

The 2019 Energy Code includes requirements for alterations and additions affecting fenestration, including windows, skylights and exterior doors that include glass.

The Energy Code Prescriptive relative solar heat gain and visible transmittance (VT) requirements take effect when:

- More than 50 ft<sup>2</sup> of skylights are altered or added, or
- More than 150 ft<sup>2</sup> of fenestration is altered

Prescriptive fenestration U-factor requirements apply to any alterations or additions to an existing building.

For alterations, default U-factor and solar heat gain coefficient (SHGC) values in [Tables 110.6-A](#) and [110.6-B](#) must be used when 200 ft<sup>2</sup> or more vertical site-built or skylight fenestration is replaced that does not have NFRC performance ratings. In this situation, the default performance values will not meet Prescriptive alterations requirements, and the Performance method must be used



# What Is Nonresidential Fenestration?

The 2019 Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) include requirements for new construction, alterations and additions affecting fenestration, including windows, skylights, Tubular Daylighting Devices (TDD) and exterior doors that include glass.

## Why?

Choosing the proper windows, glazed doors and skylights is one of the most important design decisions to ensure compliance with the Energy Code. The use of high performance fenestration can actually reduce energy consumption by decreasing the lighting and cooling loads in nonresidential and high-rise residential buildings, as well as in hotels/motels. The size, orientation and type of fenestration products can dramatically affect overall energy performance.



*The use of high performance fenestration can actually reduce energy consumption*

## Relevant Code Sections

2019 California Building Energy Efficiency Standards, Title 24, Part 6:

- [Section 10-111](#) – Certification and Labeling of Fenestration Product U-Factors, Solar Heat Gain Coefficients, Visible Transmittance and Air Leakage
- [Section 110.6](#) – Mandatory Requirements for Fenestration Products and Exterior Doors
- [Section 140.3](#) – Prescriptive Requirements for Building Envelopes
- [Nonresidential Reference Appendix NA6](#) – Alternate Default Fenestration Procedure to Calculate Thermal Performance
- [Nonresidential Reference Appendix NA7.4](#) – Installation and Acceptance Requirements for Nonresidential Buildings and Covered Processes - Building Envelope Acceptance Tests

## Relevant Compliance Forms

- [NRCC-ENV-E](#): Envelope Component Approach
- [NRCI-ENV-01-E](#): Certification of Installation – Envelope
- [NRCA-ENV-02-F](#): Fenestration Acceptance (required only for site-built fenestration)

## Compliance Requirements

Fenestration requirements apply to new construction, alterations and additions. There are both Prescriptive and Performance compliance approaches for demonstrating compliance with the Energy Code. Requirements vary by the type and area of fenestration in the project, as well as by Climate Zone. This fact sheet provides information on how to assess your project type, whether your project can use the Prescriptive or Performance approach, and the code requirements for each.

## Assessing Your Project: Applicable Prescriptive Requirements

To meet Prescriptive fenestration requirements, products may require features such as thermally-broken, double-paned windows with spectrally selective “low-e” coatings.

### Newly Constructed

Newly constructed projects are newly constructed buildings or buildings that have never been occupied. The Energy Code places Prescriptive limits on window glazing and skylight area and defines minimum performance requirements.

For newly constructed projects, the following Prescriptive requirements for fenestration performance must be met:

- U-factor, solar heat gain coefficient (SHGC) and visible transmittance (VT) performance requirements – the fenestration performance can be determined by a variety of methods (see Table 2) (note that the area-weighted U-factor, SHGC and VT must meet Prescriptive requirements)

- Window area cannot exceed 40% of gross exterior wall area or 6 feet times the display perimeter (note that fenestration in demising walls is not included in the window-to-wall ratio)
- West-facing window area cannot exceed 40% of west-facing exterior wall area or 6 feet times the display area
- Skylight area cannot exceed 5% of gross roof area or 10% of roof area for spaces with high ceilings (note that skylights over unconditioned spaces, such as atria, do not count towards the skylight-to-roof ratio (SRR) limit)
- Sufficient fenestration area provides daylighting coverage to at least 75% of floor area, for both conditioned and unconditioned spaces over 5,000 ft<sup>2</sup> that are directly under a roof and have ceiling heights taller than 15 feet

If any of these Prescriptive requirements cannot be met, the Performance approach must be used to demonstrate compliance.

**TIP:** For the daylit area requirement in spaces with high ceilings, it is important to layout multiple skylights in an arrangement so that the skylit daylit zones of adjacent skylights do not overlap. For most spaces with high ceilings, daylight coverage can be achieved with a SRR of 3%-4%. Larger skylight areas may meet the daylighting requirement, but could result in excessive solar heat gain. The Energy Code now requires that the skylight area be at least 3% of the daylit floor area to ensure that there is adequate daylight for dimming.

## Additions

Fenestration products installed in additions trigger different U-factor requirements than those in alterations and trigger the following new construction requirements for fenestration performance:

- U-factor must meet the requirements of [Table 140.3-B](#), [140.3-C](#) or [140.3-D](#)
- Window-to-wall ratio (WWR) and SRR Prescriptive limits must be met
- Skylights serving spaces over 5,000 ft<sup>2</sup> with ceiling heights above 15 feet trigger the minimum skylit and sidelit daylit area requirement in [Section 140.3\(c\)](#)

		Fixed Window	Operable Window	Curtainwall / Storefront	Glazed Door
Vertical	Max U-factor	0.36	0.46	0.41	0.45
	Max RSHGC	0.25	0.22	0.26	0.23
	Min VT	0.42	0.32	0.46	0.17
		Glass, Curb Mounted	Glass, Deck Mounted	Plastic, Curb Mounted	Tubular Daylighting Devices (TDD)
Skylight	Max U-factor	0.58	0.46	0.88	0.88
	Max SHGC	0.25	0.25	NR	NR
	Min VT	0.49	0.49	0.64	0.38

Table 1 – Fenestration Performance Requirements: New Construction and Additions

## Alterations

Prescriptive relative solar heat gain and VT requirements take effect when:

- More than 50 ft<sup>2</sup> of skylights are altered or added, or
- More than 150 ft<sup>2</sup> of fenestration is altered

Prescriptive fenestration U-factor requirements apply to any alterations or additions to an existing building.

Alterations (replacements) of fenestration trigger Prescriptive U-factor requirements by Climate Zone (CZ) shown in Table 2.

## Compliance Options

**Electrochromic glazing** is a Prescriptive compliance option for both new construction and alterations. For this type of glazing, clear values of VT and tinted values of SHGC may be used to show compliance with the Energy Code.

### Lighting Power Adjustment Factors (PAF)

Credits for sidelit daylight areas when using the Performance approach are available for daylight dimming plus OFF controls, clerestory fenestration and horizontal slats.

- Clerestory Fenestration: Luminaires in daylit areas adjacent to the clerestory
  - Luminaires that qualify for daylight dimming plus OFF control may also qualify for this PAF
- Horizontal Slats:
  - Luminaires in daylit are as adjacent to vertical fenestration with interior or exterior horizontal slats
  - Luminaires that qualify for daylight dimming plus OFF control may also qualify for this PAF

**NFRC window films** may now be used for alterations in the Performance approach to lower the effective U-factor and SHGC of the glazing. The [Nonresidential ACM Reference Manual](#) has a detailed description of the procedures used to calculate SHGC. For alterations involving the application of window films, see [Nonresidential Reference Appendix NA7.4.2 - Window Films](#) criteria and [Section 110.6](#) of the Energy Code.

	CZ 3, 5	CZ 1, 16	All Others
U-factor	0.58	0.47	0.47
SHGC	0.41	0.41	0.31
VT	Same as New Construction Requirement		

Table 2 – Vertical Fenestration Performance Requirements: Alterations

For alterations, default U-factor and SHGC values in [Tables 110.6-A](#) and [110.6-B](#) must be used when 200 ft<sup>2</sup> or more vertical site-built or skylight fenestration is replaced that does not have NFRC performance ratings. When vertical site-built or skylight fenestration area is less than 200 ft<sup>2</sup>, the U-factor and SHGC may be calculated using the Center of Glass (COG) rating from the manufacturer, using the relevant equation as set forth in [Nonresidential Reference Appendix NA6](#).

### Alternative Compliance for VT Requirement

An alternative method of demonstrating Prescriptive compliance is to show that the VT is at least 0.11/WWR, where WWR is the window area to gross wall area ratio for the entire building. This enables buildings with higher WWR to meet the Prescriptive standards with a lower VT value, since the VT requirement is tied to using daylighting potential. Note that the Prescriptive VT requirement is an area weighted average. For example, a façade that has high VT windows high along the wall for daylighting, combined with lower VT windows low along the wall is acceptable, provided that the window area-weighted VT meets the minimum Prescriptive requirement.

## Mandatory Requirements for Certifying Fenestration Products

Fenestration products with spectrally selective (“low-e”) coatings are now available that provide lower SHGC and meet the VT value requirement.

### Site-Built Fenestration

Site-built fenestration areas less than 200 ft<sup>2</sup> may use values based on glazing type and framing type and equations in [Nonresidential Reference Appendix NA6](#). Fenestration areas of 200 ft<sup>2</sup> or more must use the default U-factor and SHGC default values in [Tables 110.6-A](#) and [110.6-B](#) of the Energy Code or be NFRC rated. Note that the default values for the listed glazing and framing types will not meet Prescriptive requirements, so the Performance approach must be used in these situations.

Method	Manu- factured Windows	Manu- factured Skylights	Site-Built Fenestration (windows, skylights)	Field- Fabricated Fenestration	Glass Block
NFRC-Certified Products	Yes	Yes	No	No	No
NFRC Component Modeling Approach (CMA)	No	No	Yes	No	No
<a href="#">Tables 110.6-A &amp; 110.6-B</a>	Yes	Yes	Yes	Yes	Yes
<a href="#">Nonresidential Reference Appendix NA6</a>	No	No	Yes*	No	No

\* Applicable only for site-built fenestration with total area <200 ft<sup>2</sup>.

Table 3 – Methods for Determining Fenestration Performance

## Using NFRC Ratings

NFRC has two rating methods:

1. The traditional method is commonly used in most residential products and in many commercial products such as punched opening products or custom products that will be made only once.
  2. The Component Modelling Approach (CMA) is implemented in software named CMAST and is only available for Nonresidential products. The CMA method is convenient when the frames have already been approved and added to the approved CMAST software. If the frame choice and the glass choice are in the CMAST software, CMA certifications can be provided very quickly for specified products at a particular project address.
- Both methods result in whole product ratings that include all components (e.g., frame, glass, spacer and gas fill)
  - Both methods require initial simulation and testing typically done by the frame manufacturer
  - The principal difference is when the insulating glass unit properties are included in the calculations:
    - The whole product ratings are calculated at the time of certification by the simulation lab and already labeled before the product is shipped
    - The whole product ratings are calculated for a specific project with a specific insulating glass unit by an Accredited Calculation Entity (ACE) at the time the project is needed

 <small>National Fenestration Rating Council CERTIFIED</small>	<b>World's Best Window Co.</b> Series "2000" Casement <small>Vinyl Clad Wood Frame                  Double Glazing • Argon Fill • Low E                  ABC-X-1-00001-00001</small>	
	<b>ENERGY PERFORMANCE RATINGS</b> U-Factor (U.S. / I-P)      Solar Heat Gain Coefficient <b>0.35</b> <b>0.32</b>	
<b>ADDITIONAL PERFORMANCE RATINGS</b> Visible Transmittance      Air Leakage (U.S. / I-P) <b>0.51</b> <b>0.2</b>		
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information. www.nfrc.org</small>		
<small>This fenestration product has been certified to meet the air filtration requirements of Section 110.6(a) of the 2013 California Energy Standards.</small>		

# Forms – Which & When

In addition to a Permit, you will need the following.

## During Design:

- **NRCC-ENV-E:** Envelope Component Approach Table K. Fenestration and Glazed Door Schedule
  - Document thermal performance of fenestration construction (U-factor, SHGC, VT)
  - Completed and signed by the design professional

**Why?:** To document all fenestration (windows and skylights) specified on plans that will be installed in the building. If some fenestration products do not meet Prescriptive requirements on their own, this table must be completed to show that the area-weighted average U-factor, SHGC and VT comply.

## During Construction:

- **NRCI-ENV-01-E:** Envelope Certificate of Installation
  - Completed and signed by the installing contractor
- **NRCA-ENV-02-F:** Fenestration Acceptance
  - Completed and signed by the installing contractor

**Why?:** To verify that the field installation meets code and matches information on the certification of compliance documents. Documentation of NFRC certificates is field verified and, where applicable, special procedures for verification of window films or electrochromic glazing must be followed and documented on this form.

**STATE OF CALIFORNIA**  
**Envelope Component Approach**  
NRC-ENV-01-E (Rev. 10/19)

CA Building Energy Efficiency Standards - 2019 Nonresidential Compliance <http://www.energy.ca.gov/title24/2019/title24/> October 2019

**CERTIFICATE OF COMPLIANCE**  
This document is used to demonstrate compliance with mandatory requirements in **Table K** for newly constructed buildings, and **Table K** for alterations, related to roof and floor assemblies. It is also used to demonstrate compliance with prescriptive requirements in **Table 2** for newly constructed buildings, and **Table 2** for alterations and alterations, related to roof, wall, floor, door, fenestration and daylighting requirements.

Project Name: \_\_\_\_\_ Report Page: \_\_\_\_\_ Page # of #  
Project Address: \_\_\_\_\_ Date Prepared: \_\_\_\_\_

**A. GENERAL INFORMATION**

01	Project Location (City)	02	# of Stories (Habitable Above Grade)	03	Use in all climate zones
04	Episodic	06	Total Conditioned Floor Area (m <sup>2</sup> )	07	High-Rise Residential Occupancy: R-2 / R-3
08	Climate Zone	09	Total Unconditioned Floor Area (m <sup>2</sup> )	10	Hotel/Motel Guest Rooms Occupancy: R-4
11	Occupancy Type(s) Within Project (select all that apply)	12	Project includes unconditioned enclosed space(s) > 5,000ft <sup>2</sup> under a roof with a ceiling height of at least 15ft?		
13	If one occupancy constitutes > 80% of the conditioned floor area, the entire building envelope may be designed to comply with the provisions of that occupancy per <b>§10.10.12</b> .				

All Nonresidential, including Reconfigurable Public School Building  
 use in all climate zones  
 High-Rise Residential Occupancy: R-2 / R-3  
 Hotel/Motel Guest Rooms Occupancy: R-4

**B. PROJECT SCOPE**  
This section includes any building envelopes that are within the scope of the permit application and are demonstrating compliance using the prescriptive paths outlined in **Table K**, and **§10.10.12** and **§10.10.13** for additions and alterations.  
My project consists of (check all that apply):

01	02	Component Types
01	02	
03	04	Walls Floors Exterior Doors Fenestration/Glazed Door
05	06	Walls Floors Exterior Doors Fenestration/Glazed Door
07	08	Walls Floors Exterior Doors NA for Atriums Fenestration/Glazed Door

\*FOOTNOTE: Enclosed spaces > 5,000 ft<sup>2</sup> directly under roof with ceiling height > 15ft in climate zones 2 through 5 are required to meet the minimum glazing requirements defined in **§10.10.12**. Compliance with **§10.10.13** is documented in Table L. This is the only prescriptive requirement which applies to unconditioned spaces.

**STATE OF CALIFORNIA**  
**ENVELOPE**  
NRC-ENV-01-E (Rev. 10/19)

CA Building Energy Efficiency Standards - 2019 Nonresidential Compliance <http://www.energy.ca.gov/title24/2019/title24/> January 2020

**CERTIFICATE OF INSTALLATION**  
NRC-ENV-01-E  
(Page 1 of 2)

Enrollment Number: \_\_\_\_\_ Permit Number: \_\_\_\_\_  
Project Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_

**GENERAL INFORMATION**

DATE OF BUILDING PERMIT: \_\_\_\_\_ PERMIT # \_\_\_\_\_

BUILDING TYPE:  Nonresidential  High-Rise Residential  Hotel/Motel Guest Room

PHASE OF CONSTRUCTION:  New Construction  Addition  Alteration  Unconditioned

SCOPE OF RESPONSIBILITY  
Enter the date of approval by enforcement agency of the Certificate of Compliance that provides the specifications for the energy efficiency measures for the scope of responsibility for this Installation Certificate. Date: \_\_\_\_\_

Document Title or Description	Applicable Sheets or Pages, Tables, Schedules, etc.	Date Approved by the Enforcement Agency

**STATE OF CALIFORNIA**  
**FENESTRATION ACCEPTANCE**  
NRCA-ENV-02-F (Rev. 10/19)

CA Building Energy Efficiency Standards - 2019 Nonresidential Compliance <http://www.energy.ca.gov/title24/2019/title24/> January 2020

**CERTIFICATE OF ACCEPTANCE**  
NRCA-ENV-02-F  
(Page 1 of 2)

Enrollment Number: \_\_\_\_\_ Permit Number: \_\_\_\_\_  
Project Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_

**A. BUILDING INFORMATION**

BUILDING TYPE:  Nonresidential  Non-Residential Schools  High-Rise Residential  Hotel/Motel Guest Room

PHASE OF CONSTRUCTION:  New Building Construction  Addition  Alteration

TYPE OF LABEL:  NFRC NFRC Component Modeling Approach (NFRC Label Certificate or NFRC Certified Label)  NFRC-ENV-E for Nonresidential Fenestration Values < 200 ft<sup>2</sup>  NFRC-ENV-E for Nonresidential Fenestration Values > 200 ft<sup>2</sup>

TYPE OF INSTALLED FENESTRATION:  Vertical Fenestration  Tubular Daylighting Device (TDD)  Slugs  Dynamic Glazing  Window Film  Block Glass

**B. STATEMENT OF ACCEPTANCE**  
This Certificate of Acceptance summarizes the results of the Acceptance test as specified in the Reference Nonresidential Appendix, NA 7-A. Additional related references are in Sections 10.10.10(A), 10.10.11, 10.10.6(A)(5) of the Energy Standards.

**SUMMARY OF FENESTRATION VERIFICATION AND INSPECTION BY RESPONSIBLE PARTY**  
Individuals who perform the field testing and verification work, and provide the information required for completion of the Certificate of Acceptance documentation are not required to be licensed professionals. However, the person who signs the Certificate of Acceptance document to certify compliance with the acceptance requirements shall be licensed as specified in Standards Section 10.10.6(d) and NA 7.3.1.

	01	02	03	04
<b>For NFRC-ENV-E Product (if other than a fenestration product, use additional sheets)</b>	01	02	03	04
If Product is tested by NFRC then enter the ID # in each column. This includes any of the paper of installed fenestration label below.	NFRC Label Certificate ID #	NFRC Label Certificate ID #	NFRC Label Certificate ID #	NFRC Label Certificate ID #
<b>For Nonresidential Fenestration Attach a Copy of the NFRC-ENV-E</b>	01	02	03	04
<b>For All Fenestration Verify and Cross Reference:</b>	01	02	03	04
If receipt or order are available and if identifies the NFRC ID # then cross-reference against the NFRC Label Certificate to match label or	<input type="checkbox"/> Delivery Receipt <input type="checkbox"/> Purchase Order <input type="checkbox"/> Detailed Receipt	<input type="checkbox"/> Delivery Receipt <input type="checkbox"/> Purchase Order <input type="checkbox"/> Detailed Receipt	<input type="checkbox"/> Delivery Receipt <input type="checkbox"/> Purchase Order <input type="checkbox"/> Detailed Receipt	<input type="checkbox"/> Delivery Receipt <input type="checkbox"/> Purchase Order <input type="checkbox"/> Detailed Receipt
Cross-reference the NFRC ID # listed on the NFRC Label Certificate of NFRC-ENV-E - matches the building plan window schedule of efficiencies.	<input type="checkbox"/> Cross Reference and Matches Building Plans	<input type="checkbox"/> Cross Reference and Matches Building Plans	<input type="checkbox"/> Cross Reference and Matches Building Plans	<input type="checkbox"/> Cross Reference and Matches Building Plans



# For More Information

## Primary Documents

- Energy Code Section 10-111 – Certification and Labeling of Fenestration Product U-Factors, Solar Heat Gain Coefficients, Visible Transmittance and Air Leakage:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/10111certificationandlabelingoffenestrationproductandexteriordoo.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/10111certificationandlabelingoffenestrationproductandexteriordoo.htm)
- Energy Code Section 110.6 – Mandatory Requirements for Fenestration Products and Exterior Doors:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1106mandatoryrequirementsforfenestrationproductsandexteri.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1106mandatoryrequirementsforfenestrationproductsandexteri.htm)
- Energy Code Section 140.3 – Prescriptive Requirements for Building Envelopes:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1403prescriptiverequirementsforbuildingenvelopes.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1403prescriptiverequirementsforbuildingenvelopes.htm)
- Energy Code Nonresidential Reference Appendix NA6 – Alternate Default Fenestration Procedure to Calculate Thermal Performance:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/appendixna6alternatedefaultfenestrationproceduretocalculatetherm1.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/appendixna6alternatedefaultfenestrationproceduretocalculatetherm1.htm)
- Energy Code Nonresidential Reference Appendix NA7.4 – Installation and Acceptance Requirements for Nonresidential Buildings and Covered Processes - Building Envelope Acceptance Tests:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/na74buildingenvelopeacceptancetests.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/na74buildingenvelopeacceptancetests.htm)
- Energy Code Nonresidential Compliance Manual Section 3.2 – Building Envelope:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/32opaqueenvelopeassembly.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/32opaqueenvelopeassembly.htm)

## Compliance Forms

- Nonresidential Compliance Forms  
[energycodeace.com/NonresidentialForms/2019](http://energycodeace.com/NonresidentialForms/2019)

## California Energy Commission Information & Services

- Energy Code Hotline: 1-800-772-3300 (Free) or [Title24@energy.ca.gov](mailto:Title24@energy.ca.gov)
- Online Resource Center:  
[energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center](http://energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center)
  - The Energy Commission’s main web portal for the Energy Code, including information, documents and historical information

## Additional Resources

- National Fenestration Rating Council (NFRC):  
[nfr.org/](http://nfr.org/)
  - Component Modeling Approach (CMA):  
[nfr.org/CMA/default.aspx](http://nfr.org/CMA/default.aspx)
    - To help select windows with the desired energy performance for institutional projects
  - Energy Code Ace:  
[EnergyCodeAce.com](http://EnergyCodeAce.com)
    - An online “one-stop-shop” providing free resources and training to help appliance and building industry professionals decode and comply with Title 24, Part 6 and Title 20. The site is administered by California’s investor-owned utilities.  
*Of special interest:*
      - Trigger Sheet  
[energycodeace.com/content/resources-ace/file\\_type=trigger-sheet](http://energycodeace.com/content/resources-ace/file_type=trigger-sheet)
        - Nonresidential Fenestration 2019
      - Application Guides  
[energycodeace.com/content/resources-ace/file\\_type=application-guide](http://energycodeace.com/content/resources-ace/file_type=application-guide)
        - Nonresidential Envelope and Solar Ready 2019
- Please register with the site and select an industry role for your profile in order to receive messages about all our free offerings!



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