

Dynamic Glazing - Code Compliance Brief

Overview:

The intent of this brief is to provide additional information to help assure the measure will be deemed in acceptance with the code. Providing notes for codes officials on how to plan review and field inspect can help the builder or remodeler with the proposed designs and provide the jurisdiction with information for acceptance. Providing the same information to all interested parties (i.e., code officials, builders, designers) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

Dynamic glazing requirements were added to the residential portion of the International Energy Conservation Code (IECC) and International Residential Code (IRC) in the 2015 version. Dynamic glazing is defined as “any fenestration¹ product that has the fully reversible ability to change its performance properties, including U-factor², solar heat gain coefficient (SHGC), or visible transmittance (VT).”³ This variation in performance properties can be useful in addressing conflicts between, for example, the desire for views of the outdoors and desire for reduction in solar gain. There are two main types of dynamic glazing:

- switchable glazing products⁴
- internal shading systems.⁵

Commercially available dynamic glazing products typically focus on U-factor or SHGC, providing a range of thermal insulation or solar shading.⁶ Switchable glazing products typically provide SHGC variability, while internal shading systems may provide both U-factor and SHGC variability. The range of solar shading may be provided by window films that automatically respond to sunlight or temperature or by integrated blinds or shades that are automatically controlled.

Because dynamic glazing products have multiple U-factor or SHGC values, the question immediately arises as to which value should be compared to the fenestration requirements in the 2015 IECC/IRC. The code requirements in the 2015 IECC/IRC state that, “... if the ratio of the higher to the lower value is greater than or equal to 2.4 and the product is automatically controlled to modulate the amount of solar gain into the space in multiple steps, the product may be permitted to comply with the requirements of the Insulation and Fenestration Requirements by Component Table R402.1.2.”

For SHGC, the “upper SHGC” value for dynamic glazing is typically close to that of a “clear” window, while the “lower SHGC” for dynamic glazing is typically closer to that of a heavily tinted window. This means that for dynamic glazing products, the SHGC-0.25 requirement in climate zones 1-3 and the SHGC-0.40 requirement in climate zone 4 are not applicable. Instead, the ratio of the upper and lower SHGC values and the presence of an appropriate automated control system are substituted for the prescriptive SHGC values. A special note should be made of what are called “environmentally controlled dynamic glazing” products. These products change their SHGC based on the response of the materials incorporated into films applied to the glazing. There is not a separate “control system”. Control is provided automatically by the atomic structure and properties of the film material. These products should be considered to have an appropriate automated control system.

For U-factor, the only systems that offer U-factor variability are internal shading systems. An internal shading system with the shades “open” would typically be a “clear” window, whereas the same system with the shades “closed” would be opaque. The shading system may offer some U-factor benefit as well as SHGC benefit, with the U-factor benefit dependent on the type of material used for shading. These systems require some sort of external control system to change the mechanical shading system.

There is an exception to the dynamic glazing requirement that states that if both the upper and lower values for a dynamic glazing product are already at or below the prescriptive requirement. Given that one of the appealing features of dynamic glazing is the fact that it offers “better” views when in the high SHGC and high U-factor modes, the situation described in the exception is not expected to occur very often. However, it could happen, and the 2015 IECC/IRC is ready for it.

¹Fenestration is defined in the 2015 IECC/IRC as either vertical fenestration or skylights. Vertical fenestration is defined as windows (fixed or moveable), opaque doors, glazed doors, glazed block and combination opaque/glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of at least 60 degrees from horizontal.

²U-factor is defined in the 2015 IECC/IRC as thermal transmittance, the coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (Btu/h•ft²•°F).

³This definition is taken from the commercial section definitions in the 2015 IECC. The code change proposal that added dynamic glazing requirements to the residential section of the 2015 IECC must not have included the definition in the residential section.

⁴ Switchable glazing products include electrochromic glass systems that can be tinted or untinted in response to an electronic control signal or environmental change. (Source: Footnote 7)

⁵Internal shading systems include blinds positioned between glass panes that can open and close.

(Source: Footnote 7)

⁶The third property that may be impacted by dynamic glazing is visible transmittance. VT is associated with the amount of visible light that passes through fenestration and this property is typically associated with daylighting. Consideration of VT or these daylighting systems for residential buildings are not required in the 2015 IECC.

Plan Review:

Per the **IECC/IRC, Section R103.3/R106.3, Examination of documents**. The code official/building official must examine or cause to be examined construction documents for code compliance.

This section lists the applicable code requirements and details helpful for plan review regarding the provisions to meet the requirements for "dynamic glazing".

- **Construction Documentation**. Review the construction documents for the details on the windows and/or glass doors.
 - **2015 IECC/IRC, Section R103.2/N1101.5 Information on construction documents**. Construction documents should include:
 - U-factors and SHGCs
 - Area-weighted U-factor and SHGC calculations

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- **Ratings on Fenestration.** Confirm the products specified have been rated, certified, and labeled per the National Fenestration Rating Council (NFRC). Dynamic glazing products are labeled by the NFRC with a special label that shows the lower and upper values of SHGC that are associated with the product.⁷
 - **2015 IECC/IRC, Section R303.1.3/N1101.10.3 Fenestration Product Rating.** U-factors of fenestration products (i.e., windows and glass doors) to be determined in accordance with NFRC 100 and the SHGC with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer.
 - **2015 IECC/IRC, Section R402.4.3/N1102.4.3 Fenestration air leakage.** Windows and sliding glass doors to have an air infiltration rate of no more than 0.3 cfm per square foot when tested in accordance to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled by the manufacturer.
 - **2015 IECC/IRC, Section R402.3.1/N1102.3.1 U-factor.** An area-weighted average of fenestration products is permitted to satisfy the U-factor requirements prescriptively.
 - **2015 IECC/IRC, Section R402.3.2/N1102.3.2 Glazed fenestration SHGC.** An area-weighted average of fenestration products more than 50% glazed is permitted to satisfy the SHGC requirements prescriptively.
 - **Dynamic glazing** shall be permitted to satisfy the SHGC requirements of Table R402.1.2/N1102.1.2 provided the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4, and the *dynamic glazing* is automatically controlled to modulate the amount of solar gain into the space in multiple steps. *Dynamic glazing* shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing is not permitted.
 - Exception: *Dynamic glazing* is not required to comply with this section of the code when both the lower and higher labeled SHGC already comply with the requirements of Table R402.1.1/R1102.1.2. (Note that there is no Table R402.1.1/R1102.1.2 in the 2015 IECC/IRC and this is an obvious typo that should refer to Table R402.1.2/N1102.1.2.)

2015 IECC/IRC (Table R402.1.2/N1102.1.2)

— **2015 IECC/IRC Section R402.5/N1102.5 Maximum fenestration U-factor and SHGC.** The area-weighted average maximum fenestration U-factor and SHGC permitted using the following tradeoffs:

Climate Zone	1	2	3	4	5	6	7	8
U-factor	NR	0.40	0.35	0.35	0.35	0.32	0.32	0.32
SHGC	0.25	0.25	0.25	0.40	NR	NR	NR	NR

- Climate zones 4 and 5 – U-factor 0.48
- Climate zones 6-8 – U-factor 0.40
- Climate zones 1-3 – SHGC 0.50

— **2015 IECC/IRC Section R402.3.3/N1102.3.3 Glazed fenestration exemption.** Up to 15 square feet of glazed fenestration per dwelling unit is permitted to be exempt from the U-factor and SHGC requirements; however, this exception does not apply to the U-factor alternative approach or total UA alternative under Section R402.1.4 and R402.1.5.

— **Flashing/Moisture Control**

- **2015 IRC, Section R703.4 Flashing.** Approved corrosion-resistant flashing to be applied shingle-fashion to prevent water from entering into wall cavities or from penetrating into building structural framing components. Self-adhered flashing must comply with AAMA 711. Flashing at exterior window and door openings must extend to the surface of the exterior wall finish or to the water-resistive barrier. Flashing must be installed in accordance with one or more of the following:
 - In accordance with fenestration manufacturer's installation and flashing instructions or in accordance with the flashing manufacturer's instructions. Where instructions or details are not provided, pan flashing is to be installed at the sill of exterior window and door openings and must be sealed or sloped to direct water to the surface of the exterior wall finish or water-resistive barrier. Openings using pan flashing must also incorporate flashing or protection at the head and sides.
 - Per the flashing design or method of a registered design professional.

• **Air Sealing/Air Leakage Control**

— **2015 IRC/IECC, Table R402.4.1.1/N1102.4.1.1, Air Barrier and Insulation Installation, Windows and Doors.** Seal space between window/door jambs and framing.

⁷See http://c.ymcdn.com/sites/www.nfrccommunity.org/resource/resmgr/factsheets_2013/dynamicglazing2.pdf [1] for explanation of the NFRC dynamic glazing rating system and label.

Field Inspection:

Per the **2015 IECC, Section R104, Inspections**, construction or work for which a permit is required is subject to inspection. Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include: footing and foundation, framing and rough-in, plumbing rough-in, mechanical rough-in, and final inspection.

Per the **IRC, Section R109, Inspections**, the wording is somewhat different in that for on-site construction, from time to time the building official, upon notification from the permit holder or his agent, can make or cause to be made any necessary inspections. Further details are provided for inspections regarding foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and final inspection. Any additional inspections are at the discretion of the building official. This section provides details for inspecting to the specific provisions for “dynamic glazing” where one or more specific type of inspection per the IECC or IRC may be necessary to confirm compliance.

- *Confirm windows meet the ratings approved on the construction documents.* If the labels have been removed from the products, ask the contractor or homeowner if they saved a label to confirm the ratings meet compliance.
- *Confirm the windows have been flashed and sealed properly.* An inspection during installation to make sure the windows have been flashed properly before the siding and trim goes up is recommended. The following websites provide information on flashing/sealing windows.
 - [Guide with pictures on how to properly flash the window.](#) [2] [2]
 - [Guide with pictures on how to properly seal the window.](#) [3] [3]

Technical Validation(s):

[Advanced Glazing and Window Technologies, National Institute of Building Sciences](#) [4]