REC2D-8-23

IECC RE: SECTION 202 (New), R402.5.1.2, R402.5.1.2.1, R402.5.1.3, R403.3.1, R403.3.9, R403.6.4, R403.8, TABLE R405.4.2(1)

Proponents:

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

Add new definition as follows:

SLEEPING UNIT. A single unit that provides rooms or spaces for one or more persons, includes permanent provisions for sleeping and can include provisions for living, eating and either sanitation or kitchen facilities but not both. Such rooms and spaces that are part of a *dwelling unit* are not *sleeping units*.

Revise as follows:

~~DWELLING~~ TESTING UNIT ENCLOSURE AREA. The sum of the area of ceiling, floors, and walls separating a dwelling unit or *sleeping unit's* conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the *dwelling unit* or *sleeping unit* to the underside of the floor above.

R402.5.1.2 Air leakage testing.

The *building* or each *dwelling unit* or *sleeping unit* in the building shall be tested for air leakage. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, ASTM E1827 or ASTM E3158 and reported at a pressure differential of 0.2 inch water gauge (50 Pa). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other *infiltration* control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended *infiltration* control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous *ventilation* systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exceptions:

1. For heated~~,~~ attached private garages and heated~~,~~ detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, *building thermal envelope* tightness and insulation installation shall be considered acceptable where the items in Table R402.5.1.1, applicable to the method of construction, are field verified. Where required by the *code official*, an *approved* third party independent from the installer shall inspect both *air barrier* and insulation installation criteria. Heated~~,~~ attached private garage space and heated~~,~~ detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.13 and R402.4.5, as applicable.
2. Where tested in accordance with Section R402.5.1.2.1, testing of each *dwelling unit* or *sleeping unit* is not required.

R402.5.1.2.1 ~~Dwelling unit~~ Unit sampling.

For buildings with eight or more *dwelling units* or *sleeping units*, seven or 20 percent of the *dwelling units* or *sleeping units*, whichever is greater, shall be tested. Tested units shall include a top floor unit, a ground floor unit, a middle floor unit, and the *dwelling unit* or *sleeping unit* with the largest ~~*dwelling unit*~~ *testing enclosure area*. Where the air leakage rate of a tested unit is greater than the maximum permitted rate, corrective actions shall be taken and the unit re-tested until it passes. For each tested *dwelling unit* or *sleeping unit* with an air leakage rate greater than the maximum permitted rate, three additional units, including the corrected unit, shall be tested. Where buildings have fewer than eight *dwelling units* or *sleeping units*, each ~~*dwelling unit*~~ unit shall be tested.

R402.5.1.3 Maximum air leakage rate.

Where tested in accordance with Section R402.5.1.2, the air leakage rate for *buildings*, ~~or~~ *dwelling units*, or *sleeping units* shall be as follows:

1. Where complying with Section R401.2.1, the *building*, ~~or~~the *dwelling units* or *sleeping units* in the *building* shall have an air leakage rate not greater than 4.0 air changes per hour in Climate Zones 0, 1 and 2~~.~~; 3.0 air changes per hour in Climate Zones 3 through 5~~.~~; and 2.5 air changes per hour in Climate Zones 6 through 8.
2. Where complying with Section R401.2.2 or R401.2.3, the *building* or the dwelling units or *sleeping units* in the *building* shall have an air leakage rate not greater than 4.0 air changes per hour, or 0.22 cfm/ft^2 (1.1 L/s x m^2) of the *building thermal envelope* area or the *dwelling* ~~*unit*~~ *testing enclosure area*, as applicable.

Exceptions:

1. Where *dwelling units* or *sleeping units* are attached or located in an R-2 occupancy, and are tested without simultaneously testing adjacent *dwelling units* or *sleeping units*, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 (1.35 L/s x m^2) of the ~~*dwelling*~~ *testing unit enclosure area*. Where adjacent *dwelling units* are simultaneously tested in accordance with ASTM E779, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 (1.35 L/s x m^2) of the ~~*dwelling unit*~~*testing enclosure area* that separates *conditioned space* from the exterior.
2. Where *buildings* have 1,500 square feet (139.4 m^2) or less of *conditioned floor area*, the air leakage rate is permitted to be not greater than 0.27 cfm/ft^2 (1.35 L/s x m^2).

R403.3.1 Duct system design.

Duct systems serving one or two *dwelling units* or *sleeping units* shall be designed and sized in accordance with ANSI/ACCA Manual D. *Duct systems* serving more than two *dwelling units* or *sleeping units* shall be sized in accordance with the ASHRAE Handbook of Fundamentals, ANSI/ACCA Manual D, or other equivalent computation procedure.

R403.3.9 ~~Dwelling unit~~ Unit sampling.

For *buildings* with eight or more *dwelling units* or *sleeping units* the *duct* systems in the greater of seven, or 20 percent of the *dwelling units* or *sleeping units* in the *building* shall be tested, including a top floor unit, a ground floor unit, a middle floor unit, and the unit with the largest *conditioned floor area*. Where buildings have fewer than eight dwelling units or *sleeping units*, the *duct* systems in each unit shall be tested. Where the leakage of a *duct* system is greater than the maximum permitted *duct system* leakage , corrective actions shall be made to the *duct system* and the *duct system* shall be system re-tested until it passes. For each tested *dwelling unit* or *sleeping unit* that has a greater total *duct system* leakage than the maximum permitted *duct system* leakage , an additional three *dwelling units* or *sleeping units*, including the corrected unit, shall be tested.

R403.6.4 ~~Dwelling unit~~ Unit sampling.

For *buildings* with eight or more *dwelling units* or *sleeping units* the mechanical *ventilation* systems in seven, or 20 percent of the *dwelling units* or *sleeping units*, whichever is greater shall be tested.~~,~~ Tested systems shall include ~~a~~ systems in a top floor unit, systems in a ground floor unit, systems in a middle floor unit, and the systems in the *dwelling unit* or *sleeping unit* with the largest *conditioned floor area*. Where *buildings* have fewer than eight *dwelling units* or *sleeping units*, the mechanical *ventilation* systems in each unit shall be tested. Where the *ventilation* flow rate of a mechanical *ventilation* system is less than the minimum permitted rate, corrective actions shall be taken and the system retested until it passes. For each tested *dwelling unit* or *sleeping unit* system with a *ventilation* flow rate lower than the minimum permitted three additional systems, including the corrected system, shall be tested.

R403.8 Systems serving multiple ~~dwelling~~ units.

Except for systems complying with Section R403.9, systems serving multiple *dwelling units* or *sleeping units* shall comply with Sections C403 and C404 of the *International Energy Conservation Code*—Commercial Provisions instead of Section R403.

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS
Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	Solar reflectance = 0.25.	As proposed
	Emittance = 0.90.	As proposed
Basement and crawl space walls	Type: same as proposed.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2 , with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Roofs	Type: composition shingle on wood sheathing.	As proposed
	Gross area: same as proposed.	As proposed
	Solar reflectance = 0.25.	As proposed
	Emittance = 0.90.	As proposed
Attics	Type: vented with an aperture of 1 ft^2 per 300 ft^2 of ceiling area.	As proposed
Foundations	Type: same as proposed.	As proposed
	Foundation wall or slab extenstion above grade: 1 foot (30 cm) Foundation wall or slab extension below grade: same as proposed Foundation wall or slab perimeter length: same as proposed Soil characteristics: same as proposed.	As proposed
	Foundation wall *U*-factor and slab-on-grade *F*-factor: as specified in Table R402.1.2	

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Opaque doors	Area: 40 ft^2.	As proposed
	Orientation: North.	As proposed
	U-factor: same as fenestration as specified in Table R402.1.2 .	As proposed
Vertical fenestration other than opaque doors	Total area[h] = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. (b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: 0.92 – (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 – (0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air leakage rate	For detached one-family dwellings, the air leakage rate at a pressure of 0.2 inch water gauge (50 Pa) shall be as follows: Climate Zones 0 through 2: 4.0 air changes per hour. Climate Zones 3 , 4, and 5: 3.0 air changes per hour. Climate Zones 6 through 8: 2.5 air changes per hour. For detached one-family dwellings that are 1,500 ft2 (139.4 m^2) or smaller and attached *dwelling units* or *sleeping units*, the air leakage rate at a pressure of 0.2 inch water gauge (50 Pa) shall be 0.27 cfm/ft^2 of the ~~*dwelling*~~ *testing unit enclosure area*.	The measured air leakage rate.[a]
Mechanical ventilation rate	-	
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M where: B = 0.01 × CFA + 7.5 × (Nbr + 1), cfm. M = 1.0 where the measured air leakage rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B) Q = the proposed mechanical ventilation rate, cfm. CFA = conditioned floor area, ft2. Nbr = number of bedrooms.	The measured mechanical ventilation rate[b], Q, shall be in addition to the measured air leakage rate .

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Mechanical ventilation fan energy	The mechanical ventilation system type shall be the same as in the *proposed design*. Heat recovery or energy recovery shall be modeled for mechanical ventilation where required by Section R403.6.1. Heat recovery or energy recovery shall not be modeled for mechanical ventilation where not required by Section R403.6.1.Where mechanical ventilation is not specified in the *proposed design*: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal (8.76 × B × M)/ef where: B and M are determined in accordance with the Mechanical Ventilation Rate row of this table. e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of B × M. *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed
Internal gains	IGain, in units of Btu/day per dwelling unit, shall equal 17,900 + 23.8 ×*CFA* + 4,104 × N_{br} where: *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	Same as *standard reference design*.
Internal mass	Internal mass for furniture and contents: 8 pounds per square foot of floor area.	Same as *standard reference design*, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the *building thermal envelope* or structure.
Structural mass	For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.3, located on the interior side of the walls.	As proposed
	For other walls, ceilings, floors, and interior walls: wood frame construction.	As proposed
Heating systems[d, e, j, k]	Fuel Type/Capacity: Same as proposed design	As proposed
	Product class: Same as proposed design	As proposed
	Efficiencies:	As proposed
	Heat pump: Complying with 10 CFR §430.32	As proposed
	Fuel gas and *liquid fuel* furnaces: Complying with 10 CFR §430.32	As proposed
	Fuel gas and *liquid fuel* boilers: Complying with 10 CFR §430.32	As proposed
Cooling		

<table>
<tr><td>systems[d, f, k]</td><td></td><td></td></tr>
<tr><td>BUILDING COMPONENT</td><td>STANDARD REFERENCE DESIGN</td><td>PROPOSED DESIGN</td></tr>
<tr><td></td><td>Fuel Type: Electric
Capacity: Same as proposed design</td><td>As proposed</td></tr>
<tr><td></td><td>Efficiencies: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td>Service water heating[d, g, k]</td><td>Use, in units of gal/day = 25.5 + (8.5 × N_{br})
where: N_{br} = number of bedrooms.</td><td>Use, in units of gal/day = 25.5 + (8.5 × N_{br}) × (1 − HWDS)
where:
N_{br} = number of bedrooms.
HWDS = factor for the compactness of the hot water distribution system.
<table>
<tr><td colspan="2">Compactness ratio[i] factor</td><td>HWDS</td></tr>
<tr><td>1 story</td><td>2 or more stories</td><td></td></tr>
<tr><td>> 60%</td><td>> 30%</td><td>0</td></tr>
<tr><td>> 30% to ≤ 60%</td><td>> 15% to ≤ 30%</td><td>0.05</td></tr>
<tr><td>> 15% to ≤ 30%</td><td>> 7.5% to ≤ 15%</td><td>0.10</td></tr>
<tr><td>< 15%</td><td>< 7.5%</td><td>0.15</td></tr>
</table></td></tr>
<tr><td></td><td>Fuel Type: Same as proposed design</td><td>As proposed</td></tr>
<tr><td></td><td>Rated Storage Volume: Same as proposed design</td><td>As proposed</td></tr>
<tr><td></td><td>Draw Pattern: Same as proposed design</td><td>As proposed</td></tr>
<tr><td></td><td>Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td></td><td>Tank Temperature: 120° F (48.9° C)</td><td>Same as standard reference design</td></tr>
<tr><td>Thermal distribution systems</td><td>Duct location:
<table>
<tr><td>Foundation Type</td><td>Slab on grade</td><td>Unconditioned crawl space</td><td>Basement or conditioned crawl space</td></tr>
</table></td><td>Duct location: as proposed[l] .</td></tr>
</table>

<table>
<tr><th>BUILDING COMPONENT</th><th colspan="4">STANDARD REFERENCE DESIGN</th><th>PROPOSED DESIGN</th></tr>
<tr><td rowspan="4"></td><td>Duct location (supply and return)</td><td>One-story building: 100% in unconditioned attic

All other: 75% in unconditioned attic and 25% inside conditioned space</td><td>One-story building: 100% in unconditioned crawlspace

All other: 75% in unconditioned crawlspace and 25% inside conditioned space</td><td>75 % inside conditioned space

25 % unconditioned attic</td><td></td></tr>
<tr><td colspan="4">Duct insulation: in accordance with Section R403.3.1.</td><td>Duct insulation: as proposed[m] .</td></tr>
<tr><td colspan="4">Duct system leakage to outside:
For duct systems serving > 1,000ft^2 (92.9 m^2) of conditioned floor area, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.
For duct systems serving ≤ 1,000ft^2 (92.9 m^2) of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).</td><td>Duct System Leakage to Outside: The measured total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate.
Exceptions:
<table><tr><td>1.</td><td>Where duct system leakage to outside is tested in accordance ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered.</td></tr><tr><td>2.</td><td>Where total duct system leakage is measured without the space conditioning equipment installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.</td></tr></table></td></tr>
<tr><td colspan="4">Distribution System Efficiency (DSE): For hydronic systems and ductless systems a thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies.</td><td>Distribution System Efficiency (DSE): For hydronic systems and ductless systems, DSE shall be as specified in Table R405.4.2(2).</td></tr>
<tr><td>Thermostat</td><td colspan="4">Type: Manual, cooling temperature setpoint = 75°F;
Heating temperature setpoint = 72°F.</td><td>Same as standard reference design.</td></tr>
</table>

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Dehumidistat	Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None. Where the proposed design utilizes a mechanical ventilation system with latent heat recovery: Dehumidistat type: manual, setpoint = 60% relative humidity. Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.	Same as *standard reference design*.

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals,* or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals,* page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals,* page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a *proposed design* with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a *proposed design* without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the *standard reference design* and *proposed design*.

f. For a *proposed design* without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the *standard reference design* and the *proposed design*.

g. For a *proposed design* without a proposed water heater, the following assumptions shall be made for both the proposed design and *standard reference design*. For a proposed design with a heat pump water heater, the following assumptions shall be made for the *standard reference design*, except the fuel type shall be electric.

   Fuel Type: Same as the predominant heating fuel type

   Rated Storage Volume: 40 Gallons

   Draw Pattern: Medium

   Efficiency: Uniform Energy Factor complying with 10 CFR § 430.32

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouse units, the following formula shall be used to determine glazing area:

AF = $A_s \times FA \times F$

where:

AF = Total glazing area.

A_s = *Standard reference design* total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and

where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the “hot water rectangle”) divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

j. For a *proposed design* with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the *standard reference design*.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the *standard reference design* shall be the same as *proposed design*.

l. Only sections of *ductwork* that are installed in accordance with Items 1 or 2 of Section R403.3.4, are assumed to be located completely inside *conditioned space*. All other sections of *ductwork* are not assumed to be located completely inside *conditioned space*.

m. Sections of *ductwork* installed in accordance with Section R403.3.5.1, are assumed to have an effective duct insulation R-value of R-25.

Reason:

A problem was created when the term “sleeping unit” was introduced in the Residential provisions of the Energy Code. By mentioning “sleeping units” in some code sections but not others, an ambiguity was created regarding whether certain provisions that only mention “dwelling units” should also apply to “sleeping units.”

This is intended to be an editorial proposal offered as a clarification consistent with the intent of existing code provisions. It adds a definition for the term “sleeping unit” but it neither adds new sections nor deletes existing sections. For simplicity and to avoid unnecessarily repetitive language, we’ve modified the term “~~dwelling~~ unit enclosure area” to read “testing unit enclosure area” in Chapter 2 and wherever it’s mentioned. We also corrected some punctuation mistakes.

Cost Impact:

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

This proposal is editorial.