NEW 2016 EDITION!

International Code Requirements

For Residential Windows & Doors

Courtesy of the American Architectural Manufacturers Association

The family of International Codes published by the International Code Council is the most widely used in the history of U.S. construction codes. In addition to widespread use throughout the 50 states, numerous federal agencies—including the National Park Service and the U.S. Department of Defense—have also adopted the International Codes. Due to this adoption by federal agencies, I-codes are being enforced in countries other than the U.S. Perhaps the most notable of these is on military bases in the Middle East.

The following is intended as a summary of the major requirements set forth by the I-codes for windows, doors, skylights and other fenestration products in single-family homes, duplexes and townhouses that are four stories or less in height. These types of buildings are referred to as "low rise residential construction" within the family of International Codes. The requirements for them are established in the International Residential Code and the International Energy Conservation Code.

The most recent edition of the IRC and IECC are the 2015 editions. Manufacturers and dealers that sell products in several states should be aware that, at this time, multiple editions of the International Codes are being enforced across the country.

Emergency Escape and Rescue Openings

The 2015 IRC requires emergency escape and rescue openings in all sleeping rooms and in all basements except those that are less than 200 square feet in area

How to Use this Guide

This article focuses on the requirements of the 2015 editions of the IRC and IECC for residential fenestration, with emphasis on the changes that have occurred between the 2012 and 2015 editions of those codes.

The user of this summary is cautioned, however, that it is not intended to be a full discussion of all the requirements of the 2015 International Codes for fenestration products. Relevant sections of the codes are identified and more specific information can be gained by obtaining a copy of the relevant code or codes from ICC.

The user of this summary is also cautioned that any particular jurisdiction may be enforcing other editions of the International Codes. They may also have adopted one or more of the International Codes, and then made their own amendments at the state or local level. As a result, many jurisdictions have their own versions of these particular codes. This summary does not attempt to address all of these variations of the base model code and may not be consistent with the requirements of some jurisdictions.

The ICC website, iccsafe.org, offers updated information on which edition of its codes is in effect in each state and in various cities and counties. In some cases, the jurisdictional specific versions of the International Codes can be obtained from the ICC; in other cases, they must be obtained directly from that particular jurisdiction.

and used only to house mechanical equipment.

The requirements for sizes, locations, etc., are set forth in Section R310 of the 2015 IRC. It is important to note that the required opening size of 24 inches high, 20 inches wide and 5.0 or 5.7 square feet in area must be met by "normal" operation of the window, door or skylight without the use of keys, tools or special knowledge, and without the removal of a second sash from the opening.

Typically, the EERO requirements are met with operable windows or doors. Operable skylights and roof windows are also permitted to be used as EEROs if they meet the size requirements and the bottom of the opening is within 44 inches off the floor below.

Minimum Window Sill Heights

The 2015 IRC requires the bottom of openings created by operable windows to be a minimum height of 24 inches above the adjacent interior floor when they are more than 6 feet above the grade outside the window.

An exception is given, however, for windows that do not open more than 4 inches or that are equipped with window guards or window opening control devices that comply with ASTM F2090-10. The WOCD must limit the initial opening of the window to no more than 4 inches, but must also be releasable with no more than 15 pounds of force to open more fully. The intent of this later provision is to permit windows that are equipped with WOCDs to also be used to meet the EERO requirements of the 2015 IRC.

Means of Egress Doors in the IRC

Section R311.3.1 of the 2015 IRC restricts the threshold height of the required exit door in residences to 1½ inches from the top of the threshold to the floor or landing on each side of the door. The rise from the floor or landing to the top of the threshold at other exterior doors within the IRC is limited to 7¾ inches (which is the riser height permitted for stairs).

Section R311.2 of the 2015 IRC also specifies that:

- The width of the clear opening provided by the required egress door is to be at least 32 inches when measured from the face of the door to the door stop at the jamb of the opening, and
- The height of the clear opening provided is to be a minimum of 78 inches when measured from the door stop at the head of the opening to the top of the threshold.

Window Installation

Section R609.1 of the 2015 IRC requires that windows and doors be installed in accordance with the fenestration manufacturers' installation instructions and flashed in accordance with Section R703.4.

Section R703.4 of the 2015 IRC gives more specific provisions for the installation of flashing around the window. It requires that flashing be installed in shingle-fashion in such a manner as to prevent entry of water into the wall cavity or penetration of water to the building structural framing components. It also requires that the flashing extend to the surface of the exterior wall finish or to the water-resistive barrier for subsequent drainage.

The 2015 IRC also references some AAMA standards for flashing. Section R703.4 of the 2015 IRC requires self-adhered membranes used as flashing to comply with AAMA 711-13 and fluid-applied flashing to comply with AAMA 714-12. Item 1 of Section R703.4 requires mechanically applied flashing to comply with AAMA 712-11.

Recent Changes

There are several significant changes between the 2012 and 2015 editions of the IRC and IECC that relate to fenestration products. Cumulatively these changes include:

- The design wind speed model used for residential construction was revised from Allowable Stress Design to Strength Design for consistency with the IBC.
- A new compliance path based upon establishing an Energy Rating Index was added to the residential construction provisions in both the IECC and the IRC.
- Provisions requiring the installation of window opening control devices on replacement windows in locations where they would be required in new construction was added to the IRC.
- An exception to meeting Emergency Escape and Rescue size requirements for replacement windows that meet other specific criteria was added to the IRC.

Safety Glazing

Section R308.4 of the 2015 IRC establishes the locations where safety glazing is required. They include the following:

- Glazing in and near swinging and sliding doors;
- Large lites of glass near walkways;
- Glazing around tubs, showers, pools and similar fixtures; and
- Glazing near stairways, ramps and the landings for both.

In these applications, the glazing must be labeled per the Consumer Product Safety Commission 16 CFR 1201 requirements. There are some exceptions for applications

Code Adoption

The International Codes are the most widely used family of model codes in U.S. history. According to the ICC website, as of fall 2016:

- The International Building Code is used in 50 states and four U.S territories.
- The International Residential Code is used in 49 states and three U.S. territories.
- The International Energy Conservation Code is used in 47 states and two U.S. territories.

Adoption and use of the I-codes by foreign entities continues to increase, as well.

- All or portions of the IBC (in English or Spanish) are being used in the Caribbean, Haiti, Jamaica, Trinidad, Tobago, Colombia, Honduras, the country of Georgia, Abu Dhabi, Saudi Arabia and Afghanistan.
- All or portions of the IRC (in English or Spanish) are being used in Haiti, Jamaica, Trinidad, Tobago, Mexico and Abu Dhabi.
- All or portions of the IECC (in English or Spanish) are being used in the Caribbean, Jamaica, Mexico and Abu Dhabi.

Within the U.S., multiple editions of the International Codes are being enforced across the country.

Adoption and enforcement of a new edition of a model construction code traditionally occurs most significantly in the second and third years after its publication. This is evident in the adoption of the 2015 I-codes:

- The 2015 IBC is now being enforced in at least 11 states.
- The 2015 IRC is now being enforced in at least 10 states.
- The 2015 IECC is now being enforced in at least seven states.

For building and structural design, the ICC website indicates that the 2012 and 2009 editions of the IBC and IRC are the most commonly used. Specifically:

- The 2012 IBC is being enforced in 23 states and one U.S. territory.
- The 2009 IBC is being enforced in 11 states and three U.S. territories.
- The remaining four states are all enforcing earlier editions of the IBC.
- The 2012 IRC is being enforced either locally or statewide in 18 states and one U.S. territory.
- The 2009 IRC is being enforced either locally or statewide in 15 states and two U.S. territories.
- Six of the remaining states are either enforcing an earlier edition of the IRC, or the IRC is being enforced locally.
- Only one state (Wisconsin) continues to rely upon its own, state-developed residential code.

With regard to energy conservation, a similar pattern is evident:

- The 2012 IECC is being enforced in 18 states.
- The 2009 IECC is being enforced in 18 states.
- An earlier edition of the IECC is being enforced in three states.
- A locally developed energy conservation code that has been coordinated with the IECC is being enforced by one state (California).
- Only three states (Indiana, Mississippi and South Dakota) are not enforcing any energy conservation code at all.

Many jurisdictions have their own versions of particular codes. It is imperative that the code user verify the edition of the code being used, as well as applicable local amendments, in any specific jurisdiction prior to beginning a project there.

that are considered less hazardous, such as openings less than 3 inches in diameter in doors or decorative glass and glazing provided with a protective bar, etc.

The 2015 IRC also permits the use of glass that meets the two most stringent categories of ANSI Z97.1 in hazardous locations that are defined within those codes, but which do not fall within the scope of the federal law established by CPSC 16 CFR 1201. These locations include tub and shower enclosures, door sidelites, large lites of glass, and glazing near stairs, ramps and pools.

The criteria for these two categories of ANSI Z97.1 are similar to CPSC 16 CFR 1201 for these applications, but the former was updated in 2009, while the latter was last updated in 1977. Therefore the ANSI document is considered to be more up-to-date and consistent with products currently available.

The defined hazardous locations did not change significantly between the 2012 IRC and the 2015 IRC.

Mullions

The 2015 IRC requires testing or structural calculations to demonstrate the ability of window mullions to meet certain structural requirements. If structural calculations are used to determine adequacy, the mullion deflection is limited to L/175 of the length of the long edge of the glass being supported.

If testing is the method used to determine structural adequacy of mullions, it is to be done in accordance with AAMA 450-10, Voluntary Performance Rating Method for Mulled Fenestration Assemblies. When the mullion is tested in accordance with AAMA 450-10, the deflection limit of L/175 does not need to be met. It should be noted that this provision is only contained in the IRC. As such, it is most commonly applied to R and LC windows and not CW or AW windows.

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Design Loads

Provisions for design loads of all exterior cladding of residential structures—including fenestration—are set forth in Section R301 of the 2015 IRC. The design loads of concern for vertical glazing are design wind load and impact resistance. Skylights and sloped glazing are also subject to snow load and dead load.

Wind Loads

Tables R301.2(2) and R301.2(3) of the 2015 IRC give the design wind loads for glazed openings based on the design wind speed of the specific location where construction is to take place, the mean height of the building and its exposure to wind.

A significant change to the wind load provisions occurred between the 2012 and 2015 editions of the IRC. Specifically, the methodology used to calculate design wind loads in the IRC was changed from Allowable Stress Design to Strength Design. This change initially occurred between the 2005 and 2010 editions of the American Society of Civil Engineers 7 Minimum Design Loads for Buildings. It was brought into the 2012 IBC but not into the 2012 IRC.

This caused confusion between the 2012 editions of the IRC and IBC. Some states (such as Florida) amended the 2012 IRC, when they adopted it, for consistency with the 2012 IBC. However, the 2015 editions of the IRC and IBC both reference ASCE 7, meaning that the design wind speeds are consistent between the 2015 editions.

The standards that the fenestration industry relies upon for structural design of its products are all based upon the Allowable Stress Design method. This includes all predecessor and current editions of NAFS, ASTM E1300 and ASTM E330.

The change in methodology from Allowable Stress Design to Strength Design results in higher design-wind speeds and pressures. At first glance, this might give the appearance of placing more stringent requirements on exterior windows, doors and skylights.

In actuality, the 2015 editions of the IBC and IRC contain provisions to multiply this new, higher Strength Design Load by a factor of 0.6 for the purpose of conversion, and therefore can compare to Allowable Stress Design values. In most cases, this conversion results in required design pressure ratings for fenestration that are roughly comparable to the more traditionally determined values.

Therefore, the design wind pressure values obtained from the 2015 IRC are to be multiplied by 0.6 for the purposes of comparison to the Design Pressure rating of the fenestration product obtained by testing in accordance with NAFS-11.

This 0.6 factor is not to be applied when the design wind pressure values are obtained from the 2012 or earlier editions of the IRC. The design wind pressure values of the 2012 IRC have already been adjusted to be consistent with other design provisions within the document that are based upon Allowable Stress Design. This includes the DP rating of fenestration products under NAFS.

It is imperative that the builder, code official, manufacturer and anyone else involved in choosing or approving the windows, doors or skylights for a particular residence be aware as to whether the 0.6 conversion factor is appropriate or not. AAMA, WDMA, Fenestration Manufacturers Association and Door & Access Systems Manufacturers Association International published a technical bulletin (TB 11-1) on this topic. This bulletin can be downloaded from the AAMA online store, aamanet.org/store.

Dead Loads

The provisions for dead loads in Section R301.1 of the 2015 IRC are also based on ASCE 7-10; there are no significant changes to the dead load requirements for fenestration between the 2012 and 2015 editions.

Impact Resistance

Section R301.2.1.2 of the 2015 IRC outlines the locations where impact-resistant products are required; all exterior openings in wind-borne debris areas are required to be impact-resistant.

The geographical locations where impact protection of openings is required are similar to those given in ASCE 7-10 and are primarily defined by design wind speed.

Products that need to meet impact resistance requirements must be tested to one of a few different sets of standards. One option is testing in accordance with ASTM E1886-05 and ASTM E1996-2012a, which must be used together.

The 2015 IRC also recognizes the AAMA 506 certification label tab as evidence that a product has been tested appropriately. This tab provides a method for window manufacturers to demonstrate its product has been successfully tested in accordance with ASTM E1886 and ASTM E1996 by including the tab as part of its NAFS product certification label. The 2015 IRC also permits the use of "other approved tests." This may include Miami-Dade County test protocols, if approved by the authority having jurisdiction.

The use of protective wood panels as an alternative to impact-resistant glazing or shutters continues to be permitted for one- and two-story, single-family dwellings, duplexes and residential care facilities. ■

Replacement Windows

As a general rule, when an addition is made to a building or a component within a building is replaced, the International Codes require the new component or addition to comply with the requirements of the current code for new construction. This is also true for replacement windows.

Both the 2015 IECC and IRC require replacement windows to comply with the energy conservation requirements for fenestration in new construction. This requirement applies whether the entire window unit—including frame, sash and glazing—is being replaced, or just the sash and glazing.

New provisions in the 2015 IRC will also require installation of WOCDs on replacement windows in locations where they would be required in new construction. This would basically be windows that open more than 4 inches, which are more than 6 feet above the exterior grade and within 24 inches of the interior floor.

Difficulty occasionally arises when replacement windows are to be installed in locations where EERO would be required in new construction. Sometimes the opening in the existing home is not of sufficient size to permit the installation of a replacement window that meets the EERO size requirements.

New provisions in the 2015 IRC would permit the installation of the largest standard size window offered by the window manufacturer of the same operator type as that of the window being replaced, that will fit within the opening. And, this is even if the resulting clear opening provided does not meet the EERO size requirements. Windows of a different operating type could also be installed as long as the clear opening

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Energy Performance

Requirements for energy performance in both residential and commercial buildings are spelled out in the 2015 IECC. The energy conservation requirements for one- and two-family homes and townhouses three stories or less in height are also given in Chapter 11 of the 2015 IRC.

Beginning with the 2012 International Codes, the energy conservation provisions of Chapter 11 of the IRC are an exact duplicate of the provisions of the IECC for the same building. Previously, there was some variation in the energy performance requirements for residential buildings that were included in both the IECC and the IRC. In jurisdictions using the 2009 or earlier editions of these two codes, it is essential to verify which set of requirements are to be complied with for residential construction before beginning a project.

The residential provisions of the 2015 IECC apply to one- and two-family homes and other types of residential construction—such as multifamily buildings and assisted-living facilities—that are three stories or less in height. For these buildings, the residential provisions of the 2015 IECC govern if it has been adopted by the Authority Having Jurisdiction. (Other types of residential occupancies, such as multifamily buildings and assisted-living facilities greater than three stories in height, and hotels and motels of any height, are governed by the provisions of the 2015 IECC for commercial buildings.)

Compliance Paths

The most significant change in the residential provisions of the 2015 IECC has been the addition of a new compliance path, making a total of four for residential construction:

1. The prescriptive path,
2. The UA alternate method,
3. The whole building performance path, and
4. The Energy Rating Index path.

The prescriptive path is the simplest to use. It provides one set of energy efficiency requirements for each component of the building envelope.

Under the prescriptive path of the 2015 IECC for residential construction, there is no limit on the percentage of glazing in the exterior wall. There is also no limit on the percentage of roof area containing skylights.

The prescriptive path for residential construction establishes maximum permitted U-factor and solar heat gain coefficient requirements for fenestration. These values did not change between the 2012 and the 2015 editions of the IECC.

U-factor is to be determined in accordance with National Fenestration Rating Council 100-09 or by use of a default table in the 2015 IECC. Similarly, the SHGC of the fenestration is to be determined in accordance with NFRC 200-09 or by use of a default table. Figures 1 and 2 show the maximum permitted U-factor and SHGC for vertical fenestration and skylights in low-rise residential construction when the prescriptive path of the 2015 IECC and 2015 IRC is used.

The other three compliance paths for residential construction in the 2015 IECC permit some tradeoffs in levels of energy efficiency from one building component to another. One of these—designated the UA alternate method—only permits tradeoffs between different elements of the building envelope.

The whole building performance path permits tradeoffs between some components of the residence that impact energy use. The ability to trade off a more efficient mechanical system for other components of the building, however, is not included

in the list of those permitted in the 2015 IECC. This change from previous editions removed a significant incentive for builders to install more efficient mechanical systems than what is currently required by federal law.

Beyond this, the amount of tradeoff that is permitted for fenestration when following the UA alternate method or whole building performance paths also continues to be capped in the 2015 IECC. The performance caps are as follows:

- In the Northern climate zones 6 to 8 (roughly corresponding with Wisconsin to Alaska), the U-factor is not to exceed 0.40.
- In mid-level climates zones 4 and 5 (Northern Tennessee to Southern Wisconsin), the U-factor is not to exceed 0.48.
- In Southern climate zones 1 to 3 (Tennessee on south to the tip of Florida), there is no U-factor cap, but the SHGC is not to exceed 0.50.
- The U-factor of skylights in climate zones 4 to 8 is not to exceed 0.75. The same SHGC cap of 0.50 that applies to vertical fenestration in climate zones 1 to 3 also applies to skylights.

Exterior Glass Doors

The U-factor requirements discussed above for vertical fenestration also apply to exterior glass doors. Glass doors, by definition in the IECC, are considered to be those which are more than 50 percent glass in area. If the door is equal to or less than 50 percent glass, it is considered to be an opaque door. Although opaque doors are included in the definition of fenestration area in the 2015 IECC and 2015 IRC, they are assigned a maximum U-factor of 0.35, separate from the U-factor requirements for vertical fenestration.

According to Table R303.1.3(2) of the 2015 IECC, this criterion is considered to be met by any insulated, nonmetal edge opaque door with glazing less than 45 percent of the door area, when any glazing that does occur in the door is double pane. Also, one opaque door up to 24 square feet in area is exempt from the maximum U-factor requirement in the 2015 IECC and 2015 IRC.

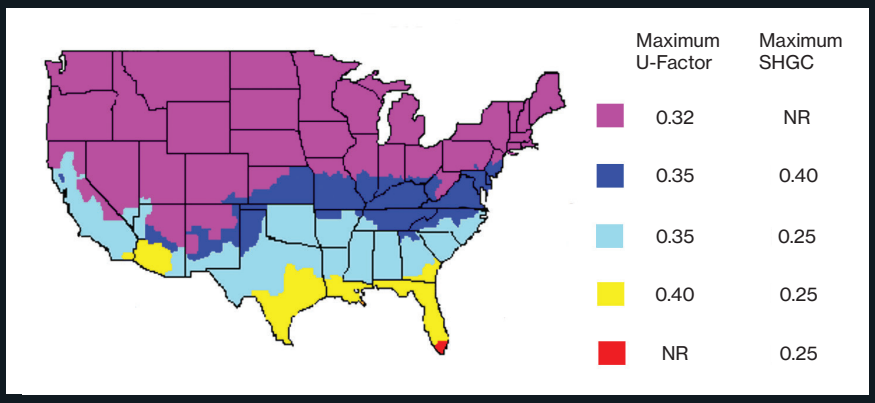

Figure 1 (above): Residential U-factor and SHGC for fenestration: prescriptive path of the 2015 IECC.

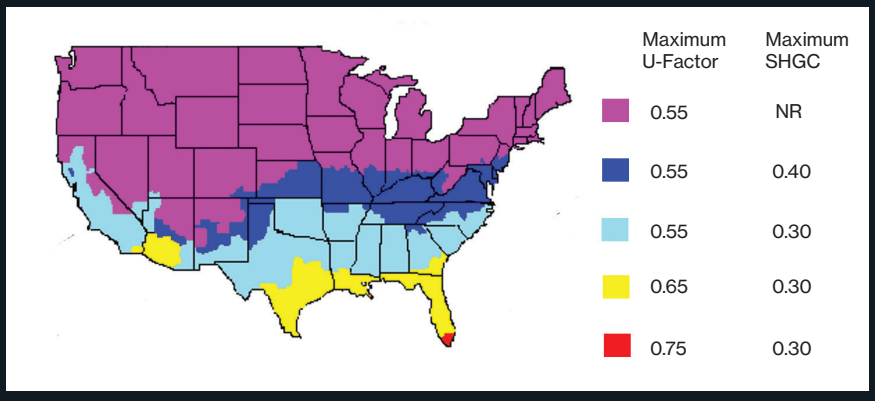

Figure 2 (above): Residential U-factor and SHGC for skylights: prescriptive path of the 2015 IECC.

The New ERI Path

The new Energy Rating Index path in the 2015 IECC compares the anticipated energy usage of the proposed residence to that of one built under the 2006 IECC. The 2015 IECC requires residences built using this compliance path to not consume more than 51 to 54 percent of the energy used for a similar size home built under the 2006 IECC, based upon location of the residence.

Although similar in concept to the whole-building performance path, there are a few key differences. Specifically:

- Use of the Energy Rating Index compliance path requires third-party verification of compliance.
- Although some trade off of U-factor and SHGC is permitted when using the ERI compliance path, both are limited to no greater than that permitted for the prescriptive path in the 2009 IECC. As a general rule, these caps are more stringent than the maximum U-factor and SHGC permitted when the whole building performance path or UA alternate method of the 2015 IRC are used.

Air Leakage

The 2015 IECC and IRC require air leakage resistance of windows, door assemblies and unit skylights to be determined in accordance with NAFS-11 or NFRC 400-09. This is similar to the requirements in the 2012 IECC and IRC.

The pass/fail criterion for windows, skylights and sliding glass doors is 0.3 cfm per square foot. The pass/fail criterion for swinging doors is 0.5 cfm per square foot. ■

they provide is equal to or greater than that which would be provided by installing windows of the same operator type.

Sunroom Additions

The 2015 IECC permits glazing in thermally isolated sunrooms to have a maximum U-factor of 0.45 in climate zones 2 to 8. By definition, a thermally isolated sunroom must be separated from the remainder of the building either by existing exterior wall construction or construction that meets the energy efficiency requirements of the 2015 IECC for exterior walls.

The sunroom must also be equipped with a separate heating or cooling system or thermostatically controlled as a separate zone, if conditioned. Previous editions of the IECC placed size restrictions on thermally isolated sunrooms but these restrictions do not occur in the 2015 IECC.

Sunrooms must be thermally isolated from the remainder of the home to take advantage of the higher permitted U-factor for fenestration. Under the 2015 IECC and IRC, sunrooms can be built as part of new construction, but they must still be thermally isolated from the remainder of the home, as discussed above, to use the U-factor of 0.45 in climate zone 2, 0.35 in climate zones 3 or 4, or 0.32 in climate zones 5 to 8.

Site-Built Windows

The 2015 IRC requires site-built windows to be tested for design pressure in accordance with ASTM E330.

Chapter 24 of the 2015 IBC references ASTM E1300-12AE1 for glass design, which addresses several types of glass layups and support combinations. Having it referenced in the 2015 IBC greatly enhances the designer's options in terms of providing glazed openings that can meet all the requirements of the code, including energy efficiency and impact resistance.

A previous provision, which requires glass to be designed by a registered design professional if the glass framing deflects more than L/175 or 3/4 of an inch, remains in the 2015 IBC. An exemption to this requirement continues to be given in Section 1709.5 for exterior windows and doors that are tested and labeled in accordance with NAFS-11.

Skylights and Sloped Glazing

The 2015 IRC has specific requirements for factory-built unit skylights:

- Factory-built unit skylights intended to be installed in a single roof opening without intermediate framing members are required to be tested and labeled for performance grade in accordance with NAFS-11.
- NAFS permits unit skylights to be evaluated for different positive and negative design pressures. This is unique to unit skylights, which are subject to snow load as well as wind and dead load. The combination of these loads will often result in varying required ratings for positive and negative pressures on unit skylights.
- The criteria for factory-built unit skylights also applies to Tubular Daylighting Devices.

The requirements for screening under skylights and sloped glazing, as set forth in Section R308.6.3 of the 2015 IRC, are consistent with previous editions of the International Codes. This includes requiring the screening to be securely fastened to the framing and to be able to support twice the dead weight of the glass.

Requirements for curbs on skylights and sloped glazing, when applicable, are also consistent with those in the previous editions of the International Codes and are set forth in Section R308.6.8 of the 2015 IRC.

Code Cycles

As noted at the outset, this article focuses on the requirements of the 2015 editions of the International Codes. Heading into 2017, it is anticipated that adoption of the 2015 IRC and IECC will accelerate. Adoption and enforcement of a new edition of a model construction code traditionally occurs most significantly in the second and third years after its publication.

Some states specifically opted to skip the 2012 edition of the International Codes and continue to use the 2009 or earlier edition until the 2015 edition became available. It is anticipated that, in a similar fashion, the 2012 International Codes will continue to be used by some jurisdictions until at least 2018 or later. This is why it is imperative that the code user verify the edition of the code being used in any specific jurisdiction prior to beginning a project there. ■

Testing and Labeling of Windows and Doors

Exterior windows and doors are covered in Section R609 of the 2015 IRC. This section requires windows and sliding doors to be tested and labeled in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11, North American Fenestration Standard/ Specification for windows, doors and skylights (NAFS-11).

The standard was developed jointly by the American Architectural Manufacturers Association, the Window & Door Manufacturers Association and the Canadian Standards Association. The complete document is available from all three organizations. Exterior side-hinged doors are to be tested and labeled in accordance with the same standard, or with AMD 100.

Other types of fenestration assemblies not included within the scope of NAFS-11, and exterior side hinged doors that have not been tested and labeled in accordance with that standard or AMD 100, are addressed in Section R609.5 of the 2015 IRC. These assemblies are to be tested in accordance with ASTM E330-02, and the glass is to be designed in accordance with ASTM E1300-12AE1.

Since 1962, AAMA has had a certification program based on the predecessor and current editions of NAFS. For doors, this program depends upon the testing of each proposed assembly, although waivers of retest can be requested for changes in equivalent components.

AMD 100 requires initial testing of the complete door assembly to certify that assembly. Depending on the type of component substituted, up to two substitutions can be made to an assembly without negating its certification under AMD 100.