



Nonresidential Fenestration Compliance in the Title 24-2013 Energy Efficiency Standards, Part 6 New Construction and Alterations

Assessing your Project

New Construction

For new construction, the following fenestration performance prescriptive requirements must be met:

- U-factor, SHGC and VT performance requirements (new) – the U-factor can be demonstrated with a variety of methods (see Table 3). Note that the U-factor of the glazing is an area-weighted average.

Window area cannot exceed 40% of gross exterior wall area or 6 feet times the display area (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 (SRR) ratio limit.
- Sufficient fenestration area provides daylighting coverage to at least 75% of floor area, for spaces over 5,000 ft² with ceilings of greater than 15 feet that are directly under a roof

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 skylight to roof ratio of 3% to 4%. Larger skylight areas may meet the daylighting requirement, but could result in excessive solar heat gain.

If any of these prescriptive requirements cannot be met, the performance approach (a computer simulation) can be used to demonstrate compliance.

Alterations

Title 24 *Prescriptive requirements* for alterations affecting fenestration take effect whenever more than 50 ft² of fenestration is added or more than 150 ft² of fenestration is altered in an existing building. Alterations (replacements) of fenestration trigger prescriptive U-factor requirements shown in Table 1.

For alterations, default U-factor values in Table 110.6-A and 110.6-B must be used when over 1,000 ft² of fenestration is replaced with site-built fenestration 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. While the replacement of fenestration in existing buildings does not in itself trigger the daylighting requirements, the specification of high-VT glazing may be beneficial for future lighting and daylighting retrofits.

Table 1- Alterations Fenestration Performance Requirements

	CZ 3,5	CZ 1,16	All Others
U-factor	0.58	0.47	0.47
SHGC	0.41	0.41	0.31
VT	See Table 3		

Additions

Additions of fenestration (windows or skylights) trigger different U-factor requirements than alterations. Additions trigger the following new construction performance requirements:

- U-factor must meet requirements of Table 140.3-B, 140.3-C, or 140.3-D of the Standards
- Window-wall ratio and skylight-roof ratio prescriptive limits must be met
- Addition of skylights serving spaces over 5,000 ft² with high ceilings above 15 feet triggers the minimum skylit and sidelit daylit area requirement in Standards 140.3(c)

Site-Built Fenestration Performance

The key change to the 2013 Standards was to limit the amount of fenestration area that could use calculated U-factor/SHGC values based on glazing type and framing type and equations in Nonresidential Reference Appendix NA6. Up to 1,000 ft² of site-built fenestration may use this procedure. Larger amounts greater than 1000 sq. ft. of fenestration must use the default U-factor and solar heat gain coefficient default values in Tables 110.6-A and 110.6-B of the Standards or be NFRC rated. Note that the default values for the listed glazing and framing types will not meet prescriptive requirements, so the performance method must be used in these situations. The performance method allows flexibility than the prescriptive method and is often used for commercial buildings.



Table 2 – Methods for Determining Fenestration Performance

Method	Manufactured Windows	Manufactured Skylights	Site-Built Fenestration (windows, skylights)	Field-Fabricated Fenestration	Glass Block
NFRC Certified Products	Y	Y	Y	N	N
NFRC's Component Modeling Approach (CMA)	Y	Y	Y	N	N
Standards Table 110.6-A, 110.6-B	Y	Y	Y	Y	Y
Nonresidential Appendix Manual NA6	N	N	Y*	N	N

* Applicable only for site-built fenestration with total area 1,000 sq. ft. or lower.

Using NFRC Ratings

NFRC has two rating methods:

- 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.
- 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, then CMA certifications can be provided very quickly for specified product(s) at a particular project address.
- Both result in whole product ratings that include all components - frame, glass, spacer, gas fill, etc.
- Both require initial simulation and testing typically done by the frame manufacturer.
- The principle 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 presented 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.

window type. The new prescriptive Standards require products such as double-paned, low-e products with thermally broken frames or window products with triple silver low-e glazing. Also, there is a new minimum visible transmittance (VT) requirement of 0.32 for operable windows, 0.42 for fixed windows, and 0.46 for curtain walls. 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. Note that the U-factor of the glazing 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 (lower than the minimum levels below) is acceptable, provided that the window area-weighted VT meets the minimum prescriptive requirement.

Fenestration products with spectrally selective (“low e”) coatings are now available that provide better Solar Heat Gain Coefficients and meets the new VT value requirement.

Table 3 – New Construction and Additions Fenestration Performance

		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

Fenestration Performance Requirements

The 2013 Standards introduced higher U-factor requirements for both windows and skylights. For nonresidential new construction, the Standards now require a relative solar heat gain coefficient¹ of 0.22 to 0.26 or lower, depending upon the

		Glass, Curb Mounted	Glass, Deck Mounted	Plastic, Curb-Mounted
Skylight	Max U-factor	0.58	0.46	0.88
	Max SHGC	0.25	0.25	NR
	Min VT	0.49	0.49	0.64

¹ Relative Solar Heat Gain Coefficient (RSHGC) is the effective solar heat gain coefficient of a fenestration product that includes the effect of an exterior overhang. If there is no overhang, they are the same value.



Forms

The following compliance forms are required for new construction:

1. NRCC-ENV-02-E: Fenestration Worksheet
2. NRCC-ENV-05-E: Fenestration Certificate Label
3. NRCI-ENV-01-E: Certification of Installation - Envelope

The following acceptance tests are required:

1. NRCA-ENV-02-F: Fenestration Acceptance: required only for site-built fenestration.

Compliance Options

In addition to new requirements, the Standards have introduced additional compliance options for qualifying products. For new construction, dynamic glazing (also referred to as switchable glazing or electrochromic glazing in some configurations) can be used with the performance method for compliance credit. The optical properties of the glazing can be controlled based on incident solar radiation, space temperature, or a schedule by using automatic controls. The use of switchable glazing does not circumvent daylighting requirements, however.

Daylighting control performance beyond minimum requirements for sidelit daylit spaces may be accomplished through the use of continuous + off dimming controls, controls that exceed dimming requirements, or with fenestration that exceeds minimum VT requirements.

For alterations, NFRC window films may now be used in the performance method 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 NA7 4.2 Window Films criteria and Section 110.6 of the Energy Efficiency Standards.

For More Information

For more information, consult the following sources:

- Trigger Sheet for Fenestration Alterations
- Title 24 Nonresidential Compliance Manual
- National Fenestration Rating Council (NFRC)

