

# What Are Fenestration Alterations?

The 2019 California Building Energy Efficiency Standards (Energy Code), Title 24, Part 6 include requirements for alterations and additions affecting fenestration, including windows, skylights and doors with more than 3 ft<sup>2</sup> of glass. When the construction type is classified as an alteration, fenestration may be replaced (altered) or increased (added). Fenestration products installed in construction projects classified as additions trigger the new construction requirements for fenestration performance and U-factor requirements. This fact sheet focuses on fenestration that is replaced or increased.

## Why?

Windows, glazed doors, dynamic glazing, window films and skylights have a significant impact on energy use in a home. Energy-efficient fenestration can greatly reduce heating and cooling loads. The size, orientation and types of fenestration products can dramatically affect the overall energy performance of a house. Glazing type, orientation and shading play a major role in a home's energy use by affecting how much HVAC systems have to heat and cool the house.



### Relevant Code Sections

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

- [Section 10-111](#) – Certification and labeling of fenestration product U-factors, SHGC, VT, and Leakage
- [Section 110.6](#) – Mandatory Requirements for Fenestration Products and Exterior Doors
- [Section 110.7](#) – Mandatory Requirements to Limit Air Leakage
- [Section 150.0\(q\)](#) – Mandatory Features and Devices - Fenestration Products
- [Section 150.1\(c\)](#) – Performance and Prescriptive Compliance Approaches for Low-Rise Residential Buildings - Fenestration & Shading
- [Section 150.2\(b\)1A](#) – Additions and Alterations to Existing Low-Rise Residential Buildings - Alterations Prescriptive Approach - Fenestration
- [Section 150.2\(b\)1B](#) – Additions and Alterations to Existing Low-Rise Residential Buildings - Alterations Prescriptive Approach - Replacement Fenestration

### Relevant Compliance Forms

- [CF1R-ALT-01-E](#): Prescriptive Residential Alterations (when HERS is triggered)
- [CF1R-ENV-02-E](#): Area Weighted Average Calculation Worksheet (if necessary)
- [CF1R-ENV-03-E](#): Solar Heat Gain Coefficient (SHGC) Worksheet (if necessary)
- [CF2R-ENV-01-E](#): Fenestration Installation
- [CF2R-ALT-05-E](#): Certificate of Compliance – Prescriptive Alterations (Simple projects that do not trigger HERS)
- [CF3R-EXC-20-H](#): Verification of Existing Conditions for Alterations

## Compliance Requirements: Prescriptive (vs) Performance

There are both Prescriptive and Performance compliance approaches for altering or adding residential fenestration to an existing building. A Prescriptive approach follows code requirements that clearly state what applies, while a Performance-based one provides more design flexibility but requires energy simulations to estimate tradeoffs between systems. Requirements vary by the type and area of fenestration added or replaced in the project, as well as Climate Zone. This Fact Sheet provides information on how to assess whether your project should use the Prescriptive or Performance approach – and the code requirements for each.

# Mandatory Requirements

Whether you use the Prescriptive or Performance approach to demonstrate compliance, new or replacement fenestration must meet the following Mandatory requirements:

- Air infiltration rates for manufactured fenestration and pet doors must be  $\leq 0.3$  cfm/ft<sup>2</sup> of window area at a pressure differential of 75 Pascals
- All new fenestration that separates conditioned space from unconditioned space or outdoors must have a maximum or weighted-average U-factor of 0.58 or lower
- All fenestration products must either have their performance rated by the [National Fenestration Rating Council \(NFRC\)](#), or use default performance values for U-factor, Solar Heat Gain Coefficient (SHGC) and visible transmittance (VT) from [Tables 110.6-A](#) and [110.6-B](#) of the Energy Code
- Buildings with unrated products will not qualify for Prescriptive compliance and must use the Performance compliance approach

## Exception:

Fenestration exempt from the maximum U-factor requirement includes:

- $\leq 10$  ft<sup>2</sup> of fenestration OR
- The fenestration area is  $\leq 0.5\%$  of the total CFA (whichever is greater) OR
- The fenestration area of dual-glazed greenhouse or garden windows is  $\leq 30$  ft<sup>2</sup>

## Repairs

No fenestration energy-efficiency requirements apply if you:

- Replace a broken pane of glass, but not the entire window
- Uninstall fenestration components for maintenance or repair and re-install in the same location without increasing the pre-existing energy consumption

# Assessing Your Project

## Prescriptive vs Performance Approach

- If you add more than 75 ft<sup>2</sup> to the building's fenestration area, the new fenestration must meet requirements for TOTAL fenestration area and WEST-facing fenestration area, as well as the U-factor and SHGC for the Climate Zone
- If you add fenestration area up to 75 ft<sup>2</sup> – or if you add up to 16 ft<sup>2</sup> of new skylight area with U-factor  $\leq 0.55$  and SHGC  $\leq 0.30$  – the total/west-facing fenestration area requirements do not apply (a skylight is fenestration installed on a roof  $< 60^\circ$  from the horizontal)
- If you replace existing fenestration, the replaced fenestration must meet the area-weighted U-factor and SHGC requirements of [Table 150.1-A](#) or [B](#)
- Exceptions are:
  - Replacements of vertical fenestration up to 75 ft<sup>2</sup> will comply with a maximum U-factor of 0.40 in Climate Zones 1-16, and a maximum SHGC of 0.35 in Climate Zones 2, 4 and 6-15
  - Replaced skylights are allowed a maximum U-factor of 0.55, and a maximum SHGC of 0.30
- If the project does not meet the Prescriptive requirements:
  - Adjust your project – for example, purchase more energy-efficient windows or add less fenestration area
  - OR**
  - Use the Performance approach – this requires using approved energy modeling software
- Check with an energy consultant before removing any existing windows or other feature
- You may be able to use the energy-efficiency values from your existing features to demonstrate compliance with the Performance approach. This would require verification by a HERS Rater of the existing features before they are changed.

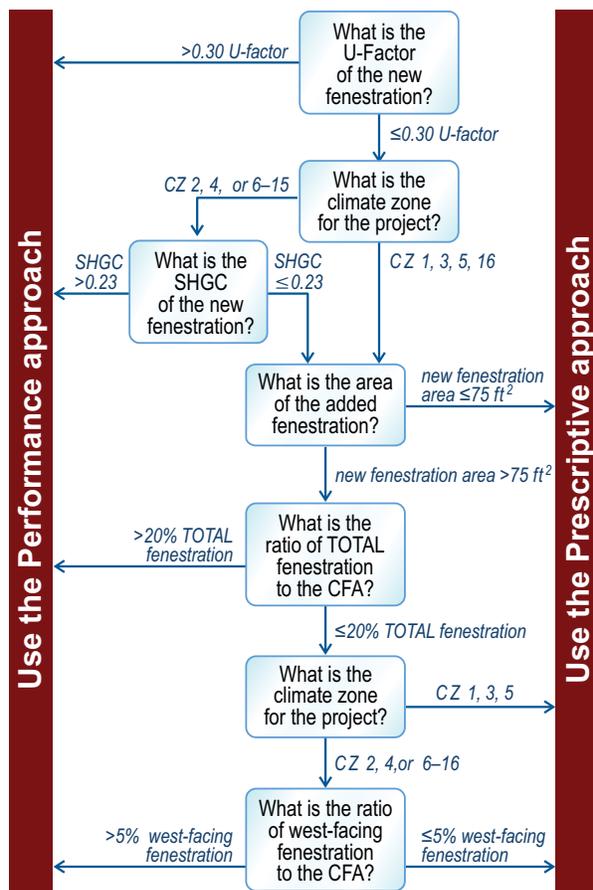


Figure 1: Prescriptive or Performance?\*

\* This flowchart depicts the most common decisions regarding fenestration alteration projects. Exceptions may apply to projects that have small glazing areas and use efficient fenestration products. For example, if the fenestration area is  $\leq 10$  ft<sup>2</sup> or 0.5% of the Conditioned Floor Area (CFA), whichever is larger, it is exempt from the maximum U-factor requirement. As another example,  $\leq 3$  ft<sup>2</sup> of new glazing area installed in doors need to meet neither the U-factor nor the SHGC maximums.

# Prescriptive Requirements

The Prescriptive requirements for fenestration vary by Climate Zone, and the type and area of the fenestration:

## More than 75 ft<sup>2</sup> additional fenestration area or more than 16 ft<sup>2</sup> of skylight area<sup>A</sup>

Climate Zones	U-Factor <sup>E</sup>	SHGC <sup>B,E</sup>	TOTAL Fenestration <sup>C</sup> Area % of CFA <sup>D</sup>	WEST-facing <sup>C</sup> Area % of CFA <sup>D</sup>
1, 3, 5, 16	0.30 or lower	na	20% or less	na
2, 4, 6-15	0.30 or lower	0.23 or lower	20% or less	5% or less

## 75 ft<sup>2</sup> or less additional fenestration area or more than 75 ft<sup>2</sup> replacement fenestration<sup>A</sup>

Climate Zones	U-Factor <sup>E</sup>	SHGC <sup>B,E</sup>
1, 3, 5, 16	0.30 or lower	na
2, 4, 6-15	0.30 or lower	0.23 or lower

## 16 ft<sup>2</sup> or less additional skylight area or replacement skylights

Climate Zones	U-Factor <sup>E</sup>	SHGC <sup>B,E</sup>
1, 3, 5, 16	0.55 or lower	na
2, 4, 6-15	0.55 or lower	0.30 or lower

## 75ft<sup>2</sup> or less replacement fenestration

Climate Zones	U-Factor <sup>E</sup>	SHGC <sup>B,E</sup>
1, 3, 5, 16	0.40 or lower	na
2, 4, 6-15	0.40 or lower	0.35 or lower



<sup>A</sup> Fenestration area is the glass plus the frame. For doors with glass area less than 50% of total door area, consider the “frame” to be two inches on all sides of the glass. For doors with glass area 50% or more of the total door area, count the entire door area as glazing.

<sup>B</sup> If the fenestration has qualifying exterior shading (e.g., a permanent awning) the SHGC may be calculated taking that shading into consideration. If you use exterior shading to meet the SHGC requirement, you must submit a [CF1R-ENV-03-E: Solar Heat Gain Coefficient \(SHGC\) Worksheet](#).

<sup>C</sup> “TOTAL fenestration” is all new fenestration plus existing fenestration that remains after the alteration. See Orientation and West-facing Fenestration (below) for a definition of west-facing fenestration.

<sup>D</sup> “CFA” is conditioned floor area; see [Section 100.1: Definitions and Rules of Construction in the Energy Code](#) for details.

<sup>E</sup> Maximum area-weighted average values.

See Exception 3 to [Section 150.1\(c\)3A](#) for fenestration containing chromogenic glazing. (Chromogenic glazing is high performance glazing that is able to vary its transmittance appropriately in response to automatic controls based on the solar intensity. This means it has the potential to improve building energy efficiency compared to standard low-e glazing.)

Table 1: Prescriptive Requirement

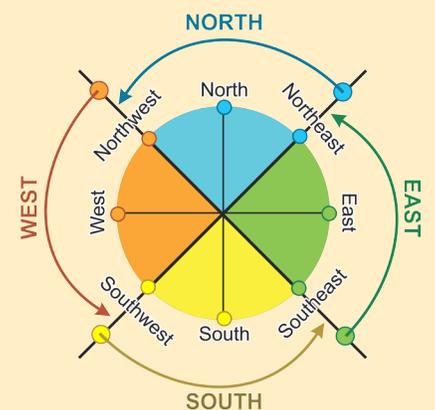
## Orientation & West-facing Fenestration

“Orientation” refers to the direction that the fenestration faces.

West-facing fenestration – a consideration in Climate Zones 2, 4 and 6 -15 – includes:

- A window (or a door with glass) that faces from  $\leq 45^\circ$  north of true west to  $< 45^\circ$  south of true west.
- Skylights tilted:
  - To the west (from  $\leq 45^\circ$  north of true west to  $< 45^\circ$  south of true west)
  - In any direction when the pitch is less than 1:12

Actual Orientation...	...Is Considered
45° east of north to 44° west of north	North-facing
45° north of west to 44° south of west	West-facing
45° west of south to 44° east of south	South-facing
45° south of east to 44° north of east	East-facing





# For More Information

## Primary Documents

- Energy Code Residential Compliance Manual Section 3.5 – Fenestration (Window/Skylight/Glazed Door) and Opaque Doors:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/35insulationproducts.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/35insulationproducts.htm)
- Energy Code Section 10-111 – Certification and labeling of fenestration product U-factors, SHGC, VT, and 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 110.7 - Mandatory Requirements to Limit Air Leakage:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1107mandatoryrequirements Tolimitairleakage.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1107mandatoryrequirements Tolimitairleakage.htm)
- Energy Code Section 150.0(q) – Mandatory Features and Devices - Fenestration Products:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1500mandatoryfeaturesanddevices.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1500mandatoryfeaturesanddevices.htm)
- Energy Code Section 150.1(c) – Performance and Prescriptive Compliance Approaches for Low-Rise Residential Buildings - Fenestration & Shading:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1501performanceandprescriptivecomplianceapproachesforlowr.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1501performanceandprescriptivecomplianceapproachesforlowr.htm)
- Energy Code Sections 150.2(b)1A – Additions and Alterations to Existing Low-Rise Residential Buildings - Alterations Prescriptive Approach - Fenestration:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1502energyefficiencystandardsforadditionsandalterationsto.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1502energyefficiencystandardsforadditionsandalterationsto.htm)
- Energy Code Sections 150.2(b)1B – Additions and Alterations to Existing Low-Rise Residential Buildings - Alterations Prescriptive Approach - Replacement Fenestration:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1502energyefficiencystandardsforadditionsandalterationsto.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1502energyefficiencystandardsforadditionsandalterationsto.htm)

## 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:  
[www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center](http://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center)
  - The Energy Commission’s main web portal for Energy Code, including information, documents, and historical information

## Additional Resources

- National Fenestration Rating Council (NFRC):  
[nfr.org](http://nfr.org)
- 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. 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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City of Oakley – Simplified CF1R-ALT-01-E form for Window Replacement

Permit Number \_\_\_\_\_ Address \_\_\_\_\_

**This form shall be filled out and signed by the installing contractor. Submit this form along with the permit application to obtain a permit. The original copy is retained by the Building Department. Keep the other copy with your permit.**

**Fill out the requested information in the applicable areas.**

**Fill out the Declaration Statement section completely including signature and date.**

**QUESTIONS? REQUEST ASSISTANCE FROM THE PERMIT TECH.**

**Fenestration Proposed Areas**

- Replacing Window Alone** – Replacement windows shall meet the U-Factor 0.32 or lower and SHGC value 0.25 or lower requirements of Component Package A table 150.1-A The TOTAL fenestration and WEST- facing area requirements are not applicable.
- Adding more than 75 ft<sup>2</sup>** to the buildings fenestration area, the new fenestration must meet requirements for TOTAL fenestration and WEST- facing fenestration as well as the U-factor of 0.32 or lower and the SHGC of 0.25 or lower.
- Replacing Skylights** – Maximum U-factor of 0.55 or lower and a SGHC of 0.30 or lower. The TOTAL fenestration and WEST- facing area requirements are not applicable.

Item	Fenestration Type and Frame (window, glass door or skylight)	Orientation North, East, South West	Proposed Area <sup>1</sup> (ft <sup>2</sup> )	Maximum U-factor 0.32	Maximum SHGC 0.25	NFRC or Default Value <sup>2</sup>
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

1. Fenestration area is the total glazed product (i.e., glass plus frame). When a door is less than 50% glass, the fenestration area may be the glass area plus a "2 inch frame" around the glass.
2. If applicable at this stage enter "NFRC" for NFRC Certified windows or CEC Default Values

**Altered Fenestration Allowed Areas (Complete if more than 75ft<sup>2</sup> of fenestration is added.)**

	A	B	C	D	E	F	G
	CFA of entire building	Allowed % of CFA	Existing Fenestration Area	Fenestration area removed	Fenestration area added	Total Area allowed (A x B)	Proposed Area (E-D) + C
Total fenestration area		.20					
West Fenestration Area		.05					

- I certify under penalty of perjury, under laws of the State of California, the information provided on this form is accurate and complete.
- I certify that the energy features and performance specifications identified on this Certificate of Compliance conform to the requirements of Title 24, Parts 1 and 6 of the California code of Regulations.

Name:	Signature:
Company:	Date:
Address:	License:
City/State/Zip	Phone:



<b>CERTIFICATE OF INSTALLATION</b>		<b>CF2R-ENV-01-E</b>
<b>Fenestration</b>		<b>(Page 1 of 2)</b>
Project Name:	Enforcement Agency: <b>City of Oakley</b>	Permit Number:
Dwelling Address:	City <b>Oakley</b>	Zip Code <b>94561</b>

*If more than one person has responsibility for installation of the items on this certificate, each person shall prepare and sign a certificate applicable to the portion of construction for which they are responsible. Alternatively, the person with chief responsibility for construction shall prepare and sign this certificate for the entire construction. The signer agrees that all applicable Mandatory Measures were met. Temporary labels are not to be removed before verification by the building inspector.*

**A. FENESTRATION/GLAZING**

Includes all Windows, Skylights, Greenhouse/Bay Windows, Glazed Doors and Skylights

1	2	3	4	5	6	7	8	9	10
Item	Manufacturer/Brand <sup>1</sup>	Installed <sup>2</sup>				Source— NFRC, CEC Default <sup>3</sup>	Number of Like Products <sup>4</sup>	Exterior Shading Devices <sup>5</sup>	Comments/Location /Special Features <sup>6</sup>
		U- factor	SHGC	Area (ft2)	Orient ation				
1									
2									
3									
4									
5									
6									

1. Temporary window labels shall not be removed until the building inspector has verified the installed windows are the same or better than listed on the CF-1R. If labels were removed before verification by the inspector, the installer must use the CEC Default values from Table 110.6-A and 110.6-B. For NFRC rated products information from the permanent labels can be used to verify efficiencies.
2. List the installed U-factor, SHGC, area and orientation for each window or like windows. Note: For each window values shall be taken from: NFRC Label, or CEC Default values from Table 110.6-A and 110.6-B.
3. For each window list the source from which the actual values were obtained (NFRC, CEC Default).
4. List the number of like products (same U-factor, SHGC, Area, and Orientation) to be installed by grouping them together.
5. If exterior shading devices are installed select the type of shading device (sunscreens, louvered, vertical roller or shades or retractable awnings or roll down or slats) or if an overhang is installed.
6. This column is reserved for Comments – Locations – Special Features to provide additional information for the field inspector.

**B. MANDATORY REQUIREMENTS FOR ALL FENESTRATION**

1	All Fenestration Products have a temporary label that lists the U-factor and SHGC.
2	Temporary label shall list how the values were determined: NFRC, or (CEC) Default Values from Table 110.6-A and 110.6-B
3	Temporary labels that use the (CEC) Defaults shall list the U-factor and SHGC followed by the appropriate default U-factor.
4	NFRC Rated products have a permanent label on the product that can be looked up in the NFRC product directory ( <a href="http://www.nfrc.org">www.nfrc.org</a> ).
5	The fenestration installed has U-factor and SHGC values less than or equal to the values listed on the CF-1R.
6	The fenestration installed area is equal to or less than the areas listed on the CF-1R
7	The fenestration is properly installed, sealed and caulked or has low expanding foam between the fenestration and framing if allowed by manufacturer to limit infiltration.
8	All gaps between the fenestration and framing are filled with insulation to a minimum R13.

**DOCUMENTATION AUTHOR'S DECLARATION STATEMENT**

1. I certify that this Certificate of Installation documentation is accurate and complete.

Name:	Signature:
Company :	Date:
Address:	CEA or CEPE or HERS Certification # If Applicable:
City/State/Zip:	Phone:

CERTIFICATE OF INSTALLATION		CF2R-ENV-01-E
Fenestration		(Page 2 of 2)
Project Name:	Enforcement Agency: City of Oakley	Permit Number:
Dwelling Address:	City Oakley	Zip Code 94561

<b>RESPONSIBLE PERSON'S DECLARATION STATEMENT</b>		
<ol style="list-style-type: none"> <li>1. I certify under penalty of perjury, under the laws of the State of California, the information provided on this form is true and correct.</li> <li>2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for construction, or an authorized representative of the person responsible for construction (responsible person).</li> <li>3. I certify that the installed features, materials, components, or manufactured devices identified on this certificate (the installation) conforms to all applicable codes and regulations, and the installation is consistent with the plans and specifications approved by the enforcement agency.</li> <li>4. I reviewed a copy of the Certificate of Compliance (CF1R) approved by the enforcement agency that identifies the specific requirements for the installation. I certify that the requirements detailed on the CF1R that apply to the installation have been met.</li> <li>5. <b>I will ensure that a completed, signed copy of this Certificate of Installation shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a signed copy of this Certificate of Installation is required to be included with the documentation the builder provides to the building owner at occupancy.</b></li> </ol>		
Company Name: (Installing Subcontractor or General Contractor or Builder/Owner)		
Responsible Person's Name:		Responsible Person's Signature:
CSLB License:	Date Signed:	Position With Company (Title):

