**WAC 51-11R-40551**  
**Table R405.5.2(1)—Specifications for the standard reference and proposed designs.**

**TABLE R405.5.2(1)**  
**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
</table>
| Above-grade walls  | Type: Mass wall if proposed wall is mass; otherwise wood frame.  
                      Gross area: Same as proposed  
                      $U$-factor: From Table R402.1.3  
                      Solar absorptance = 0.75  
                      Remittance = 0.90 | As proposed  
                      As proposed  
                      As proposed  
                      As proposed |
| Below-grade walls  | Type: Same as proposed  
                      Gross area: Same as proposed  
                      $U$-factor: From Table R402.1.3, with insulation layer on interior side of walls. | As proposed  
                      As proposed  
                      As proposed |
| Above-grade floors | Type: Wood frame  
                      Gross area: Same as proposed  
                      $U$-factor: From Table R402.1.3 | As proposed  
                      As proposed  
                      As proposed |
| Ceilings           | Type: Wood frame  
                      Gross area: Same as proposed  
                      $U$-factor: From Table R402.1.3 | As proposed  
                      As proposed  
                      As proposed |
| Roofs              | Type: Composition shingle on wood sheathing  
                      Gross area: Same as proposed  
                      Solar absorptance = 0.75  
                      Emittance = 0.90 | As proposed  
                      As proposed  
                      As proposed  
                      As proposed |
| Attics             | Type: Vented with aperture = 1 ft$^2$ per 300 ft$^2$ ceiling area | As proposed |
| Foundations        | Type: Same as proposed foundation wall area above and below-grade  
                      Soil characteristics: Same as proposed. | As proposed  
                      As proposed |
| Opaque doors       | Area: 40 ft$^2$  
                      Orientation: North  
                      $U$-factor: Same as fenestration from Table R402.1.3. | As proposed  
                      As proposed  
                      As proposed |
| Vertical fenestration other than opaque doors$^a$ | Total area$^h$ =  
                                                  (a) The proposed glazing area; where proposed glazing area is less than 15% of the conditioned floor area  
                                                  (b) 15% of the conditioned floor area; where the proposed glazing area is 15% or more of the conditioned floor area.  
                                                  Orientation: Equally distributed to four cardinal compass orientations (N, E, S & W).  
                                                  $U$-factor: From Table R402.1.3  
                                                  SHGC: From Table R402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.  
                                                  Interior shade fraction: 0.92 - (0.21 × SHGC for the standard reference design)  
                                                  External shading: None | 0.92 - (0.21 × SHGC as proposed)  
                                                  As proposed  
                                                  As proposed  
                                                  As proposed |
<p>| Skylights          | None | As proposed |</p>
<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air exchange rate</td>
<td>Air leakage rate of 5 air changes per hour at a pressure of 0.2 inches w.g. (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: $CFA = \text{conditioned floor area}$ $N_{br} = \text{number of bedrooms}$ - Energy recovery shall not be assumed for mechanical ventilation.</td>
<td>For residences that are not tested, the same air leakage rate as the standard reference design. For tested residences, the measured air exchange rate. The mechanical ventilation rate shall be in addition to the air leakage rate and shall be as proposed.</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>None, except where mechanical ventilation is specified by the proposed design, in which case: Annual vent fan energy use: $\text{kWh/yr} = 0.03942 \times CFA + 29.565 \times (N_{br} + 1)$ where: $CFA = \text{conditioned floor area}$ $N_{br} = \text{number of bedrooms}$ - Energy recovery shall not be assumed for mechanical ventilation.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Internal gains</td>
<td>$\text{IGain} = 17,900 + 23.8 \times CFA + 4104 \times N_{br}$ (Btu/day per dwelling unit)</td>
<td>Same as standard reference design</td>
</tr>
<tr>
<td>Internal mass</td>
<td>An internal mass for furniture and contents of 8 pounds per square foot of floor area.</td>
<td>Same as standard reference design, plus any additional mass specifically designed as a thermal storage element but not integral to the building envelope or structure.</td>
</tr>
<tr>
<td>Structural mass</td>
<td>For masonry floor slabs, 80% of floor area covered by R-2 carpet and pad, and 20% of floor directly exposed to room air.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>For masonry basement walls, as proposed, but with insulation required by Table R402.1.3 located on the interior side of the walls.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>For other walls, for ceilings, floors, and interior walls, wood frame construction.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Heating systems $^d, e$</td>
<td>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 WSEC—Commercial Provisions. For all other systems, the same system type as proposed, and the same system efficiency required by prevailing minimum federal standard. Capacity: Sized in accordance with Section R403.6</td>
<td>As proposed</td>
</tr>
<tr>
<td>Cooling systems $^d, f$</td>
<td>Same system type as proposed. Same system efficiency as required by prevailing minimum federal standard. Capacity: Sized in accordance with Section R403.6.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Service water heating $^d, e, f, g$</td>
<td>Same system type as proposed. Same system efficiency as required by prevailing minimum federal standard. Use: Same as proposed design</td>
<td>As proposed gal/day = $30 + (10 \times N_{br})$</td>
</tr>
<tr>
<td>Thermal distribution systems</td>
<td>Duct insulation: From Section R403.3.3. A thermal distribution system efficiency (DSE) of 0.93 shall be applied to both the heating and cooling system efficiencies for all systems.</td>
<td>As specified in Table R405.5.2(2).</td>
</tr>
<tr>
<td>Thermostat</td>
<td>Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F</td>
<td>Same as standard reference design</td>
</tr>
</tbody>
</table>

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

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.

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

For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine fenestration area:

$$ AF = A_s \times FA \times F $$

Where:

- $AF$ = Total fenestration area.
- $A_s$ = Standard reference design total fenestration area.
- $FA$ = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 x below-grade boundary wall area).
- $F$ = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

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.

$L$ and $CFA$ are in the same units.


(Effective July 1, 2020)

WAC 51-11R-40551 Table R405.5.2(1)—Specifications for the standard reference and proposed designs.

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<tbody>
<tr>
<td>Above-grade walls</td>
<td>Type: Mass wall if proposed wall is mass; otherwise wood frame. Gross area: Same as proposed $U$-factor: From Table R402.1.3 Solar absorptance = 0.75 Remittance = 0.90</td>
<td>As proposed</td>
</tr>
<tr>
<td>Below-grade walls</td>
<td>Type: Same as proposed Gross area: Same as proposed $U$-factor: From Table R402.1.3, with insulation layer on interior side of walls.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Above-grade floors</td>
<td>Type: Wood frame Gross area: Same as proposed $U$-factor: From Table R402.1.3</td>
<td>As proposed</td>
</tr>
<tr>
<td>Ceilings</td>
<td>Type: Wood frame Gross area: Same as proposed $U$-factor: From Table R402.1.3</td>
<td>As proposed</td>
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<td>------------------</td>
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</table>
| **Roofs**        | Type: Composition shingle on wood sheathing  
Gross area: Same as proposed  
Solar absorptance = 0.75  
Emittance = 0.90 | As proposed  
As proposed  
As proposed  
As proposed |
| **Attics**       | Type: Vented with aperture = 1 ft$^2$ per 300 ft$^2$ ceiling area | As proposed |
| **Foundations**  | Type: Same as proposed foundation wall area above and below-grade  
Soil characteristics: Same as proposed. | As proposed  
As proposed |
| **Opaque doors** | Area: 40 ft$^2$  
Orientation: North  
$U$-factor: Same as fenestration from Table R402.1.3. | As proposed  
As proposed  
As proposed |
| **Vertical fenestration other than opaque doors**$^a$ | Total area$^h$ = (a) The proposed glazing area; where proposed glazing area is less than 15% of the conditioned floor area.  
(b) 15% of the conditioned floor area; where the proposed glazing area is 15% or more of the conditioned floor area.  
Orientation: Equally distributed to four cardinal compass orientations (N, E, S & W).  
$U$-factor: From Table R402.1.3  
SHGC: From Table R402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.  
Interior shade fraction: 0.92 - (0.21 × SHGC for the standard reference design)  
External shading: None | As proposed |
| **Skylights**    | None | As proposed |
| **Air exchange rate** | Air leakage rate of 5 air changes per hour at a pressure of 0.2 inches w.g. (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than 0.01 × $CFA + 7.5 × (N_{br} + 1)$  
where:  
$CFA$ = conditioned floor area  
$N_{br}$ = number of bedrooms  
- Energy recovery shall not be assumed for mechanical ventilation. | As proposed$^b$. The mechanical ventilation rate$^b$ shall be in addition to the air leakage rate and shall be as proposed. |
| **Mechanical ventilation** | None, except where mechanical ventilation is specified by the proposed design, in which case:  
Annual vent fan energy use:  
kWh/$yr = (1e) × (0.0876 × CFA + 65.7 × (N_{br} + 1)$  
where:  
e$\text{f}$ = the minimum exhaust fan efficacy from Table R403.6.1 corresponding to a flow rate of 0.01 × $CFA + 7.5 × (N_{br} + 1)$  
$CFA$ = conditioned floor area  
$N_{br}$ = number of bedrooms | As proposed |
<p>| <strong>Internal gains</strong> | $IGain = 17,900 + 23.8 × CFA + 4104 × N_{br}$ (Btu/day per dwelling unit) | Same as standard reference design |
| <strong>Internal mass</strong> | An internal mass for furniture and contents of 8 pounds per square foot of floor area. | Same as standard reference design, plus any additional mass specifically designed as a thermal storage element$^c$ but not integral to the building envelope or structure. |</p>
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<td>For other walls, for ceilings, floors, and interior walls, wood frame construction.</td>
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<tr>
<td>Heating systems(^d, e)</td>
<td>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 WSEC—Commercial Provisions. For all other systems, the same system type as proposed, and the same system efficiency required by prevailing minimum federal standard. Capacity: Sized in accordance with Section R403.6</td>
<td>As proposed</td>
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<td>Cooling systems(^d, f)</td>
<td>Same system type as proposed. Same system efficiency as required by prevailing minimum federal standard. Capacity: Sized in accordance with Section R403.6.</td>
<td>As proposed</td>
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<tr>
<td>Service water heating(^d, e, f, g)</td>
<td>Same system type as proposed. Same system efficiency as required by prevailing minimum federal standard. Use: Same as proposed design</td>
<td>As proposed</td>
</tr>
<tr>
<td>Thermal distribution systems</td>
<td>Duct insulation: From Section R403.3.3. A thermal distribution system efficiency (DSE) of 0.93 shall be applied to both the heating and cooling system efficiencies for all systems. <strong>Exception:</strong> For nonducted heating and cooling systems that do not have a fan, the standard reference design distribution system efficiency (DES) shall be 1.</td>
<td>As specified in Table R405.5.2(2).</td>
</tr>
<tr>
<td>Thermostat</td>
<td>Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F</td>
<td>Same as standard reference</td>
</tr>
</tbody>
</table>

For SI:
- 1 square foot = 0.093 m\(^2\)
- 1 British thermal unit = 1055 J
- 1 pound per square foot = 4.88 kg/m\(^2\)
- 1 gallon (U.S.) = 3.785 L
- °C = (°F-3)/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 26.19 for intermittent mechanical ventilation.

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

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

\(^e\) For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

\(^f\) For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

\(^g\) For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

\(^h\) For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine fenestration area:

\[ AF = A_s \times FA \times F \]

Where:
- \( AF \) = Total fenestration area.
- \( A_s \) = Standard reference design total fenestration area.
- \( FA \) = \(((Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 x below-grade boundary wall area)).
- \( F \) = \(((Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area)) or 0.56, whichever is greater.

and where:
Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

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.

$L$ and $CF_A$ are in the same units.