

The Clear Choice Is Crystal

Crystal Wall Folding Doors

2016 Building Energy Efficiency Standards (Title24)

<http://energy.ca.gov/title24/>

Crystal Wall Folding Doors sold by Crystal Pacific Window & Door System (Crystal California) are manufactured and **site-built** (field-fabricated) by Premier Folding Doors.

Field-fabricated fenestration and field-fabricated exterior doors are an exception to mandatory certification requirements of Section 110.6(a) of the 2016 Building Energy Efficiency Standards. [Page 105]

"If the fenestration product is a vertical site-built fenestration product in a building covered by the nonresidential standards with less than 1,000 square feet of site-built fenestration, the default U-factor and SHGC may be calculated as set forth in Reference Nonresidential Appendix NA6." [Page 105]

The U-factor and SHGC can be determined by using the applicable defaults set forth in Table 110.6-A and Table 110.6-B of the 2016 Building Energy Efficiency Standards. [Pages 107 and 108]

Low-rise residential buildings must either have a maximum U-factor of 0.58 or the U-factor shall not exceed 0.58. This is according to Section 150.0(q). [Page 244]

The following is from the alternate default fenestration procedure to calculate thermal performance in the 2016 Nonresidential Appendices. Can be used for nonresidential or residential. [Appendix NA6-3]

NA6.2 Default U-factor – Equation NA6-1: $U_T = C_1 + (C_2 \times U_C)$

U_T = U-factor Is the Total Performance of the fenestration including glass and frame
 C_1 = [0.202 Metal Thermal Break or Non-Metal] Coefficient selected from Table NA6-5
 C_2 = [0.867 Metal Thermal Break or Non-Metal] Coefficient selected from Table NA6-5
 U_C = [**0.30** TE62/27 Low-E* / **0.35** Sungate 500 Low-E**] Center of glass U-factor [...]

$$0.202 + (0.867 \times 0.30) = \text{*U-factor: 0.462}$$

$$0.202 + (0.867 \times 0.35) = \text{**U-factor: 0.50}$$

NA6.3 Default Solar Heat Gain Coefficient, SHGC – Equation NA6-2: $SHGC_T = 0.08 + (0.86 \times SHGC_C)$

$SHGC_T$ = SHGC Is the Total Performance of the fenestration including glass and frame
 $SHGC_C$ = [**0.26** TE62/27 Low-E* / **0.35** Sungate 500 Low-E**] Center of glass SHGC [...]

$$0.08 + (0.86 \times 0.26) = \text{*SHGC: 0.30}$$

$$0.08 + (0.86 \times 0.35) = \text{**SHGC: 0.38}$$

Note: There are no mandatory SHGC requirements for fenestration products. There are prescriptive requirements, but designers can model their way out of prescriptive requirements.

2016

BUILDING ENERGY EFFICIENCY STANDARDS FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS

FOR THE 2016 BUILDING
ENERGY EFFICIENCY
STANDARDS

TITLE 24, PART 6, AND ASSOCIATED
ADMINISTRATIVE REGULATIONS
IN PART 1.



JUNE 2015
CEC-400-2015-037-CMF

CALIFORNIA ENERGY COMMISSION
Edmund G. Brown Jr., Governor

SECTION 110.6 – MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS

- (a) **Certification of Fenestration Products and Exterior Doors other than Field-fabricated.** Any fenestration product and exterior door, other than field-fabricated fenestration products and field-fabricated exterior doors, may be installed only if the manufacturer has certified to the Commission, or if an independent certifying organization approved by the Commission has certified that the product complies with all of the applicable requirements of this subsection.
- Air leakage.** Manufactured fenestration products and exterior doors shall have air infiltration rates not exceeding 0.3 cfm/ft² of window area, 0.3 cfm/ft² of door area for residential doors, 0.3 cfm/ft² of door area for nonresidential single doors (swinging and sliding), and 1.0 cfm/ft² for nonresidential double doors (swinging), when tested according to NFRC-400 or ASTM E283 at a pressure differential of 75 pascals (or 1.57 pounds/ft²), incorporated herein by reference.

NOTES TO SECTION 110.6(a)1:

- Pet doors must meet 0.3 cfm/ft² when tested according to ASTM E283 at 75 pascals (or 1.57 pounds/ft²).
- AAMA/WDMA/CSA 101/I.S.2/A440-2011 specification is equivalent to ASTM E283 at a pressure differential of 75 pascals (or 1.57 pounds/ft²) satisfies the air leakage certification requirements of this section.

EXCEPTION to Section 110.6(a)1: Field-fabricated fenestration and field-fabricated exterior doors.

- U-factor.** The fenestration product's U-factor shall be rated in accordance with NFRC 100, or use the applicable default U-factor set forth in TABLE 110.6-A.

EXCEPTION 1 to Section 110.6(a)2: If the fenestration product is a skylight or a vertical site-built fenestration product in a building covered by the nonresidential standards with less than 1,000 square feet of site-built fenestration, the default U-factor may be calculated as set forth in Reference Nonresidential Appendix NA6.

EXCEPTION 2 to Section 110.6(a)2: If the fenestration product is an alteration consisting of any area replacement of glass in a skylight product or in a vertical site-built fenestration product, in a building covered by the nonresidential standards, the default U-factor may be calculated as set forth in Reference Nonresidential Appendix NA6.

- Solar Heat Gain Coefficient (SHGC).** The fenestration product's SHGC shall be rated in accordance with NFRC 200, or use the applicable default SHGC set forth in TABLE 110.6-B.

EXCEPTION 1 to Section 110.6(a)3: If the fenestration product is a skylight or a vertical site-built fenestration product in a building covered by the nonresidential standards with less than 1,000 square feet of site-built fenestration, the default SHGC may be calculated as set forth in Reference Nonresidential Appendix NA6.

EXCEPTION 2 to Section 110.6(a)3: If the fenestration product is an alteration consisting of any area replacement of glass in a skylight product or in a vertical site-built fenestration product, in a building covered by the nonresidential standards, the default SHGC may be calculated as set forth in Reference Nonresidential Appendix NA6.

- Visible Transmittance (VT).** The fenestration product's VT shall be rated in accordance with NFRC 200 or ASTM E972, for tubular skylights VT shall be rated using NFRC 203.

EXCEPTION 1 to Section 110.6(a)4: If the fenestration product is a skylight or a vertical site-built fenestration product in a building covered by the nonresidential standards with less than 1,000 square feet of site-built fenestration, the default VT may be calculated as set forth in Reference Nonresidential Appendix NA6.

EXCEPTION 2 to Section 110.6(a)4: If the fenestration product is an alteration consisting of any area; replacement of glass in a skylight product or in a vertical site-built fenestration product in a building covered by the nonresidential standards, the default VT may be calculated as set forth in Reference Nonresidential Appendix NA6.

5. **Labeling.** Fenestration products shall:
 - A. Have a temporary label for manufactured fenestration products or a label certificate when the Component Modeling Approach (CMA) is used and for site-built fenestration meeting the requirements of Section 10-111(a)1. The temporary label shall not be removed before inspection by the enforcement agency ; and
 - B. Have a permanent label or a label certificate when the Component Modeling Approach (CMA) is used and for site-built fenestration meeting the requirements of Section 10-111(a)2 if the product is rated using NFRC procedures.
6. **Fenestration Acceptance Requirements.** Before an occupancy permit is granted, site-built fenestration products in other than low-rise residential buildings shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified in the Reference Nonresidential Appendix NA7 to ensure that site-built fenestration meet Standards requirements, including a matching label certificate for product(s) installed and be readily accessible at the project location. A Certificate of Acceptance certifying that the fenestration product meets the acceptance requirements shall be completed, signed and submitted to the enforcement agency.

EXCEPTION to Section 110.6(a): Fenestration products removed and reinstalled as part of a building alteration or addition.

- (b) **Installation of Field-fabricated Fenestration and Exterior Doors.** Field-fabricated fenestration and field-fabricated exterior doors may be installed only if the compliance documentation has demonstrated compliance for the installation using U-factors from TABLE 110.6-A and SHGC values from TABLE 110.6-B. Field-fabricated fenestration and field-fabricated exterior doors shall be caulked between the fenestration products or exterior door and the building, and shall be weatherstripped.

EXCEPTION to Section 110.6(b): Unframed glass doors and fire doors need not be weather stripped or caulked.

TABLE 110.6-A DEFAULT FENESTRATION PRODUCT U-FACTORS

FRAME	PRODUCT TYPE	SINGLE PANE ^{3,4} U-FACTOR	DOUBLE PANE ^{1,3,4} U-FACTOR	GLASS BLOCK ^{2,3} U-FACTOR
Metal	Operable	1.28	0.79	0.87
	Fixed	1.19	0.71	0.72
	Greenhouse/garden window	2.26	1.40	N.A.
	Doors	1.25	0.77	N.A.
	Skylight	1.98	1.30	N.A.
Metal, Thermal Break	Operable	N.A.	0.66	N.A.
	Fixed	N.A.	0.55	N.A.
	Greenhouse/garden window	N.A.	1.12	N.A.
	Doors	N.A.	0.59	N.A.
	Skylight	N.A.	1.11	N.A.
Nonmetal	Operable	0.99	0.58	0.60
	Fixed	1.04	0.55	0.57
	Doors	0.99	0.53	N.A.
	Greenhouse/garden windows	1.94	1.06	N.A.
	Skylight	1.47	0.84	N.A.

¹ For all dual-glazed fenestration products, adjust the listed U-factors as follows:

- a. Add 0.05 for products with dividers between panes if spacer is less than 7/16 inch wide.
- b. Add 0.05 to any product with true divided lite (dividers through the panes).

² Translucent or transparent panels shall use glass block values when not rated by NFRC 100.

³ Visible Transmittance (VT) shall be calculated by using Reference Nonresidential Appendix NA6.

⁴ Windows with window film applied that is not rated by NFRC 100 shall use the default values from this table.

TABLE 110.6-B DEFAULT SOLAR HEAT GAIN COEFFICIENT (SHGC)

FRAME TYPE	PRODUCT	GLAZING	FENESTRATION PRODUCT SHGC		
			Single Pane ^{2,3} SHGC	Double Pane ^{2,3} SHGC	Glass Block ^{1,2} SHGC
Metal	Operable	Clear	0.80	0.70	0.70
	Fixed	Clear	0.83	0.73	0.73
	Operable	Tinted	0.67	0.59	N.A.
	Fixed	Tinted	0.68	0.60	N.A.
Metal, Thermal Break	Operable	Clear	N.A.	0.63	N.A.
	Fixed	Clear	N.A.	0.69	N.A.
	Operable	Tinted	N.A.	0.53	N.A.
	Fixed	Tinted	N.A.	0.57	N.A.
Nonmetal	Operable	Clear	0.74	0.65	0.70
	Fixed	Clear	0.76	0.67	0.67
	Operable	Tinted	0.60	0.53	N.A.
	Fixed	Tinted	0.63	0.55	N.A.

¹ Translucent or transparent panels shall use glass block values when not rated by NFRC 200.

² Visible Transmittance (VT) shall be calculated by using Reference Nonresidential Appendix NA6.

³ Windows with window film applied that is not rated by NFRC 200 shall use the default values from this table

SUBCHAPTER 7

LOW-RISE RESIDENTIAL BUILDINGS – MANDATORY FEATURES AND DEVICES

SECTION 150.0 – MANDATORY FEATURES AND DEVICES

Low-rise residential buildings shall comply with the applicable requirements of Sections 150(a) through 150.0(r).

NOTE: The requirements of Sections 150.0(a) through 150.0(r) apply to newly constructed buildings. Sections 150.2(a) and 150.2(b) specify which requirements of Sections 150.0(a) through 150.0(r) also apply to additions or alterations.

- (a) **Ceiling and Rafter Roof Insulation.** The opaque portions of ceilings and roofs separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Items 1 through 3 below:
1. Shall be insulated to achieve a weighted average U-factor not exceeding U-0.043 or shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-22 or greater for the insulation alone. For vented attics, the mandatory insulation shall be installed at the ceiling level; for unvented attics, the mandatory insulation shall be placed at either ceiling or roof level; and
EXCEPTION to Section 150.0(a)1: Ceilings and rafter roofs in an alteration shall be insulated to achieve a weighted average U-factor not exceeding 0.054 or shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-19 or greater.
 2. Attic access doors shall have permanently attached insulation using adhesive or mechanical fasteners. The attic access shall be gasketed to prevent air leakage; and
 3. Insulation shall be installed in direct contact with a continuous roof or ceiling which is sealed to limit infiltration and exfiltration as specified in Section 110.7, including but not limited to placing insulation either above or below the roof deck or on top of a drywall ceiling..
- (b) **Loose-fill Insulation.** When loose-fill insulation is installed, the minimum installed weight per square foot shall conform with the insulation manufacturer's installed design weight per square foot at the manufacturer's labeled R-value.
- (c) **Wall Insulation.** Opaque portions of above grade walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Items 1, 2, 3 and 4 below:
1. 2x4 inch framing shall have an overall assembly U-factor not exceeding U-0.102, equivalent to an installed R-value of 13 in a wood framed assembly.
EXCEPTION to Section 150.0(c)1: Existing walls already insulated to a U-factor not exceeding U-0.110 or already insulated between framing members with insulation having an installed thermal resistance of R-11 or greater.
 2. 2x6 inch or greater framing shall have an overall assembly U-factor not exceeding U-0.074 or an installed R-value of 19 in a wood framed assembly.
 3. Opaque non-framed assemblies shall have an overall assembly U-factor not exceeding U-0.102, equivalent to an installed R-value of 13 in a wood framed assembly.
 4. Bay or Bow Window roofs and floors shall be insulated to meet the wall insulation requirements of TABLE 150.1-A.
- (d) **Raised-floor Insulation.** Raised floors separating conditioned space from unconditioned space or ambient air shall have an overall assembly U-factor not exceeding U-0.037 or an installed R-value of 19 or greater in a wood framed assembly.

- C. All elbows shall be sweep elbows or of an elbow-type that has a pressure drop of less than the pressure drop of straight pipe with a length of 30 pipe diameters.
 - 3. **Filters.** Filters shall be at least the size specified in NSF/ANSI 50 for public pool intended applications.
 - 4. **Valves.** Minimum diameter of backwash valves shall be 2 inches or the diameter of the return pipe, whichever is greater.
- (q) **Fenestration Products.** Fenestration separating conditioned space from unconditioned space or outdoors shall meet the requirements of either Item 1 or 2 below:
- 1. Fenestration, including skylight products, must have a maximum U-factor of 0.58.
 - 2. The weighted average U-factor of all fenestration, including skylight products, shall not exceed 0.58.
- EXCEPTION 1 to Section 150.0(q)1:** Up to 10 square feet of fenestration area or 0.5 percent of the Conditioned Floor Area, whichever is greater, is exempt from the maximum U-factor requirement.
- EXCEPTION 2 to Section 150.0(q)1:** For dual-glazed greenhouse or garden windows, up to 30 square feet of fenestration area is exempt from the maximum U-factor requirement.
- (r) **Solar Ready Buildings.** Shall meet the requirements of Section 110.10 applicable to the building project.

TABLE 150.0-A CLASSIFICATION OF HIGH EFFICACY LIGHT SOURCES

High Efficacy Light Sources	
Luminaires installed with only the lighting technologies in this table shall be classified as high efficacy	
Light sources in this column other than those installed in ceiling recessed downlight luminaires are classified as high efficacy and are not required to comply with Reference Joint Appendix JA8	Light sources in this column shall be certified to the Commission as High Efficacy Light Sources in accordance with Reference Joint Appendix JA8 and be marked as meeting JA8.
<ul style="list-style-type: none"> 1. Pin-based linear or compact fluorescent light sources using electronic ballasts. 2. Pulse-start metal halide. 3. High pressure sodium. 4. GU-24 sockets containing light sources other than LEDs.^{a,b} 5. Luminaires with hardwired high frequency generator and induction lamp. 6. Inseparable SSL luminaires that are installed outdoors. 7. Inseparable SSL luminaires containing colored light sources that are installed to provide decorative lighting. 	<ul style="list-style-type: none"> 8. All light sources in ceiling recessed downlight luminaires. Note that ceiling recessed downlight luminaires shall not have screw bases regardless of lamp type as described in Section 150.0(k)1C. 9. GU-24 sockets containing LED light sources. 10. Any light source not otherwise listed in this table and certified to the Commission as complying with Joint Appendix 8.
<p>Notes:</p> <ul style="list-style-type: none"> a. GU-24 sockets containing light sources such as compact fluorescent lamps and induction lamps. b. California Title 20 Section 1605(k)3 does not allow incandescent sources to have a GU-24 base. 	

2016

REFERENCE APPENDICES

FOR THE 2016 BUILDING
ENERGY EFFICIENCY
STANDARDS

TITLE 24, PART 6, AND ASSOCIATED
ADMINISTRATIVE REGULATIONS
IN PART 1.



JUNE 2015
CEC-400-2015-038-CMF

CALIFORNIA ENERGY COMMISSION
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NA6.1 Scope

This procedure provides for non-rated site-built fenestration up to 1000 ft² (other than a repair or replacement glass) an option to comply with the Energy Standards. The Center of Glass (COG) values are required to be used in Equation NA6-1, NA6-2 and NA6-3 and shall be determined by the manufacturers in accordance with NFRC procedures. A copy of the manufacturer cut sheets or data sheet shall be provided identifying the COG values as an attachment with the Fenestration Certificate (FC-1).

(a) NONRESIDENTIAL

For Nonresidential site-built fenestration up to 1,000 ft² in area, other than repair or replacement glass, the Alternate Default Fenestration Procedure shall be used when no NFRC Label Certificate is available. The manufacturer cut sheet or data sheet shall be used to identify the COG values for the U-factor, Solar Heat Gain Coefficient (SHGC_C) and Visible Transmittance (VT_C). If unable to determine center of glass information, the alternative Energy Commissions Default Tables in Section 110.6 of the Energy Standards must be used to determine the appropriate fenestration default values. The values listed in Table 110.6-A for U-factors and Table 110.6-B for SHGC values are whole fenestration product values. Since there is no default Visible Transmittance value available, the alternative is VT_C = 1.0; this will be used to determine the total fenestration product, VT_T, which includes the glass and frame of the fenestration.

For Nonresidential the altered fenestration (other than a repair) shall meet the values listed in Table 141.0-A unless the altered glass area meets the Exception to Section 140.1(b)2A in the Energy Standards. If the altered fenestration or glass alone is not rated by NFRC then the Alternate Default Fenestration Procedure can be used similar to Nonresidential up to 1000 ft² as described above.

(b) RESIDENTIAL

For Residential cases, the Alternate Default Fenestration Procedure option is available only when nonrated site-built fenestration is being installed in a residential dwelling. For Residential site-built fenestration up to 250 ft² in area or 5% times the conditioned floor area (CFA), whichever is greater shall meet Sections §110.6(a)2 and §110.6(a)3.

The Alternate Default Fenestration calculated values are typically less efficient than those listed in the Prescriptive Approach in Table 150.1-A of the Energy Standards. The Visible Transmittance (VT) value is not required to meet residential energy compliance. If unable to acquire center of glass (COG) thermal performance values from the manufacturer, then the Energy Commissions Default Tables shall be used; Table 110.6-A for U-factors and Table 110.6-B for SHGC values and documented on the on a self-produced manufactured default label. The default label shall be attached to the unrated fenestration product. An example of the label can be found in the Residential Compliance Manual.

(c) DOCUMENTATION

1. The Energy Commission's FC-1 Label Certificate Form for nonresidential application shall be used to document the Alternate Default Fenestration calculated values for each non-rated site-built fenestration unit; or
2. For residential, a manufactured Default Label attached to each non-rated site-built fenestration unit.

The equations listed below are to be used for only for unrated site-built fenestration that meets the requirements in either item 1 or 2 above.

NA6.2 Default U-factor**Equation NA6-1**

$$U_T = C_1 + (C_2 \times U_c)$$

Where:

U_T = U-factor Is the Total Performance of the fenestration including glass and frame

C_1 = Coefficient selected from Table NA6-5

C_2 = Coefficient selected from Table NA6-5

U_c = Center of glass U-factor calculated in accordance with NFRC 100 Section 4.5.3.1
<http://www.nfrc.org/software.aspx>

Table NA6-5 – U-factor Coefficients

Product Type	Frame Type	C_1	C_2
Site-Built Vertical Fenestration	Metal	0.311	0.872
	Metal Thermal Break	0.202	0.867
	Non-Metal	0.202	0.867
Skylights with a Curb	Metal	0.711	1.065
	Metal Thermal Break	0.437	1.229
	Non-Metal	0.437	1.229
Skylights with no Curb	Metal	0.195	0.882
	Metal Thermal Break	0.310	0.878
	Non-Metal	0.310	0.878

NA6.3 Default Solar Heat Gain Coefficient, SHGC

The SHGC of the fenestration product shall be calculated using the following equation:

Equation NA6-2

$$SHGC_T = 0.08 + (0.86 \times SHGC_c)$$

Where:

$SHGC_T$ = SHGC Is the Total Performance of the fenestration including glass and frame

$SHGC_c$ = Center of glass SHGC calculated in accordance with NFRC 200 Section 4.5.1.1
<http://www.nfrc.org/software.aspx>

NA6.4 Default Visible Transmittance, VT

(a) Equation NA6-3 - VT of Center of Glass (COG) calculation

$$VT_T = VT_F \times VT_C$$