NEW 2018 EDITION

International Code Requirements

FOR COMMERCIAL GLAZING SYSTEMS

Courtesy of the American Architectural Manufacturers Association

The I-codes, the family of codes published by the International Code Council (ICC), iccsafe.org, consist of several different codes that each address specific applications. Commercial buildings in the codes include all buildings except one- and two-family dwellings, townhouses and condominiums that are no more than three stories in height. The requirements for fenestration in commercial buildings are set forth in the International Building Code (IBC), the International Existing Building Code (IEBC) and the International Energy Conservation Code (IECC).

This article summarizes the major requirements for glazed assemblies, doors, skylights and other fenestration products in commercial buildings in the 2018 edition of the I-codes. The previous editions of I-codes were published in 2015. The following discussion of the 2018 I-codes requirements for commercial buildings emphasizes the changes between the 2015 and 2018 editions that are pertinent to fenestration and glazed installations in commercial buildings.

Recent changes

There are some significant changes between the 2015 and 2018 editions of the International Codes that relate to fenestration products in commercial buildings. Among the changes:

- The design wind speed maps were significantly revised, based upon similar changes from ASCE 7-10 to ASCE 7-16.
- Deflection limits for framing supporting glass in commercial glazing installations were clarified.
- Provisions to clarify the requirements for security locking systems on classroom doors in new schools were added.
- The number of Emergency Escape and Rescue Openings (EEROs) required from basement sleeping rooms in residential buildings that are equipped with a fire suppression system were reduced.
- Requirements that self-adhered membranes used as flashings of fenestration in wall assemblies comply with AAMA 711-16 and fluid applied membranes used as flashing for exterior wall openings comply with AAMA 714-15 were added.
- The use of NFPA 286-15 to test plastics for resistance to the spread of fire, in the shape actually intended for installation, is now permitted in the 2018 IBC. Previously plastic materials were required to be tested as a flat sheet in accordance with ASTM E84-13A, UL 723-08 or NFPA 701-10. Permitting the use of NFPA 286-15 is particularly significant for plastic domed skylights.

I-Code Adoption

The family of codes published by the International Code Council (ICC), iccsafe.org, is the most widely enforced set of construction codes in U.S. history. The members of this family are commonly referred to as the I-codes. The I-codes most pertinent to fenestration include the International Building Code (IBC), International Residential Code (IRC) and the International Energy Conservation Code (IECC).

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

The International Codes have also been adopted, and are being enforced, by several foreign entities:

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

Although adoption and enforcement of the I-codes is widespread, it is not necessarily uniform across the United States. Different jurisdictions are enforcing different editions of these codes, some with local amendments and some without. Although the 2018 editions of the IBC, IEBC and IECC are the most recent as of this writing, it is not yet being enforced. Manufacturers and dealers who sell products in several states should be aware that multiple editions of the I-codes are currently being enforced across the country.

According to the ICC website, as of fall 2017:

IBC

- The 2015 IBC is being enforced in at least 13 states
- The 2012 IBC is being enforced in 25 states and one U.S. territory
- The 2009 IBC is being enforced in nine states and three U.S. territories.

IRC

- The 2015 IRC is being enforced in at least 12 states
- The 2012 IRC is being enforced either locally or statewide in 20 states and one U.S. territory
- The 2009 IRC is being enforced either locally or statewide in 13 states and two U.S. territories
- Only one state (Wisconsin) continues to rely upon its own, state developed residential code.

All of the remaining states are either enforcing an earlier edition of the IBC and IRC, or these codes are being enforced locally rather than statewide.

IECC

- The 2015 IECC is being enforced in at least eight states
- The 2012 IECC is being enforced in 20 states
- The 2009 IECC is being enforced in 18 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.

It is anticipated that in 2018 many jurisdictions will be reviewing the 2018 I-codes for possible adoption. 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. A few jurisdictions, however, usually adopt them more quickly, often with few amendments. While others will adopt more slowly, sometimes with amendments. And still others may wait until the 2021 I-codes are published to update their codes.

Manufacturers may start to see the changes discussed in this article being enforced within the next year, but that enforcement is likely to be spotty and somewhat localized. It is imperative that the code user verify and review the edition of the code being used, as well as applicable local amendments, in any specific jurisdiction prior to beginning a project there.

The reader is encouraged to: first, verify the edition and any amendments adopted by a particular jurisdiction; and second, consult the relevant edition of the I-codes with subsequent local amendments for complete information prior to beginning a project.

The ICC website, iccsafe.org, offers updated information on which I-code editions are in effect in each state, as well as in various cities and counties. Members of the American Architectural Manufacturers Association can find further information at aamanet.org/StateCodes by logging into the AAMA website.

Some jurisdiction-specific versions of the International Codes can be obtained from the ICC, while others must be obtained directly from that particular jurisdiction. Contact information for ICC and other organizations mentioned in this article can be found in the Glass Magazine Association Directory.

Online: Visit GlassMagazine.com/JanFeb2018 for:

- More in-depth articles discussing individual updates to the 2018 I-codes, from Julie Ruth, AAMA code representative
- A copy of the Glass Magazine Association Directory.

- The maximum prescriptive Solar Heat Gain Coefficients (SHGC) for commercial fenestration were reduced slightly in Climate Zones 3 to 5 of the 2018 IECC.
- The percentage of roof area permitted to be skylight under the Prescriptive Path for commercial buildings was increased from 5 percent to 6 percent in the 2018 IECC.

Testing and labeling of windows, doors and skylights

Exterior windows and doors are covered in Section 1709.5.1 of the 2018 IBC. This section requires windows and sliding doors to be tested and labeled in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-17, North American Fenestration Standard/Specification for windows, doors, and skylights, also known as NAFS-17. The standard was developed jointly by the American Architectural Manufacturers Association, aamanet.org, the Window & Door Manufacturers Association, wdma.com, and the Canadian Standards Association, csagroup.org. (The complete document and more information are available from all three organizations.)

The 2017 edition of the joint standard applies to windows and sliding doors in the 2018 IBC. Other types of fenestration assemblies not included within the scope of NAFS-17, including curtain wall and storefront, are addressed in Section 1709.5.2 of the 2018 IBC. These assemblies are to be tested to 1.5 times Allowable Stress Design Wind Load in accordance with ASTM E330/E330M-14, and the glass is to be designed in accordance with ASTM E1300-12AE01.

New in the 2018 IBC are provisions that clarify the framing deflection requirements for glazed assemblies that are not tested and labeled in accordance with NAFS. These new provisions are based upon AAMA TIR A11-15 Max. Allowable Deflection of Framing Systems for Building Cladding Components at Design Wind Loads. Framing members supporting glass that are less than 13 feet 6 inches in length are not to deflect more than $1/175$ of the length of span of the framing member. The deflection limit for longer framing members is $1/4$ inch + $1/240$ of the length of span of the framing member.

Exterior swinging doors can be tested and labeled in accordance with NAFS-17 or tested to 1.5 times Allowable Stress Design Wind Load in accordance with ASTM E330/E330M-14. The 2018 IBC also permits garage doors to be tested to ANSI/DASMA 108-17 in lieu of ASTM E330.

NAFS-17 contains provisions for some types of exterior swinging doors. AAMA has a program to certify these types of products for compliance with NAFS-17. This program depends upon testing of each proposed door assembly, rather than the component based approach offered by ANSI A250.13 and other related standards.

Unit skylights are also required to be tested and labeled in accordance with NAFS-17 by the 2018 IBC. Unit skylights are factory manufactured fenestration assemblies intended to be installed in a single roof opening without intermediate framing members. Tubular Daylighting Devices are included within the definition of unit skylights in the 2018 IBC.

The requirements for skylights and sloped glazing are in Section 2405 of the 2018 IBC. Section 2405.5 permits unit skylights to be evaluated for different positive and negative design pressures, which is unique to unit skylights. Skylights are subject to snow load, as well as wind load and dead load. The combination of these loads will often result in varying required ratings for positive and negative pressures on unit skylights.

The 2018 IBC requires exterior wall cladding systems, including curtain wall, storefront and punched openings, in high wind areas to be subject to special inspections. The high wind areas are determined by exposure category of the building. If the building is in Exposure Category B (surrounded by low- to mid-rise buildings), then special inspection is required if the Allowable Stress Design wind speed is 120 miles per hour or greater (Ultimate Design wind speed is 155 mph or greater). Buildings in Exposure Category C (open prairies) or D (near large bodies of water) require special inspection if the Allowable Stress Design wind speed is 110 mph or greater (Ultimate Design wind speed is 142 mph or greater).

As a general rule, wind speeds high enough to require special inspections occur primarily along the Alaskan, Eastern and Gulf Coasts. There are a few isolated areas in certain mountainous regions of the United States that may also experience wind speeds this great. However, overall, the requirements for special inspection of exterior wall cladding systems only apply in rather limited areas and are not common throughout most of the United States.

When special inspections are indicated, they are only required for the part of the system design that requires a registered design professional. For example, if special inspections are required for a curtain wall system in a jurisdiction that only requires a registered structural design professional for the design of the system, the special inspection would only be required for the structural components of the system, such as the framing members, anchorage, joinery, etc.

Design Loads. Provisions for design loads are set forth in Chapter 16 of the 2018 IBC. 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. The design wind loads for components of the building envelope are to be calculated by the engineer of record for the project. The calculations are to be 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.

Significant changes to the wind load

provisions occurred between the 2015 and 2018 editions of the IBC.

These changes follow on the heels of changes that occurred between the 2009 and 2012 editions of the IBC. Due to these changes, it is imperative that the glazing contractor or builder be familiar not just with the specified wind loads on a project, but also with the edition of the IBC or American Society of Civil Engineers (ASCE) 7 that the rating is based upon.

The first change occurred between the 2009 IBC and the 2012 IBC, when the methodology used to calculate design wind loads (pressure) was changed from Allowable Stress Design to Strength Design. This change initially occurred between the 2005 and 2010 editions of the ASCE 7, Minimum Design Loads for Buildings.

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.

It is important to be aware, however, that the standards 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 2015 editions of the IBC and IRC contain provisions to multiply the new, higher Strength Design Wind Load by a factor of 0.6 for the purpose of conversion and comparison to the Allowable Stress Design Pressure ratings provided by our industry standards. In most cases, this conversion results in required design pressure ratings for fenestration that are roughly comparable to the more traditionally determined Allowable Stress Design values.

Therefore, the design wind loads obtained from the 2018 IBC 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 or NAFS-17. This is also true for design wind loads obtained from the 2012 or 2015 IBC.

This 0.6 factor is not to be applied when the design wind loads are obtained from the 2009 or earlier editions of the IBC.

AAMA, WDMA, Fenestration Manufacturers Association, fmausaonline.org, and Door & Access Systems Manufacturers Association International, dasma.com, published a technical bulletin (TB 11-1) on this topic. This bulletin can be downloaded from the AAMA online store, aamanet.org/store.

Additional changes occurred between the 2010 and 2015 editions of ASCE 7 that effect design wind loads in the 2018 IBC. In most of the central United States, the design wind speeds were reduced from the 2010 edition of ASCE 7 to the 2015 edition. Design wind speeds are used to calculate the design wind loads.

For vertical glazing, this reduction in design wind speed results in a reduction in design wind loads. For skylights and sloped glazing, however, other factors used to calculate design wind loads were increased. In some cases, this increase results in a higher design wind load.

This increase in design wind load was not brought into the 2018 IRC for homes that are built according to its prescriptive provisions. Therefore, they apply to all buildings built in accordance with the 2018 I-codes, except for homes three stories or less in height that are built according to the 2018 IRC using conventional balloon construction of wood or steel light framing, concrete, masonry or structural insulated panels, in geographical locations with design wind speeds less than 130 mph. These homes can still be built to the 2010 edition of ASCE 7, in accordance with the 2018 IRC.

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 of which set of provisions are being used to determine the design wind loads for the building. They need to determine whether the 0.6 conversion factor is appropriate or not, and whether it is being built under the prescriptive provisions of the IRC or not if for a single family home.

Dead Loads. The provisions for dead load in Section 1606 of the 2018 IBC are also based on ASCE 7-16. There are no significant changes to the dead load requirements for fenestration between the 2015 and 2018 editions of the IBC.

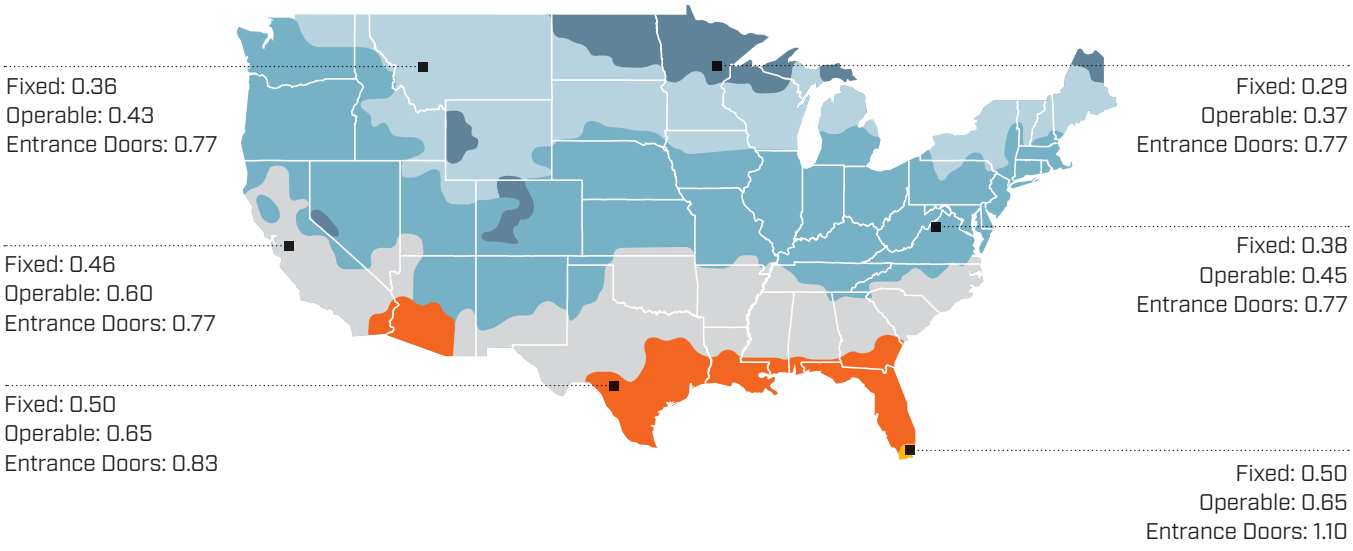
Impact Resistance. Section 1609.2 of the 2018 IBC outlines the locations where impact-resistant products are required. All exterior openings in wind-borne debris areas are required to be impact resistant in the 2018 IBC.

Determination of wind-borne debris areas in the 2018 IBC are similar to those given in ASCE 7-16 and are primarily defined by design wind speed. For most of the United States, these did not change from ASCE 7-05, but there are a few exceptions.

When the change from Allowable Stress Design to Strength Design occurred between ASCE 7-05 and ASCE 7-10, the previously used single design wind speed map for the United States was replaced by three separate maps. One map is specifically for buildings considered to be "essential facilities," such as hospitals, police stations and fire stations. They are to be designed to higher design wind speeds than buildings whose failure is considered to be a moderate or low threat to human life.

This differentiation of the maps results in some areas being considered wind-borne debris areas for buildings such as essential facilities, but not for moderate or low hazard buildings. In other words, in some parts of the country, impact resistant openings will be required for hospitals, police and fire stations, but not for office buildings, retail stores or storage facilities. These areas occur predominately in the Southeast United States. Those selling fenestration products in these areas

Fig. 1 — **Maximum U-factor permitted for vertical fenestration in commercial buildings under the prescriptive provisions of the 2018 IECC.**



need to be aware of this distinction and how it applies to their market.

Products that need to meet impact resistance requirements must be tested to one of two sets of standards. One option is testing in accordance with ASTM E1886-13A and ASTM E1996-14A, which must be used together. The 2018 IBC also permits the use of "other approved tests." This may include Miami-Dade County test protocols, if approved by the code official.

Energy

Requirements for energy performance in both residential and commercial buildings are spelled out in the International Energy Conservation Code. Commercial buildings that comply with ASHRAE 90.1-16 are also considered to be in compliance with the 2018 IECC.

The 2018 IECC and ASHRAE 90.1-16 have similar formats. They both address the building envelope, mechanical systems of the building, lighting and hot water systems. Although the specific requirements for each of these systems differ between the two standards, they are considered to be very close with regards to the actual anticipated energy use of a commercial building built under either standard.

The 2018 IECC has two compliance paths for commercial construction. One available path of compliance is the Prescriptive Path. The second is the Total Building Performance Path.

The Prescriptive Path is the simplest to use. It provides one set of energy efficiency requirements for each component of the building envelope. With regards to fenestration, it establishes maximum permitted U-factors and Solar Heat Gain Coefficients. U-factor is to be determined in accordance with NFRC 100-17 or by use of a default table in the 2018 IECC. Similarly, the SHGC of the fenestration is to be determined in accordance with NFRC 200-17 or by use of a default table in the 2018 IECC.

The maximum prescriptive U-factors for vertical fenestration and skylights in commercial buildings did not change between the 2015 and 2018 IECC. The maximum U-factors are based upon whether the fenestration is fixed, operable or an entrance door. The 2018 IECC maximum prescriptive U-factors are shown in Figure 1, above, and Figure 2, on page 54.

The 2018 IECC also limits the maximum prescriptive SHGC of fenestration in commercial buildings. The maximum permitted SHGC is based upon Climate Zone, orientation of the glazing and the projection factor of overhanging projections, if any.

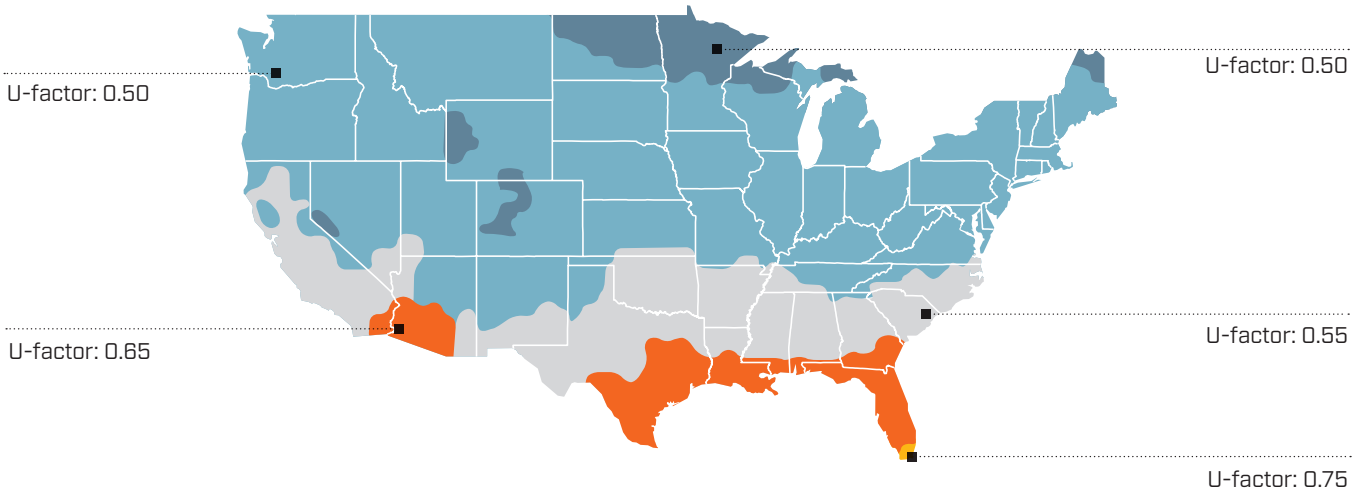
Figure 3, on page 56, shows the base maximum prescriptive SHGC for each Climate Zone. The base maximum SHGC is to be used if:

1. There are either no overhanging projections over the fenestration or the width of any overhang is less than one-fifth of the height of the fenestration from its sill to the underside of the overhanging projection. In this case, the fenestration is considered to have a Projection Factor (PF) of < 0.20 (PF = width of projection/height of fenestration from sill of fenestration to underside of projection).

2. The fenestration is oriented to the south, or within 45 degrees of true east or west towards the south.

In the 2015 IECC, the base prescriptive SHGC for Climate Zones 3-5 was 0.40.

Fig. 2 — **Maximum U-factor permitted for skylights under the prescriptive provisions of commercial buildings in the 2018 IECC.**



In the 2018 IECC, it has been reduced to 0.36 in Climate Zone 3 and 0.38 in Climate Zone 4, to provide a more gradual transition from one Climate Zone to the next.

The 2018 IECC provides variations of the maximum permitted prescriptive SHGC based upon both the presence and width of overhanging projections and the orientation of the fenestration itself.

The maximum prescriptive SHGC is permitted to be increased if a permanent overhang with PF > 0.20 is provided, or if the fenestration is oriented within 45 degrees of true north.

Table 1, on page 56, indicates the maximum permitted prescriptive SHGC in the 2018 IECC, based upon Climate zone, PF and orientation. Note there is no restriction (NR) on the prescriptive SHGC in Climate Zones 7 and 8 if the PF exceeds 0.2, or if the glazing is oriented within 45 degrees of true north.

The slight change from the 2015 IECC to the 2018 IECC in base prescriptive SHGC in Climate Zones 4 and 5 is carried over to the applicable values based upon PF and orientation in those climate zones. The changes to prescriptive SHGC in Climate Zones 4 and 5 are the only changes to fenestration SHGC from the 2015 IECC to the 2018 IECC.

Use of the Prescriptive Path in commercial buildings is limited to buildings where the vertical glazing and skylight area do not exceed certain limits. These limits are dependent upon whether or not automatic daylighting controls are provided in the daylight areas of the building. These controls reduce the artificial lighting load when daylighting is provided to a room or space. Combining automatic daylighting controls with well-placed fenestration having high transmittance of light allows fenestration to positively impact the overall energy use of the building by reducing the lighting load during daylight hours. Transmittance of light is measured as Visible Transmittance (VT), in accordance with NFRC 200-17.

If a building is equipped with automatic daylighting controls, having at least 50 percent of the conditioned floor area in a daylight zone and glazing with a VT/SHGC ratio greater than 1.1, then 40 percent of the above grade wall area is permitted to be fenestration area. If this criterion is not met, then the fenestration area is limited to 30 percent of the above grade wall area. Those parts of exterior walls not included in the calculation of the Window to Wall Ratio (WWR) must meet the requirements of the 2018 IECC for opaque walls. For example, in order for those parts of a curtain wall system glazed with opaque glass to be excluded in the calculation of the WWR, they must be insulated as required for other metal framed opaque walls in the building's exterior envelope.

Up to 6 percent of the roof area is permitted to be skylights where a building is equipped with automatic daylighting controls. Similar to vertical glazing, if the building does not have automatic daylighting controls, the area permitted to be skylights is reduced to 3 percent of the roof area.

The 2018 IECC also contains requirements for minimum daylighting. These provisions require at least half the floor area be toplit or sidelit where spaces larger than 2,500 square feet have ceilings in excess of 15 feet and are used for offices, lobbies, atriums, concourses, corridors, storage areas, gymnasiums/exercise centers, convention centers, automotive service

Fig. 3 — **Maximum base prescriptive SHGC for vertical fenestration and skylights in the 2018 IECC.**

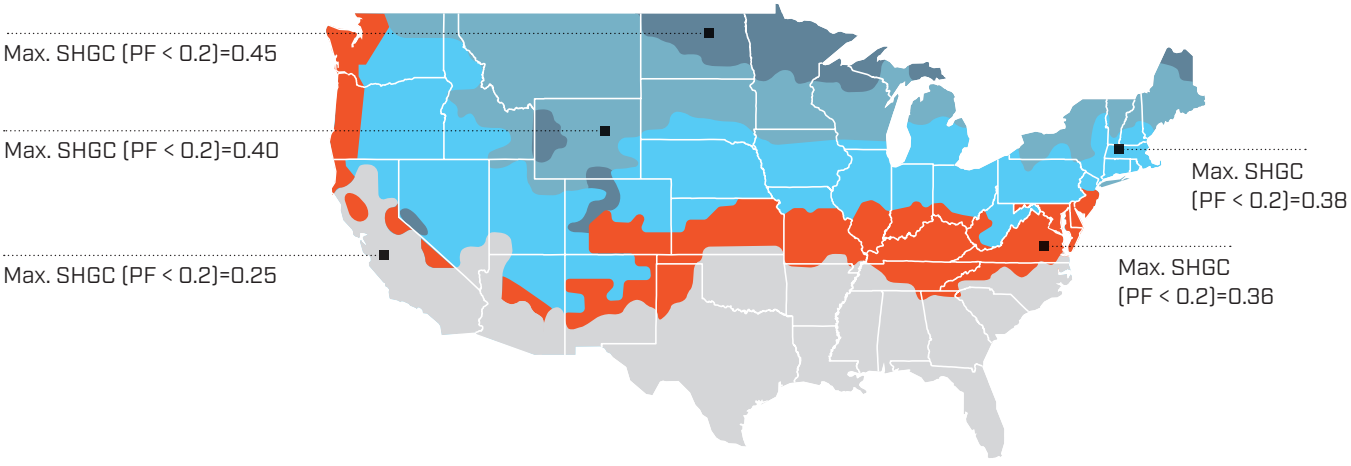


Table 1 — **Maximum permitted prescriptive SHGC for fenestration in the 2018 IECC.**

Climate Zones	1-3		4		5		6		7 & 8	
Orientation	South, East & West	North	South, East & West	North	South, East & West	North	South, East & West	North	South, East & West	North
PF < 0.2	0.25	0.33	0.36	0.48	0.38	0.51	0.40	0.63	0.45	NR
0.2 < PF < 0.5	0.30	0.37	0.46	0.53	0.46	0.56	0.48	0.58	NR	NR
PF > 0.5	0.40	0.40	0.58	0.58	0.61	0.61	0.64	0.64	NR	NR

centers, manufacturing areas, non-refrigerated warehouses, retail stores, distribution/sorting areas, transportation areas and workshops. The 2018 IECC requires all of the daylighting requirements to be met by either toplighting or sidelighting. It does not include provisions to permit a combination of both toplighting and sidelighting to meet the requirements.

The 2018 IECC requires air leakage resistance of windows, door assemblies and unit skylights to be determined in accordance with NAFS-17 or NFRC 400-17. The 2018 IECC also requires air leakage resistance of curtain wall, storefront glazing and commercial doors to be determined in accordance with ASTM E283-04 (2012).

For some applications, the air leakage criteria for windows, sliding and swinging doors and unit skylights in the 2018 IECC is more stringent than that of NAFS-17. Specifically, the maximum air leakage rate permitted for windows, sliding and swinging doors and unit skylights without condensation weepage openings in the 2018 IECC is 0.2 cubic foot per minute per square foot when tested at 1.57 pounds per square foot. The maximum air leakage rate permitted by NAFS for some Performance Classes of fenestration is 0.3 cfm/sq. ft. when tested at the same pressure. The 2018 IECC also permits an air leakage rate of 0.3 cfm/sq. ft. for these products, when tested at 6.24 psf.

At 0.06 cfm/sq. ft. the maximum air leakage rate permitted for curtain wall and storefront is significantly more stringent than that permitted for windows and sliding and swinging doors, while the rate of 1.0 cfm/sq. ft. permitted for commercial sliding doors and power operated doors is much less stringent.

The 2018 IECC includes a variation of the Prescriptive Path called the Assembly U-factor, C-factor or F-factor Based Method. This Method permits some tradeoffs between the U-, C-, and F-factors of various components of the building envelope and glazed area (both vertical glazing and skylights). The U-factor pertains to opaque walls, roofs and fenestration. The C-factor pertains to below grade walls. The F-factor pertains to the perimeter of slab-on-grade floors.

The Assembly U-factor, C-factor or

F-factor Based Method permits one component of the building envelope to not comply with the prescriptive criteria for it, when compensation for that noncompliance is made up by another component of the building envelope. The noncompliance can be with regard to the prescriptive U-factor, C-factor or F-factor, or the area of the component. For example, an increase in permitted vertical fenestration area can be obtained by increasing the insulation provided to slab-on-grade floors or below grade walls.

Although the Assembly U-factor, C-factor or F-factor Based Method was new to the 2015 IECC, it had previously been used successfully in some U.S. jurisdictions. It was retained without changes to the fenestration provisions in the 2018 IECC.

Emergency escape and rescue openings

The 2018 IBC requires emergency escape and rescue openings (EEROs) in sleeping rooms below the fourth floor of a building, and in all basements. The 2015 IBC gave exceptions for rooms in buildings that are fully equipped with a fire sprinkler system, rooms that open directly to a corridor that leads to an exit in two directions, and basements less than 200 square feet used only to house mechanical equipment. These were retained in the 2018 IBC. A new exception occurs in the 2018 IBC that permits the omission of one or more EEROs from sleeping rooms in basements of single family homes, duplexes, townhouses and group homes, such as sororities and fraternities, when the entire building is equipped with a residential (NFPA 13R or 13D) fire sprinkler system and the basement either has two means of egress, or one means of egress and one EERO.

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

The requirements for sizes, locations, etc., are set forth in Section 1030 of the 2018 IBC. 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.

Minimum window sill heights

The 2018 IBC contains requirements for minimum sill heights for operable windows in apartments, townhouses, duplexes and single-family homes. Section 1015.8 requires the bottom of openings created by these windows to be a minimum of 36 inches above the adjacent interior floor when they are 72 inches or more above grade.

There are multiple exceptions, however, to this requirement. The minimum sill height does not apply to windows that do not open more than 4 inches or that are equipped with window guards that comply with ASTM F2006-17 or ASTM F2090-17 or window opening control devices (WOCDs) that comply with ASTM F2090-17. WOCDs must limit the initial opening of the window to no more than four inches, and must also be releasable with no more than 15 pounds of force so that these kinds of windows can be used to meet the EERO requirements of the 2018 IBC.

Means of egress doors

Section 1010.1.5 of the 2018 IBC restricts the threshold height of the required exit door in residences and dwelling units to ¾ inch for sliding doors and ½ inch for other doors, as measured from the top of the threshold to the floor or landing on each side of the door. The rise from floor or landing to the top of the threshold at other exterior doors in multi-family or low rise, residential occupancies that are not required to be accessible or which do not provide access to a Type A or Type B unit are permitted to be up to 7¾ inches by Section 1010.1.7. This is the same height as that permitted for the riser height for stairs. Exterior living spaces such as decks or balconies that serve Type B units require the same threshold heights as exit doors.

It should be noted, however, that all dwelling units in a multi-family building that has more than four dwelling units, and all sleeping units in hotels or motels that have more than four sleeping units, must be Type B units. Furthermore, the U.S. Access Board has ruled that if there is an exterior living area that serves that unit, it must also meet the criteria for a Type B unit. This applies to the door between the exterior living space, such as a deck or balcony, and the interior space. Therefore, the provision that permits a threshold height of up to 7 ¾ inches often does not apply to exterior balcony doors serving residential spaces, such as apartments or hotel sleeping rooms.

The 2018 IBC permits a step down of up to 4 inches from an interior Type B space to an exterior deck or balcony serving that space. The threshold of a door between those two spaces is permitted to be up to 4 ½ inches for swinging doors or 4 ¾ inches for sliding doors, as long as it is not more than ½ or ¾ inch, respectively, above the interior floor. If the difference between the top of the threshold and the top of the floor on the interior side is greater than ¼ inch, then the floor level change must be beveled with a slope of not greater than one unit vertical for every two units horizontal.

New provisions in the 2018 IBC clarify the requirements for security locking systems on classroom doors in schools intended to serve students from kindergarten through adult education. Security locking systems are not required on classroom doors, but if they are provided they must meet the following criteria:

- The door can be unlocked from outside the classroom by use of a key or other approved means. This permits a school official, fire

fighter, emergency medical personnel or other authorized personnel to enter the classroom, if needed.

- The door can be unlocked from inside the classroom, without requiring the use of a key, tool or special knowledge (such as a lock combination).
- Installation of the security locking system does not require any modifications to hardware that is required on the door to facilitate occupants from exiting the classroom (panic hardware and door closer), or maintaining a fire separation between the corridor and the classroom (listed fire door hardware).

Window installation

Section 1404.4 of the 2018 IBC requires flashing to be installed at the perimeters of exterior door and window assemblies "in such a manner as to prevent moisture from entering the wall or to redirect it to the exterior." Although previous editions of the IBC did not reference any standards for flashing, the 2018 IBC specifies that self-adhered membranes shall comply with AAMA 711-16, if used as flashing of fenestration in wall assemblies. Where fluid applied membranes are used as flashing for exterior wall openings, those fluid applied membrane flashings shall comply with AAMA 714-15.

Safety glazing

Section 2406.4 of the 2018 IBC establishes the locations where safety glazing is required. They include the following:

- Glazing in and near swinging and sliding doors
- Large lites of glass (more than nine square feet) near walkways
- Glazing around tubs, showers, pools and similar fixtures
- Glazing near stairways, ramps and the landings for both.

In these applications, the glazing must be labeled per the Consumer Product Safety Commission CPSC 16 CFR Part 1201 - 02 requirements. There are some exceptions for applications that are considered less hazardous, such as very small openings (less than three inches in diameter) in doors, decorative glass and glazing provided with a protective bar, etc.

The 2018 IBC defines additional hazardous locations, beyond those defined by CPSC 16 CFR Part 1201. These locations include tub and shower enclosures, door sidelites, large lites of glass and glazing near stairs, ramps and pools. The 2018 IBC permits the use of glass that meets the two most stringent categories of ANSI Z97.1-15, or CPSC 16 CFR Part 1201, in these locations.

The criteria for the two most stringent categories of ANSI Z97.1 are similar to CPSC 16 CFR 1201 for these applications, but ANSI Z97.1 was last updated in 2015, while CPSC 16 CFR 1201 was last updated in 2016.

The defined hazardous locations did not change significantly between the 2015 International Codes and the 2018 International Codes.

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, with one exception.

The 2018 IBC contains special provisions for the installation of replacement windows in openings where Emergency Escape and Rescue Openings are required. In some cases, the opening is not large enough to accommodate an operable window that meets the size requirements. In those cases, an alternate size operable window can be installed, as long as it meets the following criteria:

1. The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening.
2. The replacement window is the same operating style as the existing window or a style that provides for an equal or greater window opening area than the existing window.
3. The replacement window is not part of a change of occupancy.

The 2018 IECC requires 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.

Glass design

Chapter 24 of the 2018 IBC references ASTM E1300-2012AE01 for glass design, which addresses several types of glass layups and support combinations. Having it referenced in the 2018 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.

If the framing supporting the glass deflects 1/175 of the length of the edge of glass being supported, or ¾ inch or more, the 2018 IBC requires the glass to be designed by a registered design professional. An exemption to this requirement is given in Section 1709.5.1 of the 2018 IBC for exterior windows and doors that are tested and labeled in accordance with NAFS-17.

Skylights and sloped glazing

The 2018 IBC has different requirements for factory-built unit skylights than for other types of glazed assemblies in roofs such as skylights and sloped glazing. Factory built unit

skylights that contain only one panel of glazing material are required to be tested and labeled for performance grade in accordance with NAFS-17 in the 2018 IBC. Section 2405.5 of the 2018 IBC establishes the required performance-grade rating for wind, snow and dead loads.

As for vertical glass, glass in sloped glazing is to be designed in accordance with ASTM E1300-2012AE01. The requirements for screening under skylights and sloped glazing, as set forth in Section 2405.3 of the 2018 IBC are consistent with previous editions of the International Codes. Screening must be securely fastened to the framing and 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 2405.4 of the 2018 IBC.

Code cycles

Typically, the greatest rate of adoption and enforcement of a new edition of the International Codes occurs in the second and third year after publication. Some states specifically choose to update the edition of the model code they are enforcing every six years instead of every three, so they may skip adoption of the 2018 editions entirely and wait until the 2021 editions become available.

Although we can expect to see some enforcement of the 2018 I-codes in 2018, it is anticipated that the predominant codes being enforced will remain the 2012 and 2015 editions of the I-codes. This inconsistency makes achieving code compliance for fenestration products a challenge, particularly for those manufacturers who offer products over several states or nationwide. The reader is therefore encouraged to verify the applicable code edition and amendments in place at the outset of a project.