# Design for Code Acceptance

7

## Meeting Residential Energy Requirements with Wood-Frame Construction

### Building Code Requirements

Wood and wood-based products are widely used in building construction, due in part to favorable energy performance characteristics. As energy codes become more demanding, use of wood products in the building envelope provides greater advantages due to wood's natural thermal resistance and low embodied energy combined with excellent structural performance and constructability. Ensuring the building envelope achieves ever-increasing levels of performance can be difficult, especially for walls where framing, fenestration, and insulation details affect overall energy performance. This Design for Code Acceptance (DCA) provides ways to economically meet the residential requirement of the 2012 International Energy Conservation Code (IECC).

There are four compliance methods provided in the residential provisions of the IECC. Three of these methods rely on tabulated prescriptive criteria that must be met in order to demonstrate compliance. These methods include the Prescriptive R-value method (R402.1.1), the U-factor alternative method (R402.1.3), and the Total UA alternative method (R402.1.4). The fourth method, the Simulated Performance alternative, requires a full house simulation of energy usage considering building envelope conductivity, solar heat gain, air leakage, mechanical ventilation, internal heat gain, and equipment efficiencies, which requires computer software and is beyond the scope of this document.

The Prescriptive R-value (PR) method provides minimum R-values for insulation and U-factors for fenestration components of the envelope. For wood-frame wall

assemblies, the opaque wall component requires cavity insulation or a combination of cavity and continuous insulation that provides the minimum R-value specified in the table. The PR method is the simplest compliance approach for the builder and code official to verify, since calculations are not necessary. However, it is also the least flexible approach because substitutions or tradeoffs of building envelope components are not permitted.

The U-factor alternative (UF) method is based on a table of prescribed U-factors for each building envelope assembly. Assemblies are comprised of individual components each having unique U-factors. Component U-factors are combined to determine the overall assembly U-factor. For wood-frame wall assemblies, the UF method requires that each opaque wall assembly and each fenestration assembly not exceed tabulated U-factors for the entire assembly. Although elements within an assembly

can be substituted, it does not allow for change between assembly factors for equivalent performance.

The Total UA method (TUA) is the most flexible approach since it allows the thermal performance of each building envelope assembly to be adjusted relative to tabulated U-factors to provide equivalent or better thermal performance for the entire building thermal envelope. In other words, individual U-factors for opaque walls, fenestrations, ceilings/roofs, floors, and foundations can be above or below the tabulated U-factors in the code. However, the total energy performance of the building envelope must be equivalent or better than if the U-factors from Table R402.1.3 were used. This DCA will provide a method for determining solutions that focus on varying the opaque wall and fenestration U-factors to demonstrate compliance.

## Stud Spacing and Framing Factor

The thermal performance of opaque assemblies is a combination of various components with different thermal properties, which have to be addressed in the UF and the TUA calculations. For opaque wall assemblies, the framing factor is the projected area of framing divided by the total opaque assembly area. The projected area of framing includes the projected areas of studs, headers, jack and king studs, top and bottom plates, and corner studs.

According to the ASHRAE *Handbook of Fundamentals*, for walls with studs at 16 inches on center the framing factor is 25% and for studs at 24 inches on center the factor is 22%. Where techniques such as raised headers are used, the actual framing factor would be less. The actual framing factor for each specific framing layout can be calculated or the default ASHRAE values can be used. U-factors for a variety of assemblies with different stud spacings have been calculated and are provided in Appendix A, Table 1.

## U-factors

For the UF and TUA methods, U-factors for various assemblies are provided by manufacturers or can be determined by testing or standardized calculation methods. A U-factor is the inverse of the effective R-value for a particular assembly. Unlike a prescriptive R-value, a U-factor includes contributions from all layers of the assembly including framing, sheathing, cladding ma-

terials, and air films. For wood-frame construction, the ASHRAE *Handbook of Fundamentals* recommends the parallel-path method of calculating U-factors. Appendix A, Table 1 provides several pre-calculated U-factors for wall assemblies with various cladding materials calculated in accordance with the 2009 ASHRAE *Handbook of Fundamentals*. Sample calculations are provided in Appendix C.

## Total UA Equivalencies

The TUA method allows for balancing energy performance of individual components or assemblies as long as total building envelope energy performance is maintained. For example, improved energy performance of fenestration, ceiling, and floor areas can be used to reduce required opaque wall requirements.

Typically fenestrations are an order of magnitude less efficient than insulated walls, floors, and ceilings. As a result, very small improvements in window U-factors, especially for large window areas, can make a significant difference in achieving required total envelope energy performance. The TUA method allows these improvements in fenestration UA to offset slightly higher thermal transmittance in walls, floors, and ceilings. For the purposes of this document, discussion of tradeoffs is limited to how total reductions in the required UA of opaque wall assemblies can be offset with small improvements in the UA of fenestration assemblies.

For a given building, allowable total energy thermal transmittance of the wall portion of the envelope, $UA_{wall}$, can be calculated using the fenestration area, $A_{fen}$, the opaque wall area, $A_{ow}$, and their respective U-factors. In equation form:

$$UA_{wall} = (U_{fen,ref}\, A_{fen} + U_{ow,ref}\, A_{ow}) \qquad \text{Equation (1)}$$

**where:**

$U_{Awall}$ = total energy loss of the wall assembly

$U_{fen,ref}$ = U-factor of the fenestration, from Table R402.1.3

$U_{ow,ref}$ = U-factor of the opaque wood-frame wall, from Table R402.1.3

$A_{fen}$ = Fenestration area of the wall

$A_{ow}$ = Opaque wood-frame wall area

When calculating equivalent performance for a specific opaque wall and fenestration configuration, the required $UA_{wall}$ for the specified configuration, using actual U-factors, must be less than or equal to the $UA_{wall}$ for the same configuration calculated using tabulated U-factors from the IECC. In equation form:

$$U_{ow} \le U_{ow,ref} + (U_{fen,ref} - U_{fen})(A_{fen}/A_{ow}) \qquad \text{Equation (2)}$$

**where:**

$U_{fen}$ = U-factor of the fenestration in the actual assembly

$U_{ow}$ = U-factor of the opaque wood-frame wall in the actual assembly

Appendix B provides pre-calculated tables for making this adjustment for each climate zone. The required U-factors for the fenestration and opaque wall areas from Table R402.1.3 assumed in the calculations are provided at the top of the table.

## Fenestration and Opaque Wall Areas

The fenestration area of the wall, $A_{fen}$, in the equations above is measured as the rough opening of the fenestrations because the U-factors for fenestrations are values for the entire unit, not just the glazing. The $A_{ow}$ is the area from bottom plate to top plate, plus the exterior area of floors that are part of the conditioned space. Thus $A_{ow}$ can include the bandboard or rimjoist of the floor.

# Appendix A

## U-factors of Wood-Frame Wall Assemblies including Combined Wall and Siding Details

**Table 1 U-factor Ranges of Wood-Frame Wall Assemblies**

| Exterior Sheathing | Stud Spacing | Stud Size | Cavity Insulation | U-factor Range | Detail |
|---|---|---|---|---|---|
| 7/16" OSB or Plywood | 16" o.c. | 2 x 4 | R - 13 | 0.068 - 0.084 | WSP.16 |
| | | | R - 15 | 0.064 - 0.078 | |
| | | 2 x 6 | R - 15 | 0.059 - 0.069 | |
| | | | R - 19 | 0.054 - 0.063 | |
| | | | R - 20 | 0.051 - 0.060 | |
| | | | R - 21 | 0.050 - 0.058 | |
| | | | R - 24 | 0.047 - 0.055 | |
| | 24" o.c. | 2 x 4 | R - 13 | 0.067 - 0.081 | WSP.24 |
| | | | R - 15 | 0.062 - 0.076 | |
| | | 2 x 6 | R - 15 | 0.058 - 0.067 | |
| | | | R - 19 | 0.052 - 0.061 | |
| | | | R - 20 | 0.050 - 0.058 | |
| | | | R - 21 | 0.049 - 0.056 | |
| | | | R - 24 | 0.045 - 0.053 | |
| 25/32" Fiberboard | 16" o.c. | 2 x 4 | R - 13 | 0.062 - 0.074 | SFB.16 |
| | | | R - 15 | 0.058 - 0.070 | |
| | | 2 x 6 | R - 15 | 0.054 - 0.063 | |
| | | | R - 19 | 0.050 - 0.057 | |
| | | | R - 20 | 0.047 - 0.054 | |
| | | | R - 21 | 0.046 - 0.053 | |
| | | | R - 24 | 0.044 - 0.050 | |

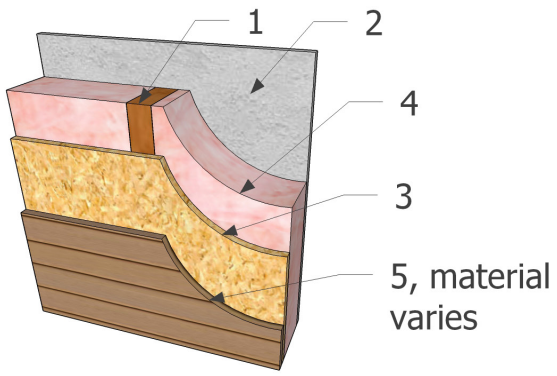
### Abbreviations:

- Wood structural panels (WSP) include oriented strand board (OSB) and plywood.
- Structural fiberboard (SFB)

Note: Details WSP.16, WSP.24, and SFB.16 are shown on the following pages and provide specific combined U-factors for walls with various siding options.

# Appendix A (continued)

**Table 1 Detail WSP.16 – Wood-Frame Wall Assembly with Studs 16″ o.c. (WSP sheathing)**




## Description

1. Framing – Wood studs @ 16″ o.c. (2x4 or 2x6, see below)
2. Interior Sheathing – 1/2″ min. gypsum wallboard
3. Exterior Sheathing – 7/16″ min. wood structural panels (plywood or oriented strand board)
4. Cavity Insulation – Varies (see below)
5. Siding – Varies (see below)

## Combined Wall and Siding U-Factors

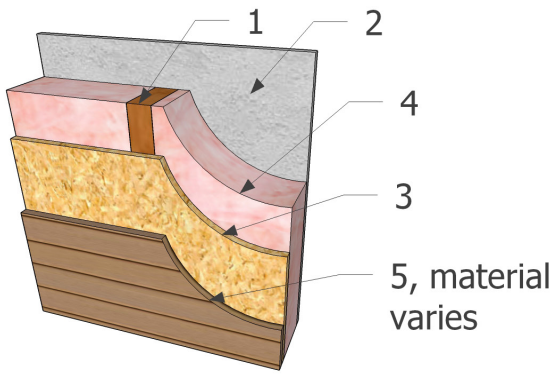
Assembly above with the following exterior sidings and stud sizes: (2009 ASHRAE Handbook)

| Siding Type | Average Thickness | $R_{siding}$ | Stud Size | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 x 4 | | 2 x 6 | | | | |
| | | | Cavity Insulation | | | | | | |
| | | | R-13 | R-15 | R-15 | R-19[1] | R-20 | R-21 | R-24 |
| | | | Wall + Siding U-factor | | | | | | |
| Baseline (no siding) | | - | 0.089 | 0.083 | 0.072 | 0.066 | 0.062 | 0.061 | 0.057 |
| Aluminum, Steel, or Vinyl siding | | | | | | | | | |
| uninsulated (hollow-back) | Varies | 0.62 | 0.084 | 0.078 | 0.069 | 0.063 | 0.059 | 0.058 | 0.054 |
| insulated (R-2) | Varies | 2.00 | 0.074 | 0.069 | 0.062 | 0.057 | 0.054 | 0.053 | 0.050 |
| insulated (R-3) | Varies | 3.00 | 0.068 | 0.064 | 0.059 | 0.054 | 0.051 | 0.050 | 0.047 |
| Brick veneer (¾″ air space) | 3-5/8" | 1.26 | 0.079 | 0.074 | 0.066 | 0.060 | 0.057 | 0.056 | 0.052 |
| Hardboard siding | 7/16" | 0.67 | 0.083 | 0.078 | 0.069 | 0.062 | 0.059 | 0.058 | 0.054 |
| Plywood siding (edges lapped) | 3/8" | 0.59 | 0.084 | 0.078 | 0.069 | 0.063 | 0.060 | 0.058 | 0.055 |
| Wood siding | | | | | | | | | |
| Drop (8") | 1" | 0.79 | 0.082 | 0.077 | 0.068 | 0.062 | 0.059 | 0.057 | 0.054 |
| Bevel (8", lapped) | 1/2" | 0.81 | 0.082 | 0.077 | 0.068 | 0.062 | 0.059 | 0.057 | 0.054 |
| Bevel (10", lapped) | 3/4" | 1.05 | 0.080 | 0.075 | 0.067 | 0.061 | 0.058 | 0.056 | 0.053 |

Notes: 1. R-19 is assumed to be R-18 when compressed into 5.5" stud cavity.

# Appendix A (continued)

**Table 1 Detail WSP.24 – Wood-Frame Wall Assembly with Studs 24″ o.c. (WSP sheathing)**




## Description

1. Framing – Wood studs @ 24″ o.c. (2x4 or 2x6, see below)
2. Interior Sheathing – 1/2″ min. gypsum wallboard
3. Exterior Sheathing – 7/16″ min. wood structural panels (plywood or oriented strand board)
4. Cavity Insulation – Varies (see below)
5. Siding – Varies (see below)

## Combined Wall and Siding U-Factors

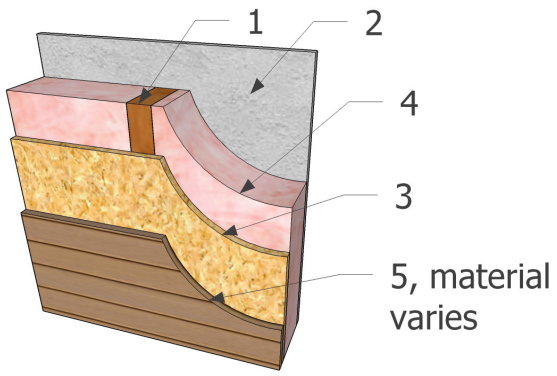
Assembly above with the following exterior sidings and stud sizes: (2009 ASHRAE Handbook)

| Siding Type | Average Thickness | $R_{siding}$ | Stud Size | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 x 4 | | 2 x 6 | | | | |
| | | | Effective Cavity Insulation | | | | | | |
| | | | R-13 | R-15 | R-15 | R-19[1] | R-20 | R-21 | R-24 |
| | | | Wall + Siding U-factor | | | | | | |
| Baseline (no siding) | | - | 0.086 | 0.080 | 0.071 | 0.064 | 0.060 | 0.059 | 0.055 |
| Aluminum, Steel, or Vinyl siding | | | | | | | | | |
| uninsulated (hollow-back) | Varies | 0.62 | 0.081 | 0.076 | 0.067 | 0.061 | 0.058 | 0.056 | 0.052 |
| insulated (R-2) | Varies | 2.00 | 0.072 | 0.067 | 0.061 | 0.056 | 0.053 | 0.051 | 0.048 |
| insulated (R-3) | Varies | 3.00 | 0.067 | 0.062 | 0.058 | 0.052 | 0.050 | 0.049 | 0.045 |
| Brick veneer (¾″ air space) | 3-5/8" | 1.26 | 0.077 | 0.072 | 0.064 | 0.058 | 0.055 | 0.054 | 0.050 |
| Hardboard siding | 7/16" | 0.67 | 0.081 | 0.075 | 0.067 | 0.061 | 0.057 | 0.056 | 0.052 |
| Plywood siding (edges lapped) | 3/8" | 0.59 | 0.082 | 0.076 | 0.068 | 0.061 | 0.058 | 0.056 | 0.053 |
| Wood siding | | | | | | | | | |
| Drop (8") | 1" | 0.79 | 0.080 | 0.075 | 0.067 | 0.060 | 0.057 | 0.056 | 0.052 |
| Bevel (8", lapped) | 1/2" | 0.81 | 0.080 | 0.074 | 0.066 | 0.060 | 0.057 | 0.055 | 0.052 |
| Bevel (10", lapped) | 3/4" | 1.05 | 0.078 | 0.073 | 0.065 | 0.059 | 0.056 | 0.055 | 0.051 |

Notes: 1. R-19 is assumed to be R-18 when compressed into 5.5" stud cavity.

# Appendix A (continued)

**Table 1 Detail SFB.16 – Wood-Frame Wall Assembly with Studs 16″ o.c. (Fiberboard sheathing)**




## Description

1. Framing – Wood studs @ 16″ o.c. (2x4 or 2x6, see below)
2. Interior Sheathing – 1/2″ min. gypsum wallboard
3. Exterior Sheathing – 25/32″ min. structural fiberboard
4. Cavity Insulation – Varies (see below)
5. Siding – Varies (see below)

## Combined Wall and Siding U-Factors

Assembly above with the following exterior sidings and stud sizes: (2009 ASHRAE Handbook)

| Siding Type | Average Thickness | $R_{siding}$ | Stud Size | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 x 4 | | 2 x 6 | | | | |
| | | | Effective Cavity Insulation | | | | | | |
| | | | R-13 | R-15 | R-15 | R-19[1] | R-20 | R-21 | R-24 |
| | | | Wall + Siding U-factor | | | | | | |
| Baseline (no siding) | | - | 0.078 | 0.073 | 0.065 | 0.060 | 0.057 | 0.055 | 0.052 |
| Aluminum, Steel, or Vinyl siding | | | | | | | | | |
| uninsulated (hollow-back) | Varies | 0.62 | 0.074 | 0.070 | 0.063 | 0.057 | 0.054 | 0.053 | 0.050 |
| insulated (R-2) | Varies | 2.00 | 0.067 | 0.063 | 0.057 | 0.053 | 0.050 | 0.049 | 0.046 |
| insulated (R-3) | Varies | 3.00 | 0.062 | 0.058 | 0.054 | 0.050 | 0.047 | 0.046 | 0.044 |
| Brick veneer (¾″ air space) | 3-5/8" | 1.26 | 0.070 | 0.066 | 0.060 | 0.055 | 0.052 | 0.051 | 0.048 |
| Hardboard siding | 7/16" | 0.67 | 0.074 | 0.069 | 0.062 | 0.057 | 0.054 | 0.053 | 0.050 |
| Plywood siding (edges lapped) | 3/8" | 0.59 | 0.074 | 0.070 | 0.063 | 0.057 | 0.054 | 0.053 | 0.050 |
| Wood siding | | | | | | | | | |
| Drop (8") | 1" | 0.79 | 0.073 | 0.069 | 0.062 | 0.057 | 0.054 | 0.053 | 0.049 |
| Bevel (8", lapped) | 1/2" | 0.81 | 0.073 | 0.069 | 0.062 | 0.057 | 0.054 | 0.053 | 0.049 |
| Bevel (10", lapped) | 3/4" | 1.05 | 0.072 | 0.067 | 0.061 | 0.056 | 0.053 | 0.052 | 0.049 |

Notes: 1. R-19 is assumed to be R-18 when compressed into 5.5" stud cavity.

# Appendix B

## Average U-Factors for Fenestrations in Various Climate Zones

### 2012 IECC Requirements - Climate Zone 1

**(Total UA Method - IECC 402.1.4)**

| | |
|---|---|
| 2012 IECC Table 402.1.3 Reference $U_{fen}$ = | 0.50 |
| 2012 IECC Table 402.1.3 Reference $U_{wall}$ = | 0.082 |

| Average U-value for Exterior Walls (including Siding) | Percentage of Fenestrations Area in Total Wall Area | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10% | 12% | 14% | 16% | 18% | 20% | 22% | 24% | 26% | 28% | 30% | 40% | 50% | 60% | 80% | 100% |
| | Average U-value for Fenestrations | | | | | | | | | | | | | | | |
| **0.082** | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| **0.083** | 0.49 | 0.49 | 0.49 | 0.49 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| **0.084** | 0.48 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| **0.085** | 0.47 | 0.48 | 0.48 | 0.48 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| **0.086** | 0.46 | 0.47 | 0.48 | 0.48 | 0.48 | 0.48 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.50 | 0.50 | 0.50 | 0.50 |
| **0.087** | 0.46 | 0.46 | 0.47 | 0.47 | 0.48 | 0.48 | 0.48 | 0.48 | 0.49 | 0.49 | 0.49 | 0.49 | 0.50 | 0.50 | 0.50 | 0.50 |
| **0.088** | 0.45 | 0.46 | 0.46 | 0.47 | 0.47 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.49 | 0.49 | 0.49 | 0.50 | 0.50 | 0.50 |
| **0.089** | 0.44 | 0.45 | 0.46 | 0.46 | 0.47 | 0.47 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.49 | 0.49 | 0.50 | 0.50 | 0.50 |
| **0.090** | 0.43 | 0.44 | 0.45 | 0.46 | 0.46 | 0.47 | 0.47 | 0.47 | 0.48 | 0.48 | 0.48 | 0.49 | 0.49 | 0.49 | 0.50 | 0.50 |
| **0.091** | 0.42 | 0.43 | 0.44 | 0.45 | 0.46 | 0.46 | 0.47 | 0.47 | 0.47 | 0.48 | 0.48 | 0.49 | 0.49 | 0.49 | 0.50 | 0.50 |
| **0.092** | 0.41 | 0.43 | 0.44 | 0.45 | 0.45 | 0.46 | 0.46 | 0.47 | 0.47 | 0.47 | 0.48 | 0.49 | 0.49 | 0.49 | 0.50 | 0.50 |
| **0.093** | 0.40 | 0.42 | 0.43 | 0.44 | 0.45 | 0.46 | 0.46 | 0.47 | 0.47 | 0.47 | 0.47 | 0.48 | 0.49 | 0.49 | 0.50 | 0.50 |
| **0.094** | 0.39 | 0.41 | 0.43 | 0.44 | 0.45 | 0.45 | 0.46 | 0.46 | 0.47 | 0.47 | 0.47 | 0.48 | 0.49 | 0.49 | 0.50 | 0.50 |
| **0.095** | 0.38 | 0.40 | 0.42 | 0.43 | 0.44 | 0.45 | 0.45 | 0.46 | 0.46 | 0.47 | 0.47 | 0.48 | 0.49 | 0.49 | 0.50 | 0.50 |
| **0.096** | 0.37 | 0.40 | 0.41 | 0.43 | 0.44 | 0.44 | 0.45 | 0.46 | 0.46 | 0.46 | 0.47 | 0.48 | 0.49 | 0.49 | 0.50 | 0.50 |
| **0.097** | 0.37 | 0.39 | 0.41 | 0.42 | 0.43 | 0.44 | 0.45 | 0.45 | 0.46 | 0.46 | 0.47 | 0.48 | 0.49 | 0.49 | 0.50 | 0.50 |
| **0.098** | 0.36 | 0.38 | 0.40 | 0.42 | 0.43 | 0.44 | 0.44 | 0.45 | 0.45 | 0.46 | 0.46 | 0.48 | 0.48 | 0.49 | 0.50 | 0.50 |
| **0.099** | 0.35 | 0.38 | 0.40 | 0.41 | 0.42 | 0.43 | 0.44 | 0.45 | 0.45 | 0.46 | 0.46 | 0.47 | 0.48 | 0.49 | 0.50 | 0.50 |
| **0.100** | 0.34 | 0.37 | 0.39 | 0.41 | 0.42 | 0.43 | 0.44 | 0.44 | 0.45 | 0.45 | 0.46 | 0.47 | 0.48 | 0.49 | 0.50 | 0.50 |
| **0.101** | 0.33 | 0.36 | 0.38 | 0.40 | 0.41 | 0.42 | 0.43 | 0.44 | 0.45 | 0.45 | 0.46 | 0.47 | 0.48 | 0.49 | 0.50 | 0.50 |
| **0.102** | 0.32 | 0.35 | 0.38 | 0.40 | 0.41 | 0.42 | 0.43 | 0.44 | 0.44 | 0.45 | 0.45 | 0.47 | 0.48 | 0.49 | 0.50 | 0.50 |
| **0.103** | 0.31 | 0.35 | 0.37 | 0.39 | 0.40 | 0.42 | 0.43 | 0.43 | 0.44 | 0.45 | 0.45 | 0.47 | 0.48 | 0.49 | 0.49 | 0.50 |
| **0.104** | 0.30 | 0.34 | 0.36 | 0.38 | 0.40 | 0.41 | 0.42 | 0.43 | 0.44 | 0.44 | 0.45 | 0.47 | 0.48 | 0.49 | 0.49 | 0.50 |
| **0.105** | 0.29 | 0.33 | 0.36 | 0.38 | 0.40 | 0.41 | 0.42 | 0.43 | 0.43 | 0.44 | 0.45 | 0.47 | 0.48 | 0.48 | 0.49 | 0.50 |
| **0.106** | 0.28 | 0.32 | 0.35 | 0.37 | 0.39 | 0.40 | 0.41 | 0.42 | 0.43 | 0.44 | 0.44 | 0.46 | 0.48 | 0.48 | 0.49 | 0.50 |
| **0.107** | 0.28 | 0.32 | 0.35 | 0.37 | 0.39 | 0.40 | 0.41 | 0.42 | 0.43 | 0.44 | 0.44 | 0.46 | 0.48 | 0.48 | 0.49 | 0.50 |
| **0.108** | 0.27 | 0.31 | 0.34 | 0.36 | 0.38 | 0.40 | 0.41 | 0.42 | 0.43 | 0.43 | 0.44 | 0.46 | 0.47 | 0.48 | 0.49 | 0.50 |
| **0.109** | 0.26 | 0.30 | 0.33 | 0.36 | 0.38 | 0.39 | 0.40 | 0.41 | 0.42 | 0.43 | 0.44 | 0.46 | 0.47 | 0.48 | 0.49 | 0.50 |
| **0.110** | 0.25 | 0.29 | 0.33 | 0.35 | 0.37 | 0.39 | 0.40 | 0.41 | 0.42 | 0.43 | 0.43 | 0.46 | 0.47 | 0.48 | 0.49 | 0.50 |
| **0.111** | 0.24 | 0.29 | 0.32 | 0.35 | 0.37 | 0.38 | 0.40 | 0.41 | 0.42 | 0.43 | 0.43 | 0.46 | 0.47 | 0.48 | 0.49 | 0.50 |
| **0.112** | 0.23 | 0.28 | 0.32 | 0.34 | 0.36 | 0.38 | 0.39 | 0.41 | 0.41 | 0.42 | 0.43 | 0.46 | 0.47 | 0.48 | 0.49 | 0.50 |
| **0.113** | 0.22 | 0.27 | 0.31 | 0.34 | 0.36 | 0.38 | 0.39 | 0.40 | 0.41 | 0.42 | 0.43 | 0.45 | 0.47 | 0.48 | 0.49 | 0.50 |
| **0.114** | 0.21 | 0.27 | 0.30 | 0.33 | 0.35 | 0.37 | 0.39 | 0.40 | 0.41 | 0.42 | 0.43 | 0.45 | 0.47 | 0.48 | 0.49 | 0.50 |
| **0.115** | 0.20 | 0.26 | 0.30 | 0.33 | 0.35 | 0.37 | 0.38 | 0.40 | 0.41 | 0.42 | 0.42 | 0.45 | 0.47 | 0.48 | 0.49 | 0.50 |

# Appendix B (continued)

## 2012 IECC Requirements - Climate Zone 2

### (Total UA Method - IECC 402.1.4)

| | |
|---|---|
| 2012 IECC Table 402.1.3 Reference $U_{fen}$ = | 0.40 |
| 2012 IECC Table 402.1.3 Reference $U_{wall}$ = | 0.082 |

| Average U-value for Exterior Walls (including Siding) | Percentage of Fenestrations Area in Total Wall Area | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10% | 12% | 14% | 16% | 18% | 20% | 22% | 24% | 26% | 28% | 30% | 40% | 50% | 60% | 80% | 100% |
| | Average U-value for Fenestrations | | | | | | | | | | | | | | | |
| **0.082** | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| **0.083** | 0.39 | 0.39 | 0.39 | 0.39 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| **0.084** | 0.38 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| **0.085** | 0.37 | 0.38 | 0.38 | 0.38 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| **0.086** | 0.36 | 0.37 | 0.38 | 0.38 | 0.38 | 0.38 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.40 | 0.40 | 0.40 | 0.40 |
| **0.087** | 0.36 | 0.36 | 0.37 | 0.37 | 0.38 | 0.38 | 0.38 | 0.38 | 0.39 | 0.39 | 0.39 | 0.39 | 0.40 | 0.40 | 0.40 | 0.40 |
| **0.088** | 0.35 | 0.36 | 0.36 | 0.37 | 0.37 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.39 | 0.39 | 0.39 | 0.40 | 0.40 | 0.40 |
| **0.089** | 0.34 | 0.35 | 0.36 | 0.36 | 0.37 | 0.37 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.39 | 0.39 | 0.40 | 0.40 | 0.40 |
| **0.090** | 0.33 | 0.34 | 0.35 | 0.36 | 0.36 | 0.37 | 0.37 | 0.37 | 0.38 | 0.38 | 0.38 | 0.39 | 0.39 | 0.39 | 0.40 | 0.40 |
| **0.091** | 0.32 | 0.33 | 0.34 | 0.35 | 0.36 | 0.36 | 0.37 | 0.37 | 0.37 | 0.38 | 0.38 | 0.39 | 0.39 | 0.39 | 0.40 | 0.40 |
| **0.092** | 0.31 | 0.33 | 0.34 | 0.35 | 0.35 | 0.36 | 0.36 | 0.37 | 0.37 | 0.37 | 0.38 | 0.39 | 0.39 | 0.39 | 0.40 | 0.40 |
| **0.093** | 0.30 | 0.32 | 0.33 | 0.34 | 0.35 | 0.36 | 0.36 | 0.37 | 0.37 | 0.37 | 0.37 | 0.38 | 0.39 | 0.39 | 0.40 | 0.40 |
| **0.094** | 0.29 | 0.31 | 0.33 | 0.34 | 0.35 | 0.35 | 0.36 | 0.36 | 0.37 | 0.37 | 0.37 | 0.38 | 0.39 | 0.39 | 0.40 | 0.40 |
| **0.095** | 0.28 | 0.30 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 | 0.36 | 0.36 | 0.37 | 0.37 | 0.38 | 0.39 | 0.39 | 0.40 | 0.40 |
| **0.096** | 0.27 | 0.30 | 0.31 | 0.33 | 0.34 | 0.34 | 0.35 | 0.36 | 0.36 | 0.36 | 0.37 | 0.38 | 0.39 | 0.39 | 0.40 | 0.40 |
| **0.097** | 0.27 | 0.29 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 | 0.36 | 0.36 | 0.37 | 0.38 | 0.39 | 0.39 | 0.40 | 0.40 |
| **0.098** | 0.26 | 0.28 | 0.30 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 | 0.36 | 0.36 | 0.38 | 0.38 | 0.39 | 0.40 | 0.40 |
| **0.099** | 0.25 | 0.28 | 0.30 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 | 0.36 | 0.36 | 0.37 | 0.38 | 0.39 | 0.40 | 0.40 |
| **0.100** | 0.24 | 0.27 | 0.29 | 0.31 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 | 0.36 | 0.37 | 0.38 | 0.39 | 0.40 | 0.40 |
| **0.101** | 0.23 | 0.26 | 0.28 | 0.30 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 | 0.36 | 0.37 | 0.38 | 0.39 | 0.40 | 0.40 |
| **0.102** | 0.22 | 0.25 | 0.28 | 0.30 | 0.31 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 | 0.37 | 0.38 | 0.39 | 0.40 | 0.40 |
| **0.103** | 0.21 | 0.25 | 0.27 | 0.29 | 0.30 | 0.32 | 0.33 | 0.33 | 0.34 | 0.35 | 0.35 | 0.37 | 0.38 | 0.39 | 0.39 | 0.40 |
| **0.104** | 0.20 | 0.24 | 0.26 | 0.28 | 0.30 | 0.31 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.37 | 0.38 | 0.39 | 0.39 | 0.40 |
| **0.105** | 0.19 | 0.23 | 0.26 | 0.28 | 0.30 | 0.31 | 0.32 | 0.33 | 0.33 | 0.34 | 0.35 | 0.37 | 0.38 | 0.38 | 0.39 | 0.40 |
| **0.106** | 0.18 | 0.22 | 0.25 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 | 0.33 | 0.34 | 0.34 | 0.36 | 0.38 | 0.38 | 0.39 | 0.40 |
| **0.107** | 0.18 | 0.22 | 0.25 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 | 0.33 | 0.34 | 0.34 | 0.36 | 0.38 | 0.38 | 0.39 | 0.40 |
| **0.108** | 0.17 | 0.21 | 0.24 | 0.26 | 0.28 | 0.30 | 0.31 | 0.32 | 0.33 | 0.33 | 0.34 | 0.36 | 0.37 | 0.38 | 0.39 | 0.40 |
| **0.109** | 0.16 | 0.20 | 0.23 | 0.26 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 | 0.33 | 0.34 | 0.36 | 0.37 | 0.38 | 0.39 | 0.40 |
| **0.110** | 0.15 | 0.19 | 0.23 | 0.25 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 | 0.33 | 0.33 | 0.36 | 0.37 | 0.38 | 0.39 | 0.40 |
| **0.111** | 0.14 | 0.19 | 0.22 | 0.25 | 0.27 | 0.28 | 0.30 | 0.31 | 0.32 | 0.33 | 0.33 | 0.36 | 0.37 | 0.38 | 0.39 | 0.40 |
| **0.112** | 0.13 | 0.18 | 0.22 | 0.24 | 0.26 | 0.28 | 0.29 | 0.31 | 0.31 | 0.32 | 0.33 | 0.36 | 0.37 | 0.38 | 0.39 | 0.40 |
| **0.113** | 0.12 | 0.17 | 0.21 | 0.24 | 0.26 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 | 0.33 | 0.35 | 0.37 | 0.38 | 0.39 | 0.40 |
| **0.114** | 0.11 | 0.17 | 0.20 | 0.23 | 0.25 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 | 0.33 | 0.35 | 0.37 | 0.38 | 0.39 | 0.40 |
| **0.115** | 0.10 | 0.16 | 0.20 | 0.23 | 0.25 | 0.27 | 0.28 | 0.30 | 0.31 | 0.32 | 0.32 | 0.35 | 0.37 | 0.38 | 0.39 | 0.40 |

# Appendix B (continued)

## 2012 IECC Requirements - Climate Zone 3

### (Total UA Method - IECC 402.1.4)

| | |
|---|---|
| 2012 IECC Table 402.1.3 Reference $U_{fen}$ = | 0.35 |
| 2012 IECC Table 402.1.3 Reference $U_{wall}$ = | 0.057 |

| Average U-value for Exterior Walls (including Siding) | Percentage of Fenestrations Area in Total Wall Area | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10% | 12% | 14% | 16% | 18% | 20% | 22% | 24% | 26% | 28% | 30% | 40% | 50% | 60% | 80% | 100% |
| | Average U-value for Fenestrations | | | | | | | | | | | | | | | |
| **0.057** | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| **0.058** | 0.34 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| **0.059** | 0.33 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| **0.060** | 0.32 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| **0.061** | 0.31 | 0.32 | 0.33 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 | 0.35 |
| **0.062** | 0.31 | 0.31 | 0.32 | 0.32 | 0.33 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 | 0.35 |
| **0.063** | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 |
| **0.064** | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 |
| **0.065** | 0.28 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 |
| **0.066** | 0.27 | 0.28 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 |
| **0.067** | 0.26 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.33 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 |
| **0.068** | 0.25 | 0.27 | 0.28 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 |
| **0.069** | 0.24 | 0.26 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 |
| **0.070** | 0.23 | 0.25 | 0.27 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 |
| **0.071** | 0.22 | 0.25 | 0.26 | 0.28 | 0.29 | 0.29 | 0.30 | 0.31 | 0.31 | 0.31 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 |
| **0.072** | 0.22 | 0.24 | 0.26 | 0.27 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 |
| **0.073** | 0.21 | 0.23 | 0.25 | 0.27 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.33 | 0.33 | 0.34 | 0.35 | 0.35 |
| **0.074** | 0.20 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 |
| **0.075** | 0.19 | 0.22 | 0.24 | 0.26 | 0.27 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 |
| **0.076** | 0.18 | 0.21 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 |
| **0.077** | 0.17 | 0.20 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 |
| **0.078** | 0.16 | 0.20 | 0.22 | 0.24 | 0.25 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.30 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 |
| **0.079** | 0.15 | 0.19 | 0.21 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.29 | 0.30 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 |
| **0.080** | 0.14 | 0.18 | 0.21 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.32 | 0.33 | 0.33 | 0.34 | 0.35 |
| **0.081** | 0.13 | 0.17 | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.29 | 0.31 | 0.33 | 0.33 | 0.34 | 0.35 |
| **0.082** | 0.13 | 0.17 | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.29 | 0.31 | 0.33 | 0.33 | 0.34 | 0.35 |
| **0.083** | 0.12 | 0.16 | 0.19 | 0.21 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 |
| **0.084** | 0.11 | 0.15 | 0.18 | 0.21 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 |
| **0.085** | 0.10 | 0.14 | 0.18 | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 |
| **0.086** | 0.09 | 0.14 | 0.17 | 0.20 | 0.22 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 |
| **0.087** | 0.08 | 0.13 | 0.17 | 0.19 | 0.21 | 0.23 | 0.24 | 0.26 | 0.26 | 0.27 | 0.28 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 |
| **0.088** | 0.07 | 0.12 | 0.16 | 0.19 | 0.21 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.30 | 0.32 | 0.33 | 0.34 | 0.35 |
| **0.089** | 0.06 | 0.12 | 0.15 | 0.18 | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.30 | 0.32 | 0.33 | 0.34 | 0.35 |
| **0.090** | 0.05 | 0.11 | 0.15 | 0.18 | 0.20 | 0.22 | 0.23 | 0.25 | 0.26 | 0.27 | 0.27 | 0.30 | 0.32 | 0.33 | 0.34 | 0.35 |

# Appendix B (continued)

## 2012 IECC Requirements - Climate Zone 4 Except Marine

### (Total UA Method - IECC 402.1.4)

| | |
|---|---|
| 2012 IECC Table 402.1.3 Reference $U_{fen}$ = | 0.35 |
| 2012 IECC Table 402.1.3 Reference $U_{wall}$ = | 0.057 |

| | | Percentage of Fenestrations Area in Total Wall Area | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 10% | 12% | 14% | 16% | 18% | 20% | 22% | 24% | 26% | 28% | 30% | 40% | 50% | 60% | 80% | 100% |
| | | Average U-value for Fenestrations | | | | | | | | | | | | | | | |
| Average U-value for Exterior Walls (including Siding) | **0.057** | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| | **0.058** | 0.34 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| | **0.059** | 0.33 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| | **0.060** | 0.32 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| | **0.061** | 0.31 | 0.32 | 0.33 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 | 0.35 |
| | **0.062** | 0.31 | 0.31 | 0.32 | 0.32 | 0.33 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 | 0.35 |
| | **0.063** | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 |
| | **0.064** | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 |
| | **0.065** | 0.28 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 |
| | **0.066** | 0.27 | 0.28 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 |
| | **0.067** | 0.26 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.33 | 0.34 | 0.34 | 0.34 | 0.35 | 0.35 |
| | **0.068** | 0.25 | 0.27 | 0.28 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 |
| | **0.069** | 0.24 | 0.26 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 |
| | **0.070** | 0.23 | 0.25 | 0.27 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 |
| | **0.071** | 0.22 | 0.25 | 0.26 | 0.28 | 0.29 | 0.29 | 0.30 | 0.31 | 0.31 | 0.31 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 |
| | **0.072** | 0.22 | 0.24 | 0.26 | 0.27 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 |
| | **0.073** | 0.21 | 0.23 | 0.25 | 0.27 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.33 | 0.33 | 0.34 | 0.35 | 0.35 |
| | **0.074** | 0.20 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 |
| | **0.075** | 0.19 | 0.22 | 0.24 | 0.26 | 0.27 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 |
| | **0.076** | 0.18 | 0.21 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.30 | 0.30 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 |
| | **0.077** | 0.17 | 0.20 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.32 | 0.33 | 0.34 | 0.35 | 0.35 |
| | **0.078** | 0.16 | 0.20 | 0.22 | 0.24 | 0.25 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.30 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 |
| | **0.079** | 0.15 | 0.19 | 0.21 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.29 | 0.30 | 0.32 | 0.33 | 0.34 | 0.34 | 0.35 |
| | **0.080** | 0.14 | 0.18 | 0.21 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.32 | 0.33 | 0.33 | 0.34 | 0.35 |
| | **0.081** | 0.13 | 0.17 | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.29 | 0.31 | 0.33 | 0.33 | 0.34 | 0.35 |
| | **0.082** | 0.13 | 0.17 | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.29 | 0.31 | 0.33 | 0.33 | 0.34 | 0.35 |
| | **0.083** | 0.12 | 0.16 | 0.19 | 0.21 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 |
| | **0.084** | 0.11 | 0.15 | 0.18 | 0.21 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 |
| | **0.085** | 0.10 | 0.14 | 0.18 | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 |
| | **0.086** | 0.09 | 0.14 | 0.17 | 0.20 | 0.22 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 |
| | **0.087** | 0.08 | 0.13 | 0.17 | 0.19 | 0.21 | 0.23 | 0.24 | 0.26 | 0.26 | 0.27 | 0.28 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 |
| | **0.088** | 0.07 | 0.12 | 0.16 | 0.19 | 0.21 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.30 | 0.32 | 0.33 | 0.34 | 0.35 |
| | **0.089** | 0.06 | 0.12 | 0.15 | 0.18 | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.30 | 0.32 | 0.33 | 0.34 | 0.35 |
| | **0.090** | 0.05 | 0.11 | 0.15 | 0.18 | 0.20 | 0.22 | 0.23 | 0.25 | 0.26 | 0.27 | 0.27 | 0.30 | 0.32 | 0.33 | 0.34 | 0.35 |

# Appendix B (continued)

## 2012 IECC Requirements - Climate Zone 5 and Marine 4

### (Total UA Method - IECC 402.1.4)

| | |
|---|---|
| 2012 IECC Table 402.1.3 Reference $U_{fen}$ = | 0.32 |
| 2012 IECC Table 402.1.3 Reference $U_{wall}$ = | 0.057 |

| | | Percentage of Fenestrations Area in Total Wall Area | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 10% | 12% | 14% | 16% | 18% | 20% | 22% | 24% | 26% | 28% | 30% | 40% | 50% | 60% | 80% | 100% |
| | | Average U-value for Fenestrations | | | | | | | | | | | | | | | |
| Average U-value for Exterior Walls (including Siding) | **0.057** | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 |
| | **0.058** | 0.31 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 |
| | **0.059** | 0.30 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 |
| | **0.060** | 0.29 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 |
| | **0.061** | 0.28 | 0.29 | 0.30 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 |
| | **0.062** | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 |
| | **0.063** | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 |
| | **0.064** | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 |
| | **0.065** | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 |
| | **0.066** | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 |
| | **0.067** | 0.23 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.30 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 |
| | **0.068** | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 |
| | **0.069** | 0.21 | 0.23 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 |
| | **0.070** | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 |
| | **0.071** | 0.19 | 0.22 | 0.23 | 0.25 | 0.26 | 0.26 | 0.27 | 0.28 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 |
| | **0.072** | 0.19 | 0.21 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 |
| | **0.073** | 0.18 | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.30 | 0.30 | 0.31 | 0.32 | 0.32 |
| | **0.074** | 0.17 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 | 0.32 |
| | **0.075** | 0.16 | 0.19 | 0.21 | 0.23 | 0.24 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 | 0.32 |
| | **0.076** | 0.15 | 0.18 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 | 0.32 |
| | **0.077** | 0.14 | 0.17 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 | 0.32 |
| | **0.078** | 0.13 | 0.17 | 0.19 | 0.21 | 0.22 | 0.24 | 0.25 | 0.25 | 0.26 | 0.27 | 0.27 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 |
| | **0.079** | 0.12 | 0.16 | 0.18 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.26 | 0.27 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 |
| | **0.080** | 0.11 | 0.15 | 0.18 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.25 | 0.26 | 0.27 | 0.29 | 0.30 | 0.30 | 0.31 | 0.32 |
| | **0.081** | 0.10 | 0.14 | 0.17 | 0.19 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.26 | 0.28 | 0.30 | 0.30 | 0.31 | 0.32 |
| | **0.082** | 0.09 | 0.14 | 0.17 | 0.19 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.26 | 0.28 | 0.30 | 0.30 | 0.31 | 0.32 |
| | **0.083** | 0.09 | 0.13 | 0.16 | 0.18 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.25 | 0.26 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 |
| | **0.084** | 0.08 | 0.12 | 0.15 | 0.18 | 0.20 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 |
| | **0.085** | 0.07 | 0.11 | 0.15 | 0.17 | 0.19 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.25 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 |
| | **0.086** | 0.06 | 0.11 | 0.14 | 0.17 | 0.19 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.25 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 |
| | **0.087** | 0.05 | 0.10 | 0.14 | 0.16 | 0.18 | 0.20 | 0.21 | 0.23 | 0.23 | 0.24 | 0.25 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 |
| | **0.088** | 0.04 | 0.09 | 0.13 | 0.16 | 0.18 | 0.20 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 |
| | **0.089** | 0.03 | 0.09 | 0.12 | 0.15 | 0.17 | 0.19 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 |
| | **0.090** | 0.02 | 0.08 | 0.12 | 0.15 | 0.17 | 0.19 | 0.20 | 0.22 | 0.23 | 0.24 | 0.24 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 |

# Appendix B (continued)

## 2012 IECC Requirements - Climate Zones 6-8

### (Total UA Method - IECC 402.1.4)

| | |
|---|---|
| 2012 IECC Table 402.1.3 Reference $U_{fen}$ = | 0.32 |
| 2012 IECC Table 402.1.3 Reference $U_{wall}$ = | 0.048 |

| Average U-value for Exterior Walls (including Siding) | Percentage of Fenestrations Area in Total Wall Area | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10% | 12% | 14% | 16% | 18% | 20% | 22% | 24% | 26% | 28% | 30% | 40% | 50% | 60% | 80% | 100% |
| | Average U-value for Fenestrations | | | | | | | | | | | | | | | |
| 0.048 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 |
| 0.049 | 0.31 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 |
| 0.050 | 0.30 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 |
| 0.051 | 0.29 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 |
| 0.052 | 0.28 | 0.29 | 0.30 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 |
| 0.053 | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 | 0.32 |
| 0.054 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 |
| 0.055 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 | 0.32 |
| 0.056 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 |
| 0.057 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 |
| 0.058 | 0.23 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.30 | 0.31 | 0.31 | 0.31 | 0.32 | 0.32 |
| 0.059 | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 |
| 0.060 | 0.21 | 0.23 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 |
| 0.061 | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 |
| 0.062 | 0.19 | 0.22 | 0.23 | 0.25 | 0.26 | 0.26 | 0.27 | 0.28 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 |
| 0.063 | 0.19 | 0.21 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 |
| 0.064 | 0.18 | 0.20 | 0.22 | 0.24 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.30 | 0.30 | 0.31 | 0.32 | 0.32 |
| 0.065 | 0.17 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 | 0.32 |
| 0.066 | 0.16 | 0.19 | 0.21 | 0.23 | 0.24 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 | 0.32 |
| 0.067 | 0.15 | 0.18 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | 0.27 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 | 0.32 |
| 0.068 | 0.14 | 0.17 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 | 0.32 |
| 0.069 | 0.13 | 0.17 | 0.19 | 0.21 | 0.22 | 0.24 | 0.25 | 0.25 | 0.26 | 0.27 | 0.27 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 |
| 0.070 | 0.12 | 0.16 | 0.18 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.26 | 0.27 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 |
| 0.071 | 0.11 | 0.15 | 0.18 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.25 | 0.26 | 0.27 | 0.29 | 0.30 | 0.30 | 0.31 | 0.32 |
| 0.072 | 0.10 | 0.14 | 0.17 | 0.19 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.26 | 0.28 | 0.30 | 0.30 | 0.31 | 0.32 |
| 0.073 | | 0.14 | 0.17 | 0.19 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.26 | 0.28 | 0.30 | 0.30 | 0.31 | 0.32 |
| 0.074 | | 0.13 | 0.16 | 0.18 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.25 | 0.26 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 |
| 0.075 | | 0.12 | 0.15 | 0.18 | 0.20 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 |
| 0.076 | | 0.11 | 0.15 | 0.17 | 0.19 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.25 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 |
| 0.077 | | 0.11 | 0.14 | 0.17 | 0.19 | 0.20 | 0.22 | 0.23 | 0.24 | 0.25 | 0.25 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 |
| 0.078 | | 0.10 | 0.14 | 0.16 | 0.18 | 0.20 | 0.21 | 0.23 | 0.23 | 0.24 | 0.25 | 0.28 | 0.29 | 0.30 | 0.31 | 0.32 |
| 0.079 | | | 0.13 | 0.16 | 0.18 | 0.20 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 |
| 0.080 | | | 0.12 | 0.15 | 0.17 | 0.19 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 |
| 0.081 | | | 0.12 | 0.15 | 0.17 | 0.19 | 0.20 | 0.22 | 0.23 | 0.24 | 0.24 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 |
| 0.082 | | | 0.11 | 0.14 | 0.17 | 0.18 | 0.20 | 0.21 | 0.22 | 0.23 | 0.24 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 |
| 0.083 | | | 0.11 | 0.14 | 0.16 | 0.18 | 0.20 | 0.21 | 0.22 | 0.23 | 0.24 | 0.27 | 0.29 | 0.30 | 0.31 | 0.32 |
| 0.084 | | | 0.10 | 0.13 | 0.16 | 0.18 | 0.19 | 0.21 | 0.22 | 0.23 | 0.24 | 0.27 | 0.28 | 0.30 | 0.31 | 0.32 |
| 0.085 | | | | 0.13 | 0.15 | 0.17 | 0.19 | 0.20 | 0.21 | 0.22 | 0.23 | 0.26 | 0.28 | 0.30 | 0.31 | 0.32 |
| 0.086 | | | | 0.12 | 0.15 | 0.17 | 0.19 | 0.20 | 0.21 | 0.22 | 0.23 | 0.26 | 0.28 | 0.29 | 0.31 | 0.32 |
| 0.087 | | | | 0.12 | 0.14 | 0.16 | 0.18 | 0.20 | 0.21 | 0.22 | 0.23 | 0.26 | 0.28 | 0.29 | 0.31 | 0.32 |
| 0.088 | | | | 0.11 | 0.14 | 0.16 | 0.18 | 0.19 | 0.21 | 0.22 | 0.23 | 0.26 | 0.28 | 0.29 | 0.31 | 0.32 |
| 0.089 | | | | 0.10 | 0.13 | 0.16 | 0.17 | 0.19 | 0.20 | 0.21 | 0.22 | 0.26 | 0.28 | 0.29 | 0.31 | 0.32 |
| 0.090 | | | | 0.10 | 0.13 | 0.15 | 0.17 | 0.19 | 0.20 | 0.21 | 0.22 | 0.26 | 0.28 | 0.29 | 0.31 | 0.32 |

# Appendix C: Example Calculations

## Example 1: U-factor Method

Given: A building is in Climate Zone 4, non-marine. Find a compliant wall.

Solution: Assuming studs are spaced 16″ o.c., from Table 1 of Appendix A, find a desired wall with a U-factor equal to or less than 0.057 (the requirement per Table 402.1.3). For example, a 2x6 wall with 7/16″ OSB sheathing and R-19 cavity insulation has a U-factor range of 0.054 - 0.063. Looking further at the WSP.16 details table, under the 2x6, R-19 column, the addition of R-2 insulated siding complies with a U-factor of 0.057.

## Example 2: TUA Method

Given: A building in Climate Zone 4, non-marine has a fenestration factor of 22% and the fenestration has a U-factor of 0.32. Given the fenestration efficiency, find an opaque wall that is compliant.

Solution: From the table for Climate Zone 4, Except Marine in Appendix B, the fenestration area percentage is found across the top, which in this case is 22%. Follow values down the column until the **last time** the actual U-factor for the window is found, which is 10 rows down in this example. Follow across that row to the far left to read the required U-factor for the wall. In this case it is 0.066. From Table 1 and WSP.16 details, a 2x6 wall with studs 16″ o.c., R-19 cavity insulation, WSP sheathing, and uninsulated (hollow-back) sheathing will comply.

By improving the windows or doors from the reference U-factor of 0.35 to 0.32, the opaque wall U-factor changes from the reference value of 0.057 to 0.066, which means R-2 insulated siding, shown in Example 1, would not be required.

## Example 3: TUA Method

Given: A building in Climate Zone 4 non-marine has a fenestration factor of 24%, 2x4 wall studs spaced 24″ o.c., R-15 cavity insulation, WSP sheathing, and uninsulated (hollow-back) vinyl siding. What minimum U-factor for windows is required?

Solution: From Table 1 Detail WSP.24, the wall configuration is shown to have a U-factor of 0.076. Using the table for Climate Zone 4, Except Marine in Appendix B, the fenestration area percentage of 24% is found across the top and the opaque wall U-factor of 0.076 is found along the left. Where the two meet, the U-factor of the needed fenestration is 0.29.

## Example 4: TUA Method, without Appendix A

Given: A building in Climate Zone 5 has the same details as shown in Example 3, except locally available windows have a U-factor of 0.29, which is better than the code minimum of 0.32 as shown in Appendix B for Climate Zone 5. There is 350 square feet of fenestration and 1400 square feet of opaque wall for a total wall area of 1750 square feet. What will the U-factor of the opaque wall need to be?

Solution: Begin by using Equation (2).

$$U_{ow\text{-}spec} \leq U_{ow,ref} + (U_{fen,ref} - U_{fen\text{-}spec})(A_{fen} / A_{ow})$$

**where:**

$U_{ow\text{-}spec}$ = U-factor of the opaque wood-frame wall in the specific assembly

$U_{ow,ref}$ = U-factor of the opaque wood-frame wall, from Table R402.1.3 (Appendix B)

$U_{fen,ref}$ = U-factor of the fenestration, from Table R402.1.3 (Appendix B)

$U_{fen\text{-}spec}$ = U-factor of the fenestration in specific assembly

$A_{fen}$ = Fenestration area of the wall

$A_{ow}$ = Opaque wood-frame wall area of the wall

$$U_{ow\text{-}spec} \leq 0.057 + (0.32 - 0.29)\,(350 / 1400)$$

$$U_{ow\text{-}spec} \leq 0.065$$

The answer is 0.065, which agrees with the answer given in Appendix B.

# Appendix C (continued)

### Example 5: Parallel Path Method

Given: Verify the U-factor of a 2x4 wall with studs 16″ o.c., 7/16″ OSB, R-15 cavity insulation, and uninsulated (hollow-back) vinyl siding. Calculate the U-factor and compare it to the value of 0.078 given in Appendix A, Table 1 Detail WSP.16.

Solution: The Parallel Path Method in the 2009 ASHRAE *Handbook of Fundamentals* requires that the R-values of both the stud path and cavity path be calculated and then inverted to find the respective U-factors (see Table C1).

An area weighted average U-factor for the wall is found by combining the U-factors of each path.

$$U_{ow} = U_{stud} F_F + U_{cavity} (1 - F_F)$$

**where:**

$U_{ow}$ = U-factor of the opaque wood-frame wall

$U_{stud}$ = U-factor of the stud path

$F_F$ = Framing Factor

$U_{cavity}$ = U-factor of the cavity path

Assuming from the 2009 ASHRAE *Handbook of Fundamentals* that the framing factor for studs 16″ o.c. is 25%:

$$U_{ow} = (0.1430)(0.25) + (0.0568)(1 - 0.25) = 0.078$$

The result corresponds to the value of 0.078 given in Table 1 Detail WSP.16.

**Table C1 Example 5 Solution using the Parallel Path Method from the *2009 ASHRAE Handbook of Fundamentals***

| Cavity Path | | Stud Path | | |
|---|---|---|---|---|
| Component | R-Value | Component | R-Value | Source* |
| Outside Air Film | 0.25 | Outside Air Film | 0.25 | Ch. 26 Table 1 |
| Vinyl Siding | 0.62 | Vinyl Siding | 0.62 | Ch. 26 Table 4 |
| 7/16″ OSB | 0.62 | 7/16″ OSB | 0.62 | |
| Cavity Insulation | 15 | 1.25 per inch of depth | 4.375 | |
| ½″ Gypsum | 0.45 | ½″ Gypsum | 0.45 | |
| Inside Air Film | 0.68 | Inside Air Film | 0.68 | Ch. 26 Table 1 |
| Sum | 17.62 | | 6.995 | |
| U-Factor (1/R) | 0.0568 | | 0.1430 | |

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