

RE35-19

IECC: TABLE R402.1.2 (IRC N1102.1.2), TABLE R402.1.4 (IRC N1102.1.4)

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2018 International Energy Conservation Code

Revise as follows:

**TABLE R402.1.2 (IRC N1102.1.2)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT***

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b, e}	CEILING R-VALUE	WOODFRAME WALL R-VALUE	MASS WALL R-VALUE ^f	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWLSPACE ^c WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40 0.35	0.65	0.25	38	13	4/6	13	0	0	0
3	0.32 0.30 ^j	0.55	0.25	38	20 or 13+5 ^h	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.32 0.30 ^j	0.55	0.40	49	20 or 13+5 ^h	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.30 ^j	0.55	NR	49	20 or 13+5 ^h	13/17	30 ^g	15/19	10, 2 ft	15/19
6	0.30 ^j	0.55	NR	49	20+5 ^h or 13+10 ^h	15/20	30 ^g	15/19	10, 4 ft	15/19
7 and 8	0.30 ^j	0.55	NR	49	20+5 ^h or 13+10 ^h	19/21	38 ^g	15/19	10, 4 ft	15/19

NR = Not Required. For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall be not less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation *R*-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.

g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an *R*-value of R-19.

h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

i. Mass walls shall be in accordance with Section R402.2.5. The second *R*-value applies where more than half of the insulation is on the interior of the mass wall.

j. A maximum *U*-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4000 feet in elevation above sea level, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the International Residential Code.

**TABLE R402.1.4 (IRC N1102.1.4)
EQUIVALENT *U*-FACTORS^a**

CLIMATEZONE	FENESTRATIONU-FACTOR	SKYLIGHTU-FACTOR	CEILINGU-FACTOR	FRAMEWALL U-FACTOR	MASS WALL U-FACTOR ^b	FLOORU-FACTOR	BASEMENTWALL U-FACTOR	CRAWLSPACE WALL U-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40 0.35	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.32 0.30	0.55	0.030	0.060	0.098	0.047	0.091 ^c	0.136
4 except Marine	0.32 0.30	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.30	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	0.026	0.045	0.057	0.028	0.050	0.055

- a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
- b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
- c. In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.

Reason: The purpose of this code change proposal is to improve occupant comfort and save energy by upgrading and strengthening fenestration

U-factors in climate zones 2 – 4 (by lowering them consistent with modest step improvements in previous code cycles). Fenestration that meets these requirements is cost-effective and will return substantial life cycle savings to homeowners, is already widely available, and is routinely installed in new and existing residential buildings in these climate zones. This proposal also adds a footnote to establish an exception to prescriptive U-factors for fenestration installed at high altitudes (above 4000 feet in elevation) and in regions that require fenestration to be resistant to windborne debris in climate zones 3 - 8. A similar footnote exception was proposed in the last code development cycle and was widely supported by building code officials in these specific regions. Overall, this proposal will improve energy efficiency across much of the nation while allowing reasonable options for fenestration in high-altitude and wind-borne debris regions.

Energy Savings and Cost-Effectiveness - Our analysis, based on the DOE cost-effectiveness methodology, shows the improvements in U-factor to be cost-effective to the consumer with a substantial life cycle benefit:

Climate Zone	Annual Energy Cost Savings	Present Value Life Cycle Benefit
2	0.9%	\$275
3	1.0%	\$312
4	1.1%	\$523

Although we believe that the upgrade in the standards will result in no cost increase in most cases, because the new specification is consistent with the standard product already used in the marketplace (as discussed below), for purposes of the life cycle cost analysis above, we used a marginal upgrade cost to be conservative. Even with this approach, the life cycle benefit is robust.

Availability of Compliant Products and Adoption – A 0.30 U-factor requirement is a natural technology level/breakpoint representing a reasonably efficient, double pane, low-e with argon wood or vinyl window. As a result, a number of national and state programs have promoted fenestration U-factors in the range of 0.30 for several years, making these products widely available and already being installed throughout most of the country:

- For example, the American Recovery and Reinvestment Act of 2009 (ARRA) provided a federal income tax credit for fenestration with a U-factor of 0.30 or lower.
- Energy Star has required 0.30 U-factors (or less) for fenestration installed in all but the southernmost climate zones since January 1, 2015. See https://www.energystar.gov/sites/default/files/ES_Final_V6_Residential_WDS_Spec.pdf
- A recent EnergyStar market penetration report estimated that the share of total window products in the market already meeting the EnergyStar standard in 2016 was about 83%. (https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2016_USD_Summary_Report.pdf?8fd5-1967).
- These findings were reinforced through the U.S. DOE Residential Field Studies, which found that even in states in climate zones 2 – 4, with weaker code U-factor requirements, builders were routinely installing fenestration with U-factors around 0.30. See https://www.energycodes.gov/sites/default/files/documents/Field_Study_120715_Final.pdf.
- The state of California has recently upgraded its U-factor requirements for vertical fenestration statewide from 0.32 to 0.30, finding the lower U-factor cost-effective in all of its climate zones (California contains climate zones 2 – 6). See Codes and Standards Enhancement (CASE) Initiative, 2019 California Building Energy Efficiency Standards, *Residential High Performance Windows and Doors – Final Report* (Aug. 2017).

Because of these national trends toward 0.30 U-factor or better fenestration, compliance will not be an issue and in most cases will not even result in an increase in construction costs.

Proposed Exception for Special Circumstances - We believe that the proposed exception is warranted due to the special measures that are taken by glass and/or fenestration manufacturers to address higher altitudes and windborne debris due to high winds.

For example, high altitude products may incorporate breather or capillary tubes in the insulating glass unit to allow pressure equalization for products that will be transported to higher elevations for installation. The pressure equalization can help avoid IG unit failures. However, the capillary tubes eliminate the ability to use certain gas fills commonly used to achieve higher levels of thermal performance. The limited exception proposed above recognizes that circumstance and provides some flexibility for builders in these regions.

Likewise, fenestration designed to withstand windborne debris usually requires special glass which (because of its increased thickness) reduces the gap width in the insulating glass unit. This will affect the thermal performance of the window. To provide some additional flexibility in zones where such fenestration is required, this proposal permits a fenestration U-factor of 0.32 for climate zones 3-8.

In sum, we believe this proposal will implement meaningful energy and cost savings and improved occupant comfort through improved fenestration U-factors that are already available and are routinely being installed by homebuilders.

Bibliography: ENERGY STAR® Product Specification Residential Windows, Doors, and Skylights Eligibility Criteria Version 6.0, Energy Star, available at https://www.energystar.gov/sites/default/files/ES_Final_V6_Residential_WDS_Spec.pdf. ENERGY STAR® Unit Shipment and Market Penetration Report Calendar Year 2016 Summary, Energy Star, available at https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2016_USD_Summary_Report.pdf?8fd5-1967.

Single Family Residential Energy Code Field Study, Building Energy Codes Program, available at https://www.energycodes.gov/sites/default/files/documents/Field_Study_120715_Final.pdf.

Codes and Standards Enhancement (CASE) Initiative, 2019 California Building Energy Efficiency Standards, *Residential High Performance Windows and Doors – Final Report* (Aug. 2017).

U.S. Dep't of Energy, Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes (Aug. 2015), *available at <https://www.energycodes.gov/residential-energy-and-cost-analysis-methodology>.*

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

It is possible that requiring more efficient fenestration may, in some cases, increase the cost of construction (and, as a result, we used an upgrade cost in our life cycle cost/benefit analysis), but in any event, the resulting energy and cost savings will overwhelmingly recoup the initial costs and will continue to benefit consumers over the useful life of the home. Moreover, it should also be noted that we would expect that the U-factor reduction will not increase costs in most cases, since the standard market products, with very high market penetration, already typically hit the proposed improved U-factor levels. We also note that for builders in high-altitude or wind-borne debris regions, the new footnote will provide additional flexibility and will likely serve to reduce costs.

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