Alterations:

- 2019 Energy Code includes requirements for alterations and additions affecting fenestration, including windows, skylights and doors with more than 3 ft² of glass
- When the construction type is classified as an alteration, fenestration may be replaced (altered) or increased (added)
- Prescriptive requirements are triggered when fenestration products are replaced or added, and vary depending on the area of replaced or added fenestration

Product Labeling

Typically, manufactured windows and doors with manufactured windows in them come with labels indicating that the National Fenestration Rating Council (NFRC) has certified the performance ratings of the window. Leave the labels on the windows and doors until the field inspection is done.
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 ft² 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.
Assessing Your Project
Prescriptive vs Performance Approach

- If you add more than 75 ft² 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 ft² – or if you add up to 16 ft² of new skylight area with U-factor ≤ 0.55 and SHGC ≤ 0.30 – the total/west-facing fenestration area requirements do not apply (a skylight is fenestration installed on a roof <60° 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 ft² 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
  - 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.

Exception:
Fenestration exempt from the maximum U-factor requirement includes:

- ≤10 ft² of fenestration OR
- The fenestration area is ≤ 0.5% of the total CFA (whichever is greater) OR
- The fenestration area of dual-glazed greenhouse or garden windows is ≤ 30 ft²

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
Prescriptive Requirements

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

**More than 75 ft² additional fenestration area or more than 16 ft² of skylight area**

<table>
<thead>
<tr>
<th>Climate Zones</th>
<th>U-Factor&lt;sup&gt;E&lt;/sup&gt;</th>
<th>SHGC&lt;sup&gt;B,E&lt;/sup&gt;</th>
<th>TOTAL Fenestration&lt;sup&gt;C&lt;/sup&gt; Area % of CFA&lt;sup&gt;D&lt;/sup&gt;</th>
<th>WEST-facing&lt;sup&gt;C&lt;/sup&gt; Area % of CFA&lt;sup&gt;D&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3, 5, 16</td>
<td>0.30 or lower</td>
<td>na</td>
<td>20% or less</td>
<td>na</td>
</tr>
<tr>
<td>2, 4, 6-15</td>
<td>0.30 or lower</td>
<td>0.23 or lower</td>
<td>20% or less</td>
<td>5% or less</td>
</tr>
</tbody>
</table>

**75 ft² or less additional fenestration area or more than 75 ft² replacement fenestration**

<table>
<thead>
<tr>
<th>Climate Zones</th>
<th>U-Factor&lt;sup&gt;E&lt;/sup&gt;</th>
<th>SHGC&lt;sup&gt;B,E&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3, 5, 16</td>
<td>0.30 or lower</td>
<td>na</td>
</tr>
<tr>
<td>2, 4, 6-15</td>
<td>0.30 or lower</td>
<td>0.23 or lower</td>
</tr>
</tbody>
</table>

**16 ft² or less additional skylight area or replacement skylights**

<table>
<thead>
<tr>
<th>Climate Zones</th>
<th>U-Factor&lt;sup&gt;E&lt;/sup&gt;</th>
<th>SHGC&lt;sup&gt;B,E&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3, 5, 16</td>
<td>0.55 or lower</td>
<td>na</td>
</tr>
<tr>
<td>2, 4, 6-15</td>
<td>0.55 or lower</td>
<td>0.30 or lower</td>
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</tbody>
</table>

**75 ft² or less replacement fenestration**

<table>
<thead>
<tr>
<th>Climate Zones</th>
<th>U-Factor&lt;sup&gt;E&lt;/sup&gt;</th>
<th>SHGC&lt;sup&gt;B,E&lt;/sup&gt;</th>
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<tr>
<td>1, 3, 5, 16</td>
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<td>na</td>
</tr>
<tr>
<td>2, 4, 6-15</td>
<td>0.40 or lower</td>
<td>0.35 or lower</td>
</tr>
</tbody>
</table>

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A 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.

B 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.

C “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.

D “CFA” is conditioned floor area; see Section 100.1: Definitions and Rules of Construction in the Energy Code for details.

E 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.)

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### 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 ≤45° north of true west to <45° south of true west.
- Skylights tilted:
  - To the west (from ≤45° north of true west to <45° south of true west)
  - In any direction when the pitch is less than 1:12

<table>
<thead>
<tr>
<th>Actual Orientation…</th>
<th>…Is Considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>45° east of north to 44° west of north</td>
<td>North-facing</td>
</tr>
<tr>
<td>45° north of west to 44° south of west</td>
<td>West-facing</td>
</tr>
<tr>
<td>45° west of south to 44° east of south</td>
<td>South-facing</td>
</tr>
<tr>
<td>45° south of east to 44° north of east</td>
<td>East-facing</td>
</tr>
</tbody>
</table>
Forms – Which & When

In addition to a Permit, you will need the following forms applicable to your project.

During Design:
- **CF1R-ALT-01-E**: Certificate of Compliance for Residential Alterations (when HERS is triggered)
  - Completed and signed by the designer, installing contractor or homeowner
  - Submitted to the building department during permit application
- **CF1R-ALT-05-E**: Certificate of Compliance – Prescriptive Alterations (Simple projects that do not trigger HERS)
  - Completed and signed by the designer, installing contractor or homeowner
  - Submitted to the building department during permit application
- **CF1R-ENV-02-E**: (if necessary) – Solar Heat Gain Coefficient (SHGC) Worksheet
  - Completed and signed by the designer, installing contractor or homeowner
  - Submitted with the CF1R-ALT-01-E when there is more than one type of window and one or more does not meet Prescriptive compliance requirements
- **CF1R-ENV-03-E**: (if necessary) – Area Weighted Average Calculation Worksheet
  - Completed and signed by the designer, installing contractor or homeowner
  - Submitted with the CF1R-ALT-01-E only if exterior shading devices are used to meet the SHGC requirement
- **CF1R-ENV-05**: (if necessary) – Alternative Default Fenestration Procedure (NA6) Worksheet
  - Completed and signed by the designer, installing contractor or homeowner
  - Submitted with the CF1R-ALT-01-E only if non-rated site-built fenestration is being installed

**Why?**: To show compliance with the Energy Code for fenestration alterations

During Construction:
- **CF2R-ENV-01-E**: Fenestration Installation
  - Completed by the installing contractor
  - Made available for the Inspector when onsite
- **CF2R-ENV-05-E**: Prescriptive Alterations Simple Non HERS
  - Completed by the installing contractor
  - Made available for the Inspector when onsite
- **CF3R-EXC-20-H**: HERS Verification of Existing Conditions for Alterations
  - Completed and signed by HERS Rater

**Why?**: To verify the field installation meets or exceeds the Energy Code

**Product Labeling per Section 10-111**

Typically, manufactured windows or exterior doors with ≥ 25% glass come with labels indicating that the NFRC has certified the performance ratings of the window. Leave the labels on the windows and doors until the field inspection is done.

Manufactured fenestration not certified by NFRC must:
- Use the CEC Default values found in Table 110.6-A and Table 110.6-B in the Energy Code
- Use the equations in Reference Appendix NA6
For More Information

Primary Documents
- Energy Code Residential Compliance Manual Section 3.5 – Fenestration (Window/Skylight/Glazed Door) and Opaque Doors:
- Energy Code Section 10-111 – Certification and labeling of fenestration product U-factors, SHGC, VT, and Leakage:
- Energy Code Section 110.6 – Mandatory Requirements for Fenestration Products and Exterior Doors:
- Energy Code Section 110.7 - Mandatory Requirements to Limit Air Leakage:
- Energy Code Section 150.0(q) – Mandatory Features and Devices - Fenestration Products:
- Energy Code Section 150.1(c) – Performance and Prescriptive Compliance Approaches for Low-Rise Residential Buildings - Fenestration & Shading:
- Energy Code Sections 150.2(b)1A – Additions and Alterations to Existing Low-Rise Residential Buildings - Alterations Prescriptive Approach - Fenestration:
- Energy Code Sections 150.2(b)1B – Additions and Alterations to Existing Low-Rise Residential Buildings - Alterations Prescriptive Approach - Replacement Fenestration:

Compliance Forms
- Residential Compliance Forms
  energycodeace.com/ResidentialForms/2019

California Energy Commission Information & Services
- Energy Code Hotline: 1-800-772-3300 (Free) or Title24@energy.ca.gov
- Online Resource Center:
  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):
  nfrc.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!