by additional wall and roof insulation. The overall envelope TDV energy approach combines the heat loss and heat gain equations into a single trade-off equation that calculates the annual TDV energy of space cooling and heating based on the thermal performance of envelope. Trade-offs would be compared using TDV energy instead of source energy, which allows for trade-offs between cooling and heating aspects of the envelope in one equation. The impacts of each building envelope component are estimated by a set of weighting coefficients that are dependent on climate and building type. See the ENV-3C forms.

TDV energy for the proposed building is calculated according to procedures in Reference Nonresidential Appendix NA7. TDV energy of the standard building, which minimally complies with prescriptive requirements, is also calculated. As long as overall envelope TDV energy of the proposed building does not exceed the TDV energy of the standard building, the building is in minimum compliance with the prescriptive requirements.

The overall envelope TDV energy approach permits trade-offs between many building envelope components, but no trade-offs are permitted with the interior lighting system or mechanical systems. The performance approach is required in order to make these trade-offs.

### 3.1.3 Performance Approach

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The performance approach may be used for compliance, or may include lighting and mechanical system compliance when these systems are permitted at the same time. When the performance approach is used for the envelope only, the computer model deals with the energy efficiency of the entire envelope under both heating and cooling conditions. This means that trade-offs can be made among all envelope components. The computer analysis is much more sophisticated and can account for more subtle energy effects due to surface orientation and hourly changes in the outside temperature. If the envelope is combined with other parts of the building for energy compliance, then more trade-offs can be made, such as increasing envelope efficiency in order to allow more lighting power or a less efficient mechanical system. See Chapter 9 for a more complete discussion of the performance approach.

### 3.1.4 What's New in the 2008 Standards

With the update to the Standards, there were several important changes to the building envelope requirements, as described below:

1. A new section §143(c) reduces the prescriptive area requirement for skylights in large enclosed spaces in nonresidential buildings from 25,000 ft² down to 8,000 ft².

2. The building plans must show all skylit and primary side lit areas that total more than 2,500 ft² in an enclosed space (room) §131(c)2B&C. This will require coordination between the architect and the lighting designer so the daylit areas are relocated when the location or sizes of windows and skylights change in design iterations.
3. A new prescriptive requirement for **steep-sloped roofing products** (cool roof).

4. **Overall Building Envelope Method** - The overall building envelope method has been revised to combine heating and cooling and to provide simplified trade-offs for roofing alterations.

5. **Site-Built Fenestration - Acceptance Requirements**. The Standards introduce Acceptance Requirements, ENV-2A, for site-built fenestration products.

6. NFRC’s new Component Method Approach (CMA) for manufacturers and fenestration specifiers to calculate the U-factor and SHGC through computer simulation. Speeds up the process in acquiring an NFRC label Certificate for nonresidential manufactured and site-built fenestration for energy compliance.

7. Default Table 116-A and 116-B now includes Block Glass values.

8. **Insulation Levels** - Revised prescriptive roof, wall, and floor insulation requirements levels in certain climate zones.

9. The **alteration requirements for roofing products** have been changed to clarify that all replacements, recovering or recoating of the exterior surface of existing nonresidential roofs shall meet the requirements of §118(i).

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### 3.2 Fenestration

Fenestration (windows), glazed doors, skylights, and overhangshading devices have a large impact on envelope-related heating and cooling loads in nonresidential and high-rise residential buildings. The size, orientation, and frame typetype of fenestration products can dramatically affect overall energy performance of the HVAC system and the comfort of the occupants.

### 3.2.1 Mandatory Measures

The mandatory measures for doors, windows, and skylights address the air-tightness of the units and how their U-factor and SHGC are determined. Fenestration products must be labeled with a U-factor and SHGC, and the manufacturer or an independent certifying organization must certify that the product meets the air infiltration requirements of §116(a).

### Certification and Labeling

The Administrative Regulations §10-111 and §116 require that fenestration products have labels that list the U-factor, the solar heat gain coefficient (SHGC), and the methods used to determine those values. The label must also certify that the fenestration product meets the requirements for air leakage. The air leakage requirements are specified in §116 and limit the infiltration rate to 0.3 cfm/ft² for most products.
Manufactured (Factory-Assembled) Fenestration Label Certificates

Each manufactured (factory-assembled) fenestration product must have a clearly visible temporary label attached to it, which is not to be removed before inspection by the enforcement agency. For rating and labeling manufactured fenestration products, the manufacturer rates their products for U-factor and SHGC:

1. The manufacturer can choose to have the fenestration product rated and labeled in accordance with the NFRC Rating Procedure (NFRC 100 for U-factors and NFRC 200 for SHGC). If the manufactured fenestration product is rated using the NFRC Rating Procedure, it must also be permanently labeled in accordance with NFRC procedures. Or

2. The manufacturer can choose to use Energy Commission's less efficient default values for U-factors and SHGC as shown in §116. If default values are used, the manufacturer must attach a temporary label meeting specific requirements (permanent labels are not required). Product meets the air infiltration requirements of §116(a)1, U-factor criteria of §116(a)2, and SHGC criteria of §116(a)3, in the Building Energy Efficiency Standards for Residential and Nonresidential Buildings.

Where possible, it is best to select fenestration that is NFRC-rated, and to do so before completing compliance documents. This enables the use of NFRC-certified data to be used for energy compliance purposes.

Default Temporary Label

Although there is no exact format for the default temporary label, Figure 3-1 shows a sample default temporary label and must be clearly visible and large enough for the enforcement agency field inspectors to read easily and it must include all information required by the regulations. The suggested label size is 4 in. x 4 in. The label must have the words “California Energy Commission Default U-factor” followed by the correct value for that fenestration product from Table 116-A in the Standards and the words “California Energy Commission Default SHGC” followed by the correct value from Standards Table 116-B. The U-factor and SHGC default values should be large enough to be visible from 4 ft. For skylights, the label must indicate when the product was rated with a built-in curb.

If the product claims the default U-factor for a thermal-break product, the manufacturer must certify that the thermal-break criteria, upon which the default value is based, are met. Placing the term “Meets Thermal-Break Default Criteria” on the temporary label can do this.
Site-Built and Manufactured Lab Certificates

Site-built fenestration is fenestration designed to be field-glazed or field-assembled using specific factory-cut or otherwise factory-formed framing and glazing units that are manufactured with the intention of being assembled at the construction site. Manufactured or “knocked-down” fenestration product is constructed of materials which are factory cut or otherwise factory formed with the specific intention of being used to fabricate a fenestration product and is typically factory-assembled before delivery to a job site.

Site-built or manufactured fenestration must either have an NFRC label certificate using NFRC 100 or 200 procedures or use less efficient default values in §116 and as described in Section 10-111. Site-built fenestration may be pre-assembled off-site by the glazing contractor. The glazing contractor may pre-assemble the site-built fenestration. Examples of site-built fenestration include storefront systems, curtain walls, and atrium roof systems. Site-built or manufactured fenestration in large projects (more than or equal to 10,000 ft² of site-built fenestration area, which includes windows, non-opaque doors, and skylights) must have either a label certificate issued by NFRC that is filed at the job site in the contractor’s project or building managers office during construction, or a label certificate issued by the glazing fabricator using California Energy Commission Default U-factor and SHGC values. For further discussion of the NFRC’s new Component Modeling Approach (CMA), see below.

For site-built or manufactured fenestration products, the glazing specifier (e.g., architect, responsible party, glazing contractor, extrusion manufacturer, IG fabricator or glass manufacturer) will likely generate a pre-bid label first then an NFRC Label Certificate using CMA after the construction project is awarded. For compliance purposes, the designer should select a U-factor and SHGC for the
fenestration system that is reasonable and achievable. If the site-built fenestration is not NFRC-certified, the designer should model the appropriate less efficient default U-factor and SHGC values for the glass and frame type selected from Table 116-A and Table 116-B or if less than 10,000 ft² of site-built fenestration area, which includes windows, non-opaque doors, and skylights) the alternative equations for U-factor and SHGC as indicated in Reference Nonresidential Appendix NA6. Note that the Reference Nonresidential Appendix NA6 equation for default U-factors and SHGC can only be used in buildings with less than 10,000 ft² using only site-built fenestration. For non NFRC rate manufactured fenestration including either use the fenestration table values. Document the thermal performance by the less efficient default document the values using Energy Commission's Fenestration Certificate FC-1/FC-2. A different FC-1/ FC-2 Default Label Certificate should be completed for each product line that results in a different U-factor and SHGC. See example on page 3-124.

The Default Label Certificate should state the total amount of this product line throughout the project, the locations in the project where the product line is installed, and the pages in the drawings and fenestration schedule that show this product line. The Default Label Certificate should clearly identify the appropriate table or equation that is used to determine the default U-factor and SHGC and, if applicable, the center of glass SHGCC used in calculating the SHGCfen. Manufacturer’s documentation of these product characteristics must also be attached to the plans.

The Default Label Certificate may also include the visible (light) transmittance (VT) factor to determine whether daylit area credit may be taken in conjunction with daylighting controls. The person taking responsibility for fenestration compliance can choose to attach Default Temporary Labels to each fenestration product as described in the previous paragraph instead of providing Default Label Certificates for each product line.

**NFRC’s New Component Modeling Approach (CMA) Product Certification Program and the Energy Standards**

The National Fenestration Rating Council ("NFRC") has developed a new commercial certification product program that rates whole fenestration products to include site-built and manufactured fenestration in accordance with NFRC 100 and NFRC 200. This new approach determines the U-factor, Solar Heat Gain Coefficient (SHGC) and Visible Transmittance (VT) of a product faster and more accurately without actual physical laboratory testing in most cases. Such results can be used in a pre-bid report or for other energy performance analysis, and can be used for obtaining an NFRC Certified CMA Label Certificate.

Each component that makes up a fenestration product shall have values that are NFRC-approved and maintained by NFRC. NFRC’s Approved Component Library Database includes the glazing, spacer and frame components. Each of the components are NFRC certified before they are included into the library’s database.

The component manufacturers shall have their products approved by NFRC in accordance with the new NFRC 705 Component Modeling Approach Product Certification Program (CMA-PCP). Before the components can be accepted into
Compliance for Specifiers

To comply with NFRC’s new CMA approach:

The new NFRC CMA software tool may be used to obtain non-certified performance ratings for pre-bid purposes and pre-design values to be used in energy analysis programs. CMA will be made available to the public through NFRC as of January 1, 2010. The window specifier or energy consultant uses the software tool program to select components from the library, model them and calculate the thermal performance of the whole product. This data can then be exported and used in a pre-bid report or for other energy performance analysis. However, to meet energy compliance an NFRC certified CMA Label Certificate must first be generated before installation of fenestration. CMA Label Certificate and copies of the purchase orders must first be verified by the field inspector before fenestration is installed on the building and meet the acceptance requirements by the installer. The installer will follow the set procedures in Reference Nonresidential Appendices NA7.

Note: To acquire an NFRC-approved label certificate the CMA program must first meet NFRC’s license agreement. Only an IA, Independent Agency, which has been licensed by NFRC can certify CMA’s simulation report and issue an NFRC Label Certificate. For a list of certified IA’s and further procedures, see NFRC’s CMA Product Certification Program (CMA-PCP, NFRC 705) at www.NFRC.org.

Field-Fabricated Fenestration

Field-fabricated fenestration is not the same as site-built fenestration. Field-fabricated fenestration is a very limited category of fenestration that is made at the construction site out of materials that were not previously formed or cut with the intention of being used to fabricate a fenestration product. No labeling is required for field-fabricated fenestration products. Field-fabricated fenestration and field-fabricated exterior doors may be installed only if the compliance documentation has demonstrated compliance using U-factors from Standards Table 116-A and SHGC values from Standards Table 116-B. The field inspector is responsible for ensuring field-fabricated fenestration meets the specific criteria described in Standards Tables 116-A and 116-B for the U-factor and SHGC used for compliance. Thermal break values do not apply to field-fabricated fenestration products.