

EC96–09/10
402.5; IRC N1102.3.6 (New)

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THIS IS A 2 PART CODE CHANGE. PART I WILL BE HEARD BY THE IECC COMMITTEE. PART II WILL BE HEARD BY THE IRC BUILDING/ENERGY COMMITTEE. SEE THE TENTATIVE HEARING ORDERS FOR THESE COMMITTEES.

PART I – IECC

Revise as follows:

402.5 Maximum fenestration U-factor and SHGC (Mandatory). The area-weighted average ~~maximum fenestration~~ U-factor permitted for fenestration products when complying with this code using trade offs under from Section 402.1.4 or Section 405 shall not exceed ~~be 0.48 in zones 4 and 5 and 0.40 in zones 6 4 through 8~~ for vertical fenestration, and 0.75 in zones 4 through 8 for skylights. The area-weighted average ~~maximum fenestration~~ SHGC permitted for fenestration products when complying with this code using trade-offs from Section 405 in Zones 1 through 3 shall not exceed ~~be 0.450~~.

PART II – IRC BUILDING/ENERGY

Add new text as follows:

N1102.3.6 Maximum fenestration U-factor and SHGC. The area-weighted average U-factor permitted for fenestration products when complying with this code using trade offs under Section N1102.1.3 or Section 405 of the IECC shall not exceed 0.40 in zones 4 through 8 for vertical fenestration, and 0.75 in zones 4 through 8 for skylights. The area-weighted average SHGC permitted for fenestration products when complying with this code using trade-offs from Section 405 in Zones 1 through 3 shall not exceed 0.45.

Reason: This proposal updates the fenestration U-factor and SHGC trade-off limits in the *IECC* to reflect the reductions in prescriptive U-factors and SHGCs in the *2009 IECC* and *IRC* and to ensure that effective, efficient glazing is being installed in all eight climate zones. The proposal also makes editorial changes to the language of this section to clarify the operation of the caps in response to criticisms from opponents to the caps in previous code cycles that the language was difficult to understand and/or confusing. Finally, it is proposed that this provision also be added to chapter 11 of the *IRC*, making the two codes consistent in this area.

Turning to the proposed changes in the requirements, this proposal replaces the 0.48 cap for climate zones 4-5 with the same 0.40 U-factor already applicable to zones 6-8. This change reflects the prescriptive U-factor changes last cycle, where a 0.35 U-factor is now the prescriptive requirement across all of these climate zones. Similarly, following the reduction in maximum SHGC in climate zones 1-3 from 0.40 in the *2006 IECC* to 0.30 SHGC in the *2009 IECC* and 0.35 in the *2009 IRC*, this proposal reduces the maximum value from 0.50 SHGC to 0.45 SHGC.

The fenestration trade-off limits currently found in Section 402.5 of the *2009 IECC* are simple, mandatory measures that ensure all new homes contain high-quality, cost-effective windows that save energy, provide reasonable comfort, resist condensation in colder climates and block unwanted solar gain in warmer climates. Without the protection of Section 402.5, fenestration values could be traded away to levels unacceptable in modern building practice. Given the improvements to window efficiency brought about by the *2009 IECC* and the *2009 IRC* and our nation's high priority for energy efficiency, this proposal is a common-sense update to an effective code requirement.

Compliance is simple. The current fenestration maximums are effective and easy to understand. These requirements have been successfully applied for the past few years. All states that have already adopted the 2004, 2006, and 2009 *IECC* have adopted these maximums without amendment. They are also already seamlessly built into compliance software such as the Department of Energy's REScheck. Compliance could not be simpler.

The standard is flexible. The area-weighted average approach embodied in Section 402.5 allows considerable flexibility for builders to install decorative glass, glass block, and other fenestration products, while maintaining a baseline performance for the home's overall glazing. In short, not all products are required to individually meet the maximum values; only the area-weighted average of all products in the home is required to meet the maximum values specified in this code provision. Thus, there is substantial room and flexibility for the builder to utilize products that are exceptions. For example, with the 0.45 proposed SHGC limit, up to half of the glass installed could be a 0.55 SHGC (perhaps for a passive solar application), so long as the remainder was at or below 0.35 (the weighted average would be 0.45). In short, the limits constitute a modest backstop that can be easily satisfied by most glazing products currently on the market in each climate zone. The codes currently employ a number of other mandatory measures (including mandatory maximum fenestration air leakage) to ensure that the minimum code house is reasonably constructed – *IECC* Section 402.5 is no different.

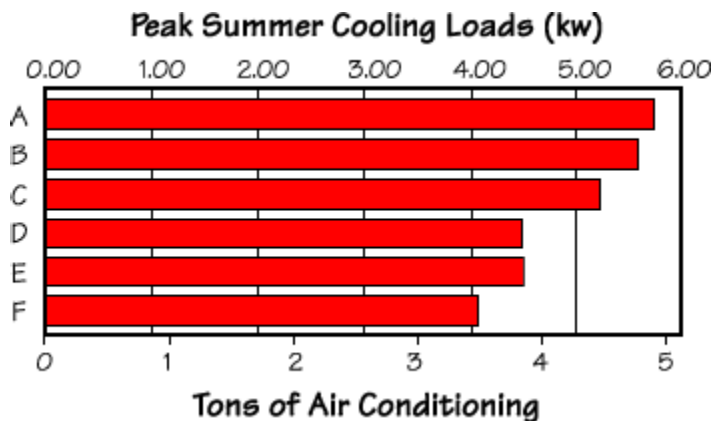
Maximums protect the consumer and the builder. The maximums are a key safety net and provide important homeowner and builder protection against bad or impractical trade-offs.

Benefits of Section 402.5 Fenestration Maximums:

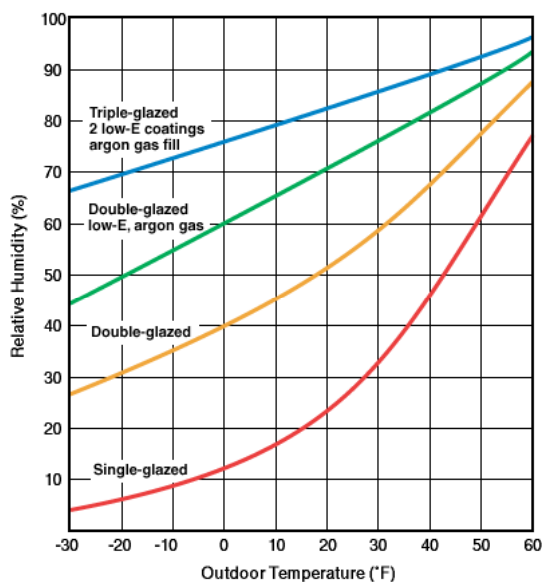
1. Quality Windows, Energy Savings and Peak Demand Savings Nationwide. The fenestration maximums encourage the use of cost-effective low-e windows nationwide. Efficient windows bring immediate cost savings to the builder who can downsize heating and cooling equipment, and bring long-term energy savings, greater comfort and reduced condensation for consumers. On a larger scale, because low-SHGC windows reduce energy consumption during the peak summer months in warmer climates, and low U-Factor windows reduce energy consumption during peak heating months in colder climates, high-quality windows can help reduce the strain on the electric grid and delay the need to build peak generation. They will also reduce the need for natural gas and help to reduce the amount of oil that is imported. Consumers also enjoy the reduced costs that come with economies of scale and market transformation. By avoiding extreme trade-offs of windows with resulting long-term detriment, fenestration maximums are a critical part of a well-functioning energy code.

The following chart, developed by the U.S. Department of Energy's Lawrence Berkley National Laboratory (LBNL), which is found on the Efficient Window Collaborative (EWC) website (www.efficientwindows.org), shows the potential for saving peak demand for different window types.

Window F is the low SHGC, low U-factor window that would satisfy the window maximums across the country (by contrast, window A is a single pane window). As is readily apparent, improved windows are crucial to lower peak cooling loads and smaller HVAC sizes (with lower costs).



2. Improved Condensation Resistance. Window condensation and the associated problems are a function of the window's U-factor, the indoor relative humidity, and the outside temperature. Glass with a lower U-factor maintains a higher room-side temperature, which means the glass can withstand lower exterior temperatures and more interior humidity without attracting condensation. Glass with a high U-factor will succumb to condensation much more easily. The following chart also provided by LBNL on the EWC website shows the condensation potential for different window types.

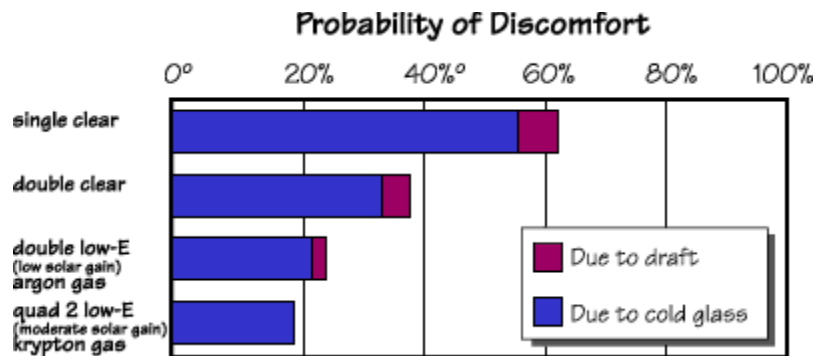


Note: Condensation occurs above the lines for each product type

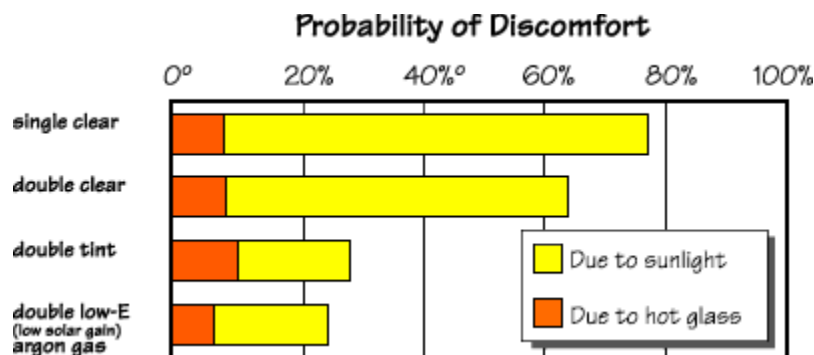
According to the chart, a typical double-glazed low-e window can withstand a 0 degree outdoor temperature and 60% relative humidity inside before condensation will begin to collect. By contrast, a regular double-glazed window can only withstand 40% humidity at the same outdoor temperature. In other words, a low-e window has a 50% more effective ability to resist condensation. A single-glazed low-e window is far worse – it can withstand less than 15% humidity at the same temperature – a virtual guarantee of damaging condensation. The fenestration maximums substantially reduce the likelihood of condensation in the colder months, enhancing durability and long-term benefits for the homeowner.

3. More Comfortable Homes and Less Energy Use. The energy code revolves around occupant comfort -- any perceived energy savings will be instantly lost if an occupant is uncomfortable and adjusts the thermostat. Incremental changes in window efficiency can have a disproportionate impact on occupant comfort because even the most efficient windows are, at best, still only the equivalent of an R-3 wall. Hot spots created by high solar gain in the summer and cold or drafty glass in the winter months can force an occupant to adjust the thermostat to compensate (which will increase cooling and heating bills at a time when natural gas costs about \$1.20 per therm on the wholesale market and heating oil costs over \$3.60 per gallon wholesale). The charts below, again produced by LBNL and displayed on the EWC website, show that occupant discomfort can double or triple, depending on the type of glass installed.

For example, the following chart shows the probability of discomfort during winter from poorer windows ranging from over 60% with single clear and almost 40% with double clear. This risk declines to almost 20% with a low-e window as specified by Section 402.5. This problem is due to the cold window -- at zero degrees outdoors, the single pane glass is less than 20 degrees on the inside surface, the double clear glass is slightly over 40 degrees, while the low-e glass is approaching 60 degrees. Obviously, the warmer the interior glass surface, the less likelihood of discomfort.



Similarly, the following chart shows the probability of discomfort during summer from sunlight and hot glass. The potential comfort problem from bad windows is even worse in the summer. The summertime probability of discomfort ranges from almost 80% with single clear and over 60% with double clear declining to almost 20% with windows as specified by Section 402.5.



In heating-dominated climates, a good low-e window will keep occupants more comfortable during the coldest months. In cooling-dominated climates, windows with low SHGC will protect against hot spots and occupant discomfort, and will make it less likely that occupants will need to adjust the thermostat and use more energy.

4. Conclusion. As shown above, the fenestration maximums serve an important role in ensuring residential energy efficiency. We recommend that the fenestration maximums in the *IECC* be updated to match the enhanced efficiency requirements in the 2009 *IECC* and also adopted for the *IRC*.

Cost Impact: The code change proposal will not increase the cost of construction.

PART I – IECC

Public Hearing: Committee: AS AM D
 Assembly: ASF AMF DF

PART II – IRC BUILDING/ENERGY

Public Hearing: Committee: AS AM D
 Assembly: ASF AMF DF

ICCFILENAME: PRINDLE-EC-20-402.5-N1102.3.6