= 1.15 \times UA_{\text{prescriptive reference}}$ 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 to 85% 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% 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.

TABLE R405.4.2(1) (TABLE N1105.4.2(1))
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN		
Heating systems[d, e, i, 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.~~	~~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.~~ ~~Capacity: sized in accordance with Section R403.7.~~	~~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]	~~As proposed.~~ Use, in units of gal/day = 25.5 + (8.5 × Nbr) where: N br= number of bedrooms.	~~As proposed~~ Use, in units of gal/day = 25.5 + (8.5 × Nbr) × (1 – HWDS) where: Nbr = number of bedrooms. HWDS = factor for the compactness of the hot water distribution system.		

<table>
<tr><td></td><td></td><td colspan="2">Compactness ratio[i] factor</td><td>HWDS</td></tr>
<tr><td></td><td></td><td>1 story</td><td>2 or more stories</td><td></td></tr>
<tr><td></td><td></td><td>> 60%</td><td>> 30%</td><td>0</td></tr>
<tr><td></td><td></td><td>> 30% to ≤ 60%</td><td>> 15% to ≤ 30%</td><td>0.05</td></tr>
<tr><td></td><td></td><td>> 15% to ≤ 30%</td><td>> 7.5% to ≤ 15%</td><td>0.10</td></tr>
<tr><td></td><td></td><td>< 15%</td><td>< 7.5%</td><td>0.15</td></tr>
<tr><td></td><td>Fuel Type: Same as proposed design</td><td colspan="3">As proposed</td></tr>
<tr><td></td><td>Rated Storage Volume: Same as proposed design</td><td colspan="3">As proposed</td></tr>
<tr><td></td><td>Draw Pattern: Same as proposed design</td><td colspan="3">As proposed</td></tr>
<tr><td></td><td>Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32</td><td colspan="3">As proposed</td></tr>
<tr><td></td><td>Tank Temperature: 120° F (48.9° C)</td><td colspan="3">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</td><td>50% inside conditioned space

50% unconditioned attic</td></tr></table></td><td colspan="3">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</td></tr>
</table>

			space	

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).

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 all systems other than tested duct systems. a~~ For hydronic systems and ductless systems.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.~~

~~**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).~~

~~As tested or, where not tested,~~ For hydronic systems and ductless systems, DSE shall be as specified in Table R405.4.2(2).

g. For a proposed design ~~with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design~~ without a proposed water heater, ~~a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed~~ the following assumptions shall be made for both the proposed design and standard reference design.
Fuel Type: Same as the predominant heating fuel type
Rated Storage Volume: 40 Gallons
Draw Pattern: Medium
Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

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 R405.4.2(2)
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

Distribution system components located in unconditioned space	NA	0.95
~~Untested d~~Distribution system~~s~~ 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.

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 430-2021	Energy Conservation Program for Consumer Products: Energy and Water Conservation Standards and their compliance dates.

Reason:

The 2021 IECC introduced equipment with efficiencies above federal minimums as prescriptive compliance options (Section R408) for use with both performance and prescriptive paths. This proposed change improves the usability and consistency of the performance paths by including energy neutral equipment trade-offs directly within the performance path. The change will provide energy modelers the option to demonstrate code compliance fully through Section 405 (Performance Path) without the burden of combining performance design with a limited choice of prescriptive packages in Section R408, which in many respects defeats the purpose of the performance design.

There is a major inconsistency in Section R401.2.5 (Item 2) of 2021 IECC for the performance compliance path: Item 2.1 allows the use of high efficiency equipment for compliance through Section 408, whereas the parallel option - Item 2.2 - does not allow the use of higher efficiency equipment for compliance. There is no basis for this disparity and is a significant oversight.

Furthermore, the goals set out in the new IECC framework cannot be reasonably achieved without the option to use higher efficiency mechanical systems. Building envelope requirements are already at the levels that exceed rational cost effectiveness criteria, even on a life-cycle basis. Therefore, equipment efficiency must be a design choice in the performance path.

This proposal provide a balanced approach to energy neutral trade-offs by including an additional thermal envelope backstop via a UA calculation. (We leave it to the judgment of the committee whether the current backstop to 2009 IECC is already sufficient or if both backstops are needed.) The UA calculation will be performed internally with the compliance software. It is an easy calculation as all the necessary information is already entered (component area and U-factors/R-values) and a similar calculation is done for windows. Energy neutral equipment trade-offs had been in the IECC residential section in the past. Equipment trade-offs are included in every other energy code/standard and above code program in the United States:

IECC Commercial

ASHRAE 90.1

IgCC

National Green Building Standard

LEED Commercial

LEED for Homes

EnergyStar

RESNET 301

Cost Impact:

The code change proposal will decrease the cost of construction.

This change will help achieve higher performing dwellings while adding flexibility. It will provide an option to optimize performance and increase cost-effectiveness.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: changes the envelope backstop and increases trade-offs for mechanical equipment in return for modifying the % of energy savings required in R405. The proponent also agreed to support a further modification to include HRV/ERV requirements in the performance path where required in the prescriptive path.

REPI-126-21

IECC®: R406.2, R406.3, R406.3.1, R406.3.2, R406.4, R406.5, TABLE R406.5

Proponents: Robby Schwarz, BUILDTank, Inc., representing 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.

$UA_{Proposed\ design} \leq 1.15 \times UA_{Prescriptive\ reference\ design}$ **(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	~~52~~ 51	40
2	~~52~~ 51	40
3	~~51~~ 50	40
4	~~54~~ 53	40
5	~~55~~ 54	40
6	~~54~~ 53	40
7	~~53~~ 52	40
8	~~53~~ 52	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.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy 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