High-R Windows

Select high-performance windows that meet or exceed code and energy-efficiency program requirements. High-efficiency windows typically consist of two or more panes of glass in a fiberglass, vinyl, wood, or combination insulated frame, with low-emissivity (low-e) coatings on the glass panes and a nontoxic inert gas like argon filling the space between the panes to provide better insulation than plain air. Windows are typically the weakest performing component of the wall from a thermal insulation perspective. Windows typically have insulation values of R-1 for single-pane aluminum-framed windows to R-6 for the highest-performing triple-pane windows. In comparison, insulated walls typically have R-values of R-13 to R-25 or higher. Therefore, selecting and properly installing high-performance windows during initial construction can be a cost-effective measure over the life of the home. For more information about the features of high-performance windows, see the guide **ENERGY STAR Windows** .

DOE Zero Energy Ready Home (Revision 07)

Exhibit 1 Mandatory Requirements.
Exhibit 1, Item 1) Certified under the ENERGY STAR Qualified Homes Program or the ENERGY STAR Multifamily New Construction Program.
Exhibit 1, Item 2) Fenestration shall meet or exceed ENERGY STAR requirements. See Footnote 11 for specific U, SHGC values, and exceptions.

Footnote 11) Windows shall meet the ENERGY STAR Window Product Criteria as listed in the table below. Note that the Cold Climate U and SHGC values shown below are based on the older ENERGY STAR v5.0 Window Specifications. DOE will periodically review the feasibility of adopting ENERGY STAR v6.0 Window Specifications for the Cold Climate Zones, which entail lower U values. Any program update to require the v6.0 window specs in Cold Climates will be announced with a minimum 1-year phase-in.

Window Specs Required for DOE Zero Energy Ready Home Projects	**Hot Climates IECC CZ 1-2**		**Mixed Climates IECC CZ 3-4 except Marine**		**Cold Climates IECC CZ 5-8 and 4 Marine**	
	U-Value	SHGC	U-value	SHGC	U-Value	SHGC
	0.40	0.25	[CZ 3] 0.30 [CZ 4] 0.30	[CZ 3] 0.25 [CZ 4] 0.40	0.30 0.31 0.32	Any ≥0.35 ≥0.40

Window Specs Required for DOE Zero Energy Ready Home Projects (Source: **DOE Zero Energy Ready Home (Revision 07)**).

The following exceptions apply:

1. An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements;
2. An area-weighted average of fenestration products ? 50% glazed shall be permitted to satisfy the SHGC requirements;
3. 15 square feet of glazed fenestration per dwelling unit shall be exempt from the U-factor and SHGC requirements, and shall be excluded from area-weighted averages calculated using a) and b), above;
4. One side-hinged opaque door assembly up to 24 square feet in area shall be exempt from the U-factor requirements and shall be excluded from area-weighted averages calculated using a) and b), above;
5. Fenestration utilized as part of a passive solar design shall be exempt from the U-factor and SHGC requirements, and shall be excluded from area-weighted averages calculated using a) and b), above. Exempt windows shall be facing within 45 degrees of true South and directly coupled to thermal storage mass that has a heat capacity > 20 btu / ft3x?F and provided in a ratio of at least 3 sq. ft. per sq. ft. of South facing fenestration. Generally, thermal mass materials will be at least 2 in. thick.
6. For homes achieving PHIUS+ certification where triple glazed window assemblies with thermal breaks/spacers between the panes are used, such windows are deemed to meet this requirement even in the absence of an ENERGY STAR certification.

Exhibit 2 DOE Zero Energy Ready Home Target Home.
The U.S. Department of Energy's Zero Energy Ready Home program allows builders to choose a prescriptive or performance path. The DOE Zero Energy Ready Home prescriptive path requires builders to meet or exceed the minimum HVAC efficiencies listed in Exhibit 2 of the National Program Requirements (Rev 07), as shown below. The DOE Zero Energy Ready Home performance path allows builders to select a custom combination of measures for each home that is equivalent in performance to the minimum HERS index of a modeled target home that meets the requirements of Exhibit 2 as well as the mandatory requirements of Zero Energy Ready Home Exhibit 1.

Windows[24, ,25, 26]			
	Hot Climates (2015 IECC Zones 1,2,)	**Mixed Climates** (2015 IECC Zones 3, 4 except Marine)	**Cold Climates** (2015 IECC Zones 4 Marine, 5,6,7,8)
SHGC	0.25	0.25	any
U-Value	0.4	0.3	0.27
Homes qualifying through the Prescriptive Path with a total window-to-floor area greater than 15% shall have adjusted U-values or SHGCs.[27]			

Exhibit 2 - DOE ZERH Target Home Window Requirements (Source: **DOE Zero Energy Ready Home (Revision 07)**).

Footnote 1) Local energy code specifications that exceed the DOE Zero Energy Ready Home National Program Requirements always take precedence and shall be used instead of DOE Zero Energy Ready Home specifications to determine DOE Zero Energy Ready Home compliance.

Footnote 24) All decorative glass and skylight window areas count toward the total window area to above-grade conditioned floor area (WFA) ratio.
Footnote 25) DOE strongly encourages all DOE Zero Energy Ready Home partners to consider using R-5 windows in cold climates in anticipation of them becoming the state-of-the-art window choice in the near future.

Footnote 26) For homes using Exhibit 2 for Prescriptive compliance with the DOE Zero Energy Ready Home, the following exceptions to the U-Value and SHGC requirements in Exhibit 2 apply:

1. An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements;
2. An area-weighted average of fenestration products ? 50% glazed shall be permitted to satisfy the SHGC requirements;
3. 15 square feet of glazed fenestration per dwelling unit shall be exempt from the U-factor and SHGC requirements, and shall be excluded from area-weighted averages calculated using a) and b), above;
4. One side-hinged opaque door assembly up to 24 square feet in area shall be exempt from the U-factor requirements and shall be excluded from area-weighted averages calculated using a) and b), above;
5. Fenestration utilized as part of a passive solar design shall be exempt from the U-factor and SHGC requirements, and shall be excluded from area-weighted averages calculated using a) and b), above. Exempt windows shall be facing within 45 degrees of true South and directly coupled to thermal storage mass that has a heat capacity > 20 btu / ft3x ?F and provided in a ratio of at least 3 sq. ft. per sq. ft. of South facing fenestration. Generally, thermal mass materials will be at least 2 in. thick.

Footnote 27) For Prescriptive Path: All decorative glass and skylight window areas count toward the total window area to above-grade conditioned floor area (WFA) ratio. For homes using the Prescriptive Path that have a WFA ratio > 15%, the following additional requirements apply:

1. In Climate Zones 1, 2, and 3, an improved window SHGC is required and is determined by:
   Improved SHGC = [0.15 / WFA] x [ENERGY STAR SHGC]
   Where the ENERGY STAR SHGC is the maximum allowable SHGC in Exhibit 1, ENERGY STAR Reference Design, for the Climate Zone where the home will be built.
2. In Climate Zones 4, 5, 6, 7, and 8, an improved window U-Value is required and is determined by:
   Improved U-Value = [0.15 / WFA] x [ENERGY STAR U-Value]
   Where the ENERGY STAR U-Value is the maximum allowable U-Value in Exhibit 1, ENERGY STAR Reference Design, for the Climate Zone where the home will be built.

ENERGY STAR Certified Homes Notes

ENERGY STAR Certified Homes (Ver. 3/3.1, Rev 09) windows criteria are provided in the Building America Solution Center guide **ENERGY STAR Windows**.

More Info.

Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

References and Resources*

1. **DOE Zero Energy Ready Home National Program Requirements (Rev. 07)**
   Author(s): U.S. Department of Energy
   Organization(s): DOE
   Publication Date: May, 2019
   Standard requirements for DOE's Zero Energy Ready Home national program certification.

*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

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