

Response to Comments on Criteria Analysis Report

ENERGY STAR® for Exterior and Interior Storm Windows

Contents

Background	2
Support for Proposed Specification	2
Differentiating ENERGY STAR Storm Windows	2
ENERGY STAR Label	4
Installation Instructions	5
Consumer Checklist	5
Definitions	6
Scope	7
Criteria Analysis Report (CAR)	7
Performance Metrics	11
Qualification Criteria	12
Safety / Structural	17
Test Methods	18
Third-Party Certification	19
Appendix A – Consumer Checklist	23
Consumer Checklist for ENERGY STAR Storm Windows	23

Background

In January 2016, the U.S. Environmental Protection Agency (EPA) released a Framework Document describing research and laying out the opportunity and rationale for introducing an ENERGY STAR specification for exterior and interior storm windows. EPA requested public comments on the concepts laid out in the Framework Document and, based on comments received and additional analysis, released a proposed Draft 1 of the specification in July 2017. EPA requested and received additional public comments on the proposed Draft 1 criteria. These are EPA's responses to the Draft 1 comments:

Support for Proposed Specification

Several commenters expressed general support for EPA's proposed specification for storm windows and provided specific reasoning for their support of the specification. The comments included:

- Agreement with EPA that providing low-e storm windows with an ENERGY STAR label would enable consumers to identify a simple, affordable and cost-effective way to improve the energy efficiency of their windows.
- Appreciation for the thorough process that EPA undertook to ensure that a specification for storm windows aligns with the guiding principles of the ENERGY STAR label.
- Agreement with EPA's conclusion that storm windows meet all of the ENERGY STAR guiding principles.
- Support for the development of an ENERGY STAR specification for window attachments, including storm windows, because such products can deliver cost-effective savings to consumers.
- Agreement with EPA that a significant opportunity exists to improve the efficiency of U.S. homes because an estimated 63 percent of U.S. homes have single-pane or double-pane clear glass windows.
- Note that storm windows provide the means to improve window performance where homeowners will not or cannot replace their windows.
- Suggestion that creating an ENERGY STAR program for storm windows would also make it easier for utilities to develop incentive programs for storm windows.
- Agreement with EPA that storm windows are ideal for historic homes, which are often required to maintain certain physical features of the building or preserve its aesthetics.

EPA Response:

EPA thanks the commenters for their support of the proposed specification. EPA agrees that an ENERGY STAR specification for storm windows would provide cost-effective energy savings for consumers, help utilities develop incentive programs, differentiate products in the market, and provide benefits to a variety of market sectors.

Differentiating ENERGY STAR Storm Windows

Several stakeholders expressed concern over differentiating storm windows from primary windows, and the impact a potential ENERGY STAR storm windows specification would have on the ENERGY STAR program for primary windows. EPA addresses these issues in the following section.

Impact on ENERGY STAR Windows Program

One commenter expressed concern that the proposed ENERGY STAR specification for storm windows could significantly undercut EPA's current, highly successful, windows program. The commenter suggested that storm window manufacturers could make the unjustified claim that ENERGY STAR windows and storm windows are equivalent, which would confuse consumers and harm the ENERGY STAR windows brand.

EPA Response:

EPA thanks the commenter for their concern. The available research shows a tremendous opportunity for an ENERGY STAR label to guide consumers who are shopping for storm windows to select better-performing storm windows. EPA also remains committed to ensuring that the ENERGY STAR program for windows, doors, and skylights is valuable and beneficial to consumers. EPA believes that consumers will make their own decisions regarding whether to replace existing windows or install low-emissivity storm windows based on their own preferences. EPA plans to communicate the differences between the two product categories on the ENERGY STAR Web site. Based on these considerations, EPA does not believe that low-emissivity storm windows will adversely impact the ENERGY STAR program for windows, doors, and skylights.

Comparison of Storm Windows and Primary Windows

Two commenters stated that EPA should avoid suggesting that storm windows can provide equivalent benefits, performance, and durability compared to full replacement with ENERGY STAR primary windows. One commenter requested that EPA clearly differentiate the storm windows program from the primary windows program. Another commenter stated that EPA should not claim that storm windows have a lower cost than primary windows, and should instead promote both product categories separately.

EPA Response:

EPA thanks the commenters for their suggestions. EPA agrees that full primary window replacement can be an affordable and cost-effective option for consumers to improve the energy efficiency of their homes. The consumer checklist provides guidance for consumers who are shopping for storm windows, but avoids stating any preference for either product category (see Appendix A).

Complete Product or Component

One commenter suggested that EPA be cautious in extending the ENERGY STAR brand to a "component" where the performance is partly based on an unknown existing product.

EPA Response:

EPA thanks the commenter for their concern. Interior and exterior storm windows are different in nature from what industry generally considers to be components of fenestration products, such as insulated glazing units, frames or spacers. Instead, storm windows are sold as stand-alone consumer products, and have energy performance characteristics that can be measured independently from the primary window. Therefore, EPA believes that this product category is suitable for an ENERGY STAR specification.

Consumer Education

EPA received several comments about consumer education efforts related to low-e storm windows in addition to the consumer checklist. Two commenters believe that an ENERGY STAR storm window program may lead to confusion between ENERGY STAR certified primary windows and storm windows. The commenters suggested that EPA promote low-e storm windows through a consumer education campaign instead of developing an ENERGY STAR specification for storm windows. One commenter suggested that EPA promote full window replacement as the preferred option from an energy efficiency perspective. One commenter asks that EPA's consumer messaging be available for public review prior to implementation of the specification.

In addition, one commenter stated that storm windows installed over primary windows that use polymer components can cause these components to fail as a result of a greenhouse effect that causes very high temperatures. The commenter suggested that EPA issue a warning to inform homeowners.

EPA Response:

EPA appreciates the commenters' concerns. As previously stated in response to comments on the Framework Document, EPA believes that research published to date supports the development of an ENERGY STAR specification for this product category. EPA's goal is to help consumers choose a more energy-efficient option when shopping for a particular product category, and EPA's consumer messaging will make clear that storm windows and primary windows are separate product categories. EPA also has considered stakeholder input and released a revised consumer checklist (see Appendix A).

EPA appreciates the commenter's concern regarding storm windows installed over primary windows that use polymer components. Other stakeholders have provided analysis (available for review on the specification development Web page) regarding the effects of low-e storm windows on the internal temperature of fenestration. This analysis found that internal temperatures will not get high enough to damage polymer components, such as vinyl frames, except in extreme conditions where outside temperatures exceed 115 degrees Fahrenheit. To help make consumers aware of this potential issue, EPA has provided guidance in the consumer checklist (see Appendix A).

ENERGY STAR Label

Several commenters suggested that EPA differentiate the ENERGY STAR label for storm windows from the ENERGY STAR label for windows, doors, and skylights to avoid consumer confusion. Specific suggestions included eliminating the Climate Zone map from the label, requiring clear statements that storm windows do not provide equivalent energy savings compared to primary windows, and using a different label format and shape.

Two commenters asked whether ENERGY STAR certified storm windows would be required to carry a label showing product performance characteristics. One commenter specifically suggested requiring air leakage ratings on the label to be consistent with the ENERGY STAR program for windows.

EPA Response:

EPA thanks the commenters for these suggestions. EPA has designed a new ENERGY STAR label for storm windows that can be found in the Draft 2 specification. The dimensions of the new label are different from the ENERGY STAR label for primary windows, and the label clearly states that the product is an ENERGY STAR certified storm window. This design will help to ensure that consumers see a difference in the label and should minimize potential confusion. The new label continues to use the ENERGY STAR Climate Zone map because this is necessary to differentiate where a product is certified.

EPA appreciates the question concerning the placement of product performance information on labels. EPA does not plan to require product performance to be shown on the product; however, the ENERGY STAR label will have a URL to the ENERGY STAR storm window Web page where consumers can search the certified product list and find performance characteristics.

Installation Instructions

EPA received two comments related to installation instructions: One commenter recommended that the required installation instructions be clear in stating that thermal breaks are necessary when installing storm windows over metal-framed primary windows. The commenter suggested the following content for the installation instructions: “Guidance on the need for thermal breaks and providing them when installed over metal-framed primary windows, and instructions for installing thermal breaks. (Inclusion of diagrams/pictures is preferred, but optional.)” Another commenter stated that it is possible that new storm windows could be replacing older storm windows over the same primary window. The commenter recommended that the installation instructions provide guidance on the safe removal and recycling of old storm windows.

EPA Response:

EPA thanks both commenters for their recommendations, and has revised the installation instructions related to thermal breaks and added a section related to the removal and disposal of old storm windows.

Consumer Checklist

Several commenters supported the inclusion of a consumer checklist as part of the storm window program, and agreed that it is an important means for consumers to better understand the product and what aspects should be taken into account when considering storm windows as an option. Commenters also suggested revisions to the consumer checklist. Specific suggestions included:

- Providing consumers with information on the advantages of ENERGY STAR window replacement as an alternative to installing storm windows.
- Explaining how a storm window differs from a primary window.
- Clarifying that ENERGY STAR storm windows are better than other storm windows, as opposed to better than primary windows.

- Clarifying that energy efficiency improvements from the installation of storm windows may vary depending on the characteristics of the existing windows.
- Recommending that consumers strongly consider professional installation of storm windows.
- Including a stronger statement on the need to assess escape and rescue during a fire or other emergency, and not recommending storm windows for bedrooms and other locations where emergency egress may be required.
- Providing additional guidance that clearly indicates that emergency escape and rescue openings are required by code, and that impeding them or decreasing the opening size could reduce safety and be in violation of building codes.
- Deleting the reference to historic homes unless EPA is certain that adding storm windows would comply with all historic preservation requirements.
- Rephrasing “If your windows are rotted, damaged, or broken ...” to “If your windows are rotted or unrepairable” to avoid steering people away from easy-to-resolve issues, such as broken glass or a crumbling glazing compound.
- Adding that “Windows in poor condition could make proper installation of storm windows impossible and reduce the energy efficiency benefits.”
- Modifying the point that says, “If you already have double-pane or low-e coated windows” to “If you already have low-e coated primary windows,” because the analysis does not support a potential concern with double-pane clear windows.

EPA Response:

EPA thanks the commenters for their support and for the suggested additions and revisions to the consumer checklist. EPA has considered all of this input in its revised consumer checklist, included in Appendix A of this document.

Definitions

Several commenters provided feedback related to the definitions used in the Draft 1 specification, including:

- A suggestion to remove “to the incident solar ratio” from the air leakage definition so that it reads, “the volume of air flowing per unit time per unit area (cfm/ft²) through a fenestration system.”
- A suggestion to remove “due” from the Solar Heat Gain Coefficient (SHGC) definition so it reads, “the ratio of solar radiation that passes through a fenestration system to incident solar radiation.”
- A suggestion to rename the program “ENERGY STAR Interior and Exterior Storm Panels” as originally proposed by EPA instead of “ENERGY STAR Interior and Exterior Storm Windows.” The commenter stated that the term “storm window” implies that it is a window, instead of an attachment to a window.
- A question as to why Visual Transmittance, U-factor, and SHGC are defined in the product specification document when they are not proposed performance metrics for storm window

qualification. The commenter suggested removing those terms as they are not discussed or mentioned anywhere in the document.

EPA Response:

EPA thanks all of the commenters and will revise the definitions for air leakage and SHGC accordingly.

EPA changed the name of the product category in response to feedback from several stakeholders that “storm window” is the most common term for these products. EPA also understands that “storm panel” is a common term for opaque panels used to protect windows in hurricane-prone areas. Therefore, EPA will continue to refer to this category as “storm windows.”

While U-factor and SHGC are not proposed metrics for storm windows, those terms were referenced in the Criteria Analysis Report (CAR). EPA will follow the commenter’s suggestion and remove terms from the list of definitions that are not referenced directly in the specification document.

Scope

EPA received comments from two stakeholders related to the scope of the specification: One commenter asked whether EPA planned to develop a specification for exterior storm doors, and if not, could storm doors use the same criteria as exterior storm windows. The commenter suggested that the definition of an exterior storm window could serve as a reasonable definition of an exterior storm door. Another commenter suggested that EPA develop specifications for other window attachment products such as blinds, shades and shutters. The commenter stated that modeling by the Lawrence Berkeley National Laboratory (LBNL) and field studies conducted by the Pacific Northwest National Laboratory have shown substantial energy savings opportunities for these products.

EPA Response:

EPA thanks both commenters for their suggestions. At this time, it is EPA’s intention to propose a specification that only includes storm windows. The energy savings analysis for storm windows relied on certain assumptions, including the impact of the frame on the performance of the product and the performance of the base window. Storm doors have different physical characteristics, applications and product costs, which means that a separate analysis would be needed to determine whether an ENERGY STAR specification for storm doors is justified. Although there are similarities between the definitions of storm windows and storm doors, EPA will specifically exclude storm doors from the scope of this specification to clarify what is covered and what is not covered. Furthermore, EPA will thoughtfully consider developing ENERGY STAR specifications for other attachment products in the future.

Criteria Analysis Report (CAR)

In addition to receiving positive feedback on the CAR from several stakeholders, EPA received a number of specific suggestions that are addressed below.

Storm Window Energy Savings

Several commenters supported the conclusions of the CAR. One commenter agreed that storm windows have a significant energy savings potential for individual households, as well as at the national level. Another commenter noted that EPA had conducted robust analysis and research to demonstrate that the draft specification upholds the ENERGY STAR guiding principle that “significant energy savings can be realized on a national basis.” The commenter suggested that achieving energy savings above baseline products was a critical consideration for utility programs, and stated that independent research has found results consistent with those cited in EPA’s analysis.

In contrast, one commenter suggested that the actual performance of low-e storm windows will differ from the results of the analysis that EPA cited. For example, low-e storm windows installed over aged, low-performing primary windows would not deliver the energy efficiency and comfort expected by consumers. In addition, the commenter noted that Appendix A in the CAR showed that the combined U-factor of the storm window and primary window can vary from 0.56 to 0.42, depending on the characteristics of the base window. As a result, the commenter suggested that the proposed storm windows program runs the risk of promoting less efficient results in the real world.

EPA Response:

EPA appreciates the commenters’ feedback on the CAR results and for expressing their concern. EPA acknowledges that overall performance of the fenestration system is affected by the characteristics of the primary window; however, the research that EPA cited in the CAR addresses this issue by evaluating several common primary window scenarios. Based on this research, EPA is confident that consumers will experience better energy performance when selecting low-e storm windows compared to storm windows with clear glass. While full primary window replacement may offer better energy savings benefits than low-e storm windows in many situations, consumers may consider a variety of other factors when shopping for home improvement options.

U-Factor and SHGC of Additional Glass Options

One commenter pointed out that Appendix A of the CAR does not include combined U-factor and SHGC ratings for any alternative low-e glass options, including the low solar transmittance glass option used to evaluate energy savings and the cost-effectiveness of the proposed criteria for the Southern and South-Central Climate Zones. The commenter asked EPA to assess the potential U-factor and SHGC of other glass options listed in Appendix B of the CAR in order to determine the appropriate criteria.

EPA Response:

EPA thanks the commenter for raising this issue. The commenter is correct that Appendix A of the CAR did not include the implicit U-factor and SHGC performance of low solar transmittance glass and other low-e glass options identified in Appendix B of the CAR. To address this, EPA has completed an additional analysis of available glass options, which is available for review on the specification development Web page.

Energy Savings Analysis for 0.22 Emissivity

Several commenters pointed out that the analysis cited in the CAR assumed storm windows with an emissivity of 0.15; however, EPA’s proposed criteria for emissivity was ≤ 0.22 . One commenter stated that the higher emissivity rating would result in an increase of about 0.02 in the center-of-glass U-factor

rating of the combined fenestration system. As a result, some commenters suggested that the energy savings cited by EPA were overstated. The commenters suggested that EPA conduct additional analysis to determine the energy savings and cost-effectiveness at the less stringent performance level to justify the proposed criteria.

EPA Response:

EPA thanks the commenters for raising this issue. The research that EPA cited in the CAR assumed an emissivity of 0.15 for low-e storm windows based on the typical performance of products that are currently available in the marketplace. EPA proposed a higher emissivity of 0.22 to align with existing energy efficiency programs and allow other viable low-e glass options to be certified. To address stakeholders' concerns and confirm the cost-effectiveness of the proposed emissivity level, EPA has conducted additional analysis on a range of glass options. This analysis is available for review on the specification development Web page. See the Qualification Criteria section below for additional information.

Fan Energy in RESFEN

One commenter suggested that RESFEN energy modeling software does not account for fan energy, which could be a significant part of HVAC energy use. The commenter further suggested that the inclusion of fan energy would reduce the energy benefit of passive solar heating from low-e glass with high solar transmittance.

EPA Response:

EPA thanks the commenter for their suggestion. In the CAR, EPA relied on the most current modeling software and assumptions available. These tools also are used by the U.S. Department of Energy (DOE), national laboratories and other stakeholders for fenestration-related analyses. In the future, EPA will consider using updated software and revised assumptions if they are demonstrated to be more accurate. The current modeling approach supports the conclusion that high solar transmittance glass provides a net benefit in the Northern Climate Zone.

Market Share of Low-E Storm Windows

One commenter questioned EPA's assumption of a current market share of 10 percent for low-e storm windows. The commenter pointed out that the research cited in the CAR included a market share estimate from 2011; however, EPA's market research found that 88 out of 121 storm window product lines used low-e glass.

EPA Response:

EPA thanks the commenter for raising this issue. While EPA found a variety of low-e options for sale by major retailers, these figures do not necessarily correlate to market share. Currently, EPA is not aware of low-e storm window market share data better than the research cited in the CAR.

Thermal Breaks

One commenter pointed out that energy savings for a non-thermally broken low-e storm window over a metal-framed primary window are virtually the same as a clear glass storm window in a thermally broken mount. The commenter suggested either mandating thermal breaks or limiting the program to non-metal base windows.

EPA Response:

EPA thanks the commenter for their suggestion. EPA understands the importance of thermal breaks when attaching storm windows to metal-framed primary windows. To address this issue, EPA proposed that manufacturers include guidance on thermal breaks in their installation instructions. To provide further guidance, EPA has included additional language in the revised consumer checklist. EPA is not able to enforce any program requirements that apply directly to the installation of the product or the base window.

Payback for 0.15 Emissivity

One commenter asked whether there are higher costs for storm windows with emissivity of 0.15 compared to 0.22, and suggested that EPA assess payback for the more stringent criteria.

EPA Response:

EPA thanks the commenter for raising the issue. EPA's cost-effectiveness analysis was based on the cost of low-e storm windows currently available from major retailers. Most glass options used with low-e storm windows have emissivity ratings in the lower range (0.15–0.17); therefore, EPA believes that the estimated costs reflect the more stringent emissivity that was analyzed and represent a conservative estimate for payback.

Laminated Glass Options

Two commenters suggested that some of the glass options that EPA listed in Appendix B of the CAR are not realistic or cost-effective applications for storm windows. The commenters specifically cited laminated and tinted glass options. One commenter asked whether EPA has identified the incremental costs of such glass options and assessed whether they are actually used in the market.

EPA Response:

EPA thanks the commenters for raising this issue. EPA included a variety of glass options that meet the proposed criteria for the Northern and Southern Climate Zones in Appendix B of the CAR to show the range of glazing options available to manufacturers. EPA based its cost-effectiveness analysis on the average cost of low-e storm windows at major retailers across the United States. While some of the glazing options that EPA identified may not be commonly used, EPA is confident that a variety of low solar transmittance glass options are available to manufacturers if they choose to sell ENERGY STAR certified storm windows in the Southern Zone. Manufacturers can select glazing options that make sense for their market and applications.

Ventilation in RESFEN

One commenter asked whether EPA considered how the storm window would be opened to match the ventilation schedules that are part of the RESFEN program. The commenter suggested that if the storm window operates on a different ventilation schedule from the primary window, air-conditioning loads would be underestimated and high solar transmittance glass options would be less cost-effective.

EPA Response:

EPA thanks the commenter for the question. EPA has proposed that manufacturer's installation instructions provide information on matching the operability of storm windows and primary windows.

EPA also has provided guidance on matching the operability of storm windows and primary windows in the consumer checklist. EPA expects that consumers will install operable storm windows over operable primary windows, and as a result, the use of storm windows will not impact the ventilation schedule. As a result, EPA believes that the default ventilation assumptions in RESFEN are still applicable.

Performance Metrics

Several stakeholders expressed support for the metrics that EPA proposed in the Draft 1 specification, while a few stakeholders made specific suggestions for EPA to consider. EPA has addressed these suggestions below.

Support for Proposed Performance Metrics

Several commenters supported the metrics that EPA proposed in the Draft 1 specification. One commenter suggested that the metrics that EPA proposed effectively address the guiding principle “product energy consumption and performance can be measure and verified with testing.” One commenter supported the proposed criteria, but recommended that EPA also consider adopting the Attachments Energy Rating Council’s (AERC) Annual Energy Performance (AEP) metric in the future. The commenter also suggested that AEP rating is the easiest way for consumers to understand and make comparisons between products.

EPA Response:

EPA thanks the commenters for their support and suggestions. EPA plans to consider AERC’s Annual Energy Performance metric after AERC has completed development of its rating and certification process.

Center-of-Glass U-Factor

One commenter suggested adding center-of-glass U-factor as an alternative metric. The commenter noted that a simple insulating glass unit would perform better than a monolithic low-e panel; therefore, the specification should be designed for those products to qualify.

EPA Response:

EPA thanks the commenter for their suggestion. In its review of the market, EPA found one manufacturer that currently makes storm panels with insulated glazing through a customized, on-site design process, but did not find any storm windows with factory-manufactured insulating glass units available to consumers. As a result, EPA believes that the performance metrics proposed in the Draft 1 specification would successfully differentiate better performing products for the vast majority of the storm windows market.

Availability of Performance Ratings to Consumers

One commenter suggested that emissivity and solar transmittance data were not readily available to consumers. The commenter asked how a consumer would compare the emissivity and solar transmittance of various storm windows in the marketplace if that information was not independently tested, certified and labeled by a credible third-party certification program.

EPA Response:

EPA thanks the commenter for raising this issue. All ENERGY STAR certified storm windows will be independently tested and certified in accordance with ENERGY STAR certification requirements. Participating third-party certification bodies will collect air leakage, emissivity and solar transmittance performance data when products are certified, and submit that data to EPA. Performance data for all certified storm windows will be available to consumers on the ENERGY STAR Web site. See the comments on Third Party Certification for additional information.

[Encouraging Product Improvements](#)

One commenter suggested that the specification that EPA proposed failed to encourage or recognize product improvements such as insulating glass units and improved frames. The commenter asked whether the use of glass-only properties and air leakage sufficiently captured the energy efficiency of storm windows.

EPA Response:

EPA thanks the commenter for their concern. When selecting performance metrics, ENERGY STAR focuses on products that are currently available in the market and for sale. Based on the research that EPA cited in the CAR and comments received from other stakeholders, EPA is confident that the proposed metrics sufficiently capture the energy efficiency of storm windows on the market today. As new products become available, EPA will consider additional or alternative performance metrics.

[Qualification Criteria](#)

EPA received several comments in support of qualification criteria proposed in the Draft 1 specification, as well as a number of concerns and suggestions. EPA has addressed the specific stakeholder comments below.

[Emissivity](#)

Several commenters expressed support for the proposed criteria, stating that the criteria would appropriately differentiate modern low-e storm windows from less efficient products. One commenter noted that the criteria would be cost-effective and easy to verify, ultimately leading to significant consumer benefits and energy savings. Another commenter noted that the criteria would not adversely impact other product performance factors and that the criteria would increase the range of ENERGY STAR storm windows available to homeowners.

In contrast, two commenters suggested that the emissivity requirements for storm windows should be more stringent, specifically ≤ 0.15 or 0.16 . One commenter stated that the research cited in the CAR assumed an emissivity of 0.15 , and EPA should fully evaluate and justify the less stringent criteria that EPA proposed (emissivity ≤ 0.22).

EPA Response:

EPA thanks the commenters for their support of the proposed criteria, as well as for raising the emissivity requirement issue. EPA has conducted additional analysis to evaluate the energy savings and payback for storm windows at a range of performance levels. The table below shows the incremental

paybacks in different climate zones for three glass options with different emissivity and solar transmittance levels, assuming a single-pane, wood-framed primary window.

Glass Product	Emissivity	Solar Transmission	Incremental Payback (Years)		
			Climate Zone 6	Climate Zone 5	Climate Zone 4
AGC Comfort Select 73 on 3 mm (#1032)	0.148	0.688	7.9	9.8	9.7
Guardian IS20 on 3 mm (#3179)	0.198	0.766	7.7	9.9	10.3
PPG Sungate 500 on 3 mm (#5242)	0.215	0.690	8.7	10.9	10.8

Zones 4–6 represent the highest concentration of storm window sales opportunities and therefore are the most important for evaluating the cost-effectiveness of the criteria. EPA concluded that while payback was slightly longer at the higher emissivity level, such products would still deliver cost-effective energy savings to consumers and therefore should be eligible for ENERGY STAR certification.

EPA believes that for this initial specification for storm windows, the ENERGY STAR label should reinforce the differentiation between clear glass and low-e storm windows instead of differentiating between different low-e products. The higher proposed emissivity level also allows manufacturers to use more glass options and aligns the criteria with existing regional storm window programs. EPA will continue to evaluate the market for storm windows and plans to revisit the criteria in the future as needed. The complete analysis is available for review on the specification development Web page.

Air Leakage

One commenter supported the inclusion of air leakage requirements for storm windows, but asked how EPA justifies the proposed qualification criteria of 1.5 cmf/ft² for exterior storm windows and 0.5 cmf/ft² for interior storm windows. The commenter pointed out that the research cited in the CAR assumed tighter air leakage of 0.3 cmf/ft² for exterior storm windows and 0.1 cmf/ft² for interior storm windows, and that the ENERGY STAR requirement for primary windows was 0.3 cmf/ft². The commenter also asked whether it was reasonable to set different air leakage values for interior and exterior storm windows.

EPA Response:

EPA thanks the commenter for their questions. Storm windows present a unique scenario because the product is placed over a primary window with unknown air leakage characteristics. In addition, it is important for exterior storm windows to allow some degree of air leakage through weep holes or other moisture management features. To address these issue, the proposed test procedure uses a calibrated panel to simulate a standard amount of air leakage from the primary window. Air leakage using this test method may be higher than the actual air leakage of a storm window combined with an average primary window, which is why the research cited in the CAR assumes lower air leakage.

Based on AERC testing, EPA proposed a less stringent specification for air leakage to establish air leakage as a performance metric for storm windows and allow a variety of products to be certified. EPA will

collect air leakage performance data as products are certified and reevaluate the criteria for future specification revisions. While this approach may allow some products with above average air leakage performance to be certified, EPA does not believe that consumers will lose significant energy savings as a result. It is important to note that EPA did not claim energy savings from reduced air leakage as part of its justification for the proposed criteria.

Solar Transmittance

Two commenters suggested that EPA eliminate the solar transmittance criteria entirely, citing a variety of reasons:

- There would be a limited number of cost-effective glass options available that meet the low solar transmittance requirement.
- Questions regarding whether the energy savings calculations justify the different solar transmittance criteria.
- RESFEN analysis shows minimal differences between regular low-e and low solar transmittance low-e in all locations except Climate Zone 2.
- The ENERGY STAR specification for primary windows had no SHGC requirement in the Northern Zone, suggesting that the criteria for storm windows should be consistent across programs.
- The proposal to not certify interior storm windows in the Southern and South-Central Zones means that the proposed criteria do not provide enough of a unique difference in performance.
- Eliminating the solar transmittance criteria would allow ENERGY STAR to avoid a Climate Zone map and reduce the possibility of confusion with the windows program.
- The differentiation between high and low solar transmittance at 0.55 is arbitrary.

EPA Response:

EPA thanks the commenters for raising these issues. EPA conducted additional analysis to evaluate whether the proposed solar transmittance requirements are appropriate and whether a Climate Zone map is necessary for this product category. The table below shows the incremental paybacks in different climate zones for four glass options: three with solar transmittance greater than 0.55 and one with solar transmittance less than 0.55.

Glass Product (3 mm)	Emissivity	Solar Transmission	Incremental Payback (Years)			
			Climate Zone 5	Climate Zone 4	Climate Zone 3	Climate Zone 2
AGC Comfort Select 73 (#1032)	0.148	0.688	9.8	9.7	10.6	9.8
Guardian IS20 (#3179)	0.198	0.766	9.9	10.3	13.8	16.3
PPG Sungate 500 (#5242)	0.215	0.690	10.9	10.8	11.8	11.2
Pilkington Solar-E (#9932)	0.166	0.459	14.7	11.5	7.7	4.7

This analysis shows that the glass option with solar transmittance of 0.46 has a significantly better payback in the South-Central and Southern Climate Zones (IECC Zones 3 and 2, respectively) than the glass options with solar transmittance greater than 0.55. In addition, the lower solar transmittance option has a significantly longer payback in the Northern Climate Zone (IECC Zone 5). In the North-Central Climate Zone (IECC Zone 4), payback is longer, on average, for the lower solar transmittance

than the other options; however, payback varies between different cities in the North-Central Zone, and in certain cases, payback is nearly equivalent for low and high solar gain products.

Therefore, EPA believes that it is necessary to include solar transmittance criteria to ensure that consumers receive appropriate guidance on the type of storm window product that is cost-effective for their location. In addition, EPA believes that it is appropriate to allow any solar transmittance in the North-Central Zone to give consumers the ability to select ENERGY STAR certified products that suit their needs in a mixed climate. Furthermore, EPA believes that the cut-off point between “high” and “low” solar transmittance of 0.55 is appropriate because that criteria is used by the Regional Technical Forum as the minimum requirement for a Northern climate, and a review of available glass options shows that a natural gap in glass solar transmittance performance occurs at that level.

EPA concludes that there are realistic, cost-effective glass options for manufacturers to choose from that have both low and high solar transmittance levels. EPA is confident that low solar transmittance glass options are available to manufacturers if they choose to sell ENERGY STAR certified storm windows in the Southern and South-Central Zones. Manufacturers can select glazing options that make sense for their market and applications. The fact that different criteria are justified for different climate zones makes it necessary to require a Climate Zone map as part of the ENERGY STAR label for this product category.

Specification Language for Solar Transmittance

One commenter suggested using “Any” instead of “ ≤ 0.55 or > 0.55 ” in the specification language for solar transmittance in the North-Central Climate Zone.

EPA Response:

EPA thanks the commenter for their suggestion. EPA will revise the criteria table to simplify the language.

Consistency with ENERGY STAR Windows

Two commenters stated that the proposed solar transmittance criteria for the North-Central Zone was inconsistent with the Solar Heat Gain Coefficient (SHGC) criteria for primary windows in the North-Central Zone, which set a maximum SHGC.

EPA Response:

EPA thanks the commenters for raising this issue. EPA acknowledges that the proposed criteria for storm windows are different from the criteria for primary windows in the North-Central Climate Zone. The research and analysis cited in the CAR, as well as EPA’s expanded analysis, demonstrates that both low and high solar transmittance is justified for the North-Central Zone (IECC Zone 4). EPA does not believe that it is appropriate to compare the storm window criteria to those for full-window replacement because storm windows are designed to be installed over an existing primary window and therefore the performance of the complete fenestration system may vary. In addition, glass options available for storm windows are different from those for primary, multi-glazed products, and therefore require a different set of criteria.

Interior Storm Windows in the Southern Climate Zone

One commenter noted that EPA did not propose a specification for interior low-e storm windows for Southern and South-Central Climate Zones. The commenter stated that interior low-e storm windows do provide energy benefits from reduced air leakage and lower U-factor in those zones, as well as other benefits such as improved comfort and reduced noise. The commenter suggested that an interior storm window could be a very good application in southern climates, especially for windows with low solar exposure.

EPA Response:

EPA thanks the commenter for raising this issue. EPA acknowledges that interior storm windows provide a number of energy-related benefits that would apply to homes in the Southern and South-Central Climate Zones. EPA has previously received comments that absorbing solar control low-e coatings are not good applications for interior storm windows. EPA has conducted additional analysis on these products and determined that interior storm windows with low solar transmittance (Tsol) glass are cost-effective in the North-Central (IECC Zone 4), South-Central (IECC Zone 3), and Southern Climate Zones (IECC Zones 1 & 2) (see the table below for payback results). Interior storm windows with low-e coating on the interior face (surface 4) have shorter payback periods than surface 3 low-e coatings in Zones 2 and 3. In Zone 4, the payback periods are comparable. Therefore, EPA has revised its original proposal to allow interior storm windows with low Tsol glass to be certified in the Southern and South-Central Climate Zones, as well as allowing any Tsol to be certified in the North-Central Zone.

Glass Product (3 mm)	Emissivity	Solar Transmission	Incremental Payback (Years)			
			Climate Zone 5	Climate Zone 4	Climate Zone 3	Climate Zone 2
AGC Comfort Select 73 on Surface 3 (#1032)	0.15	0.69	8.8	9.1	12.5	15.5
PNA Solar-E on Surface 3 (#9932)	0.17	0.46	9.5	9.4	10.9	10.8
PNA Solar-E on Surface 4 (#9932)	0.17	0.46	10.2	9.6	8.5	6.7

Differentiation Among Low-E Storm Windows

Two commenters suggested that the proposed criteria would only differentiate between low-e storm windows and clear glass storm windows. The commenters suggested that the ENERGY STAR program for storm windows should differentiate better performing low-e storm windows to be meaningful and valuable.

EPA Response:

EPA thanks the commenters for their concerns. The goal of the ENERGY STAR program is to help consumers identify more energy-efficient products within a given product category. The research that EPA cited in the CAR and the additional analysis performed in response to comments confirm EPA's conclusion that the most appropriate specification level is one that differentiates storm windows with low-e glass from storm windows with clear glass. EPA concluded that the difference in payback between

0.15 emissivity and 0.22 emissivity was not significant enough to justify more stringent criteria for an initial product specification. In addition, EPA found that a low-e glass option with higher emissivity may outperform an option with lower emissivity, depending on the solar transmittance of the two options, meaning that a lower emissivity is not automatically better. Furthermore, EPA has not identified any subcategory of better performing low-e glass that would represent a clear natural break in the market between low-e glass with 0.22 emissivity and a more stringent performance level. In the future, EPA plans to evaluate the criteria to determine whether further differentiation of energy-efficient products in the category is warranted.

[Existing Regional Specifications](#)

One commenter suggested that adopting the criteria currently used by one regional entity (the Regional Technical Forum in the Pacific Northwest) without further analysis is not the best practice for a national program with the scope of ENERGY STAR. The commenter noted that doing so may reinforce existing market signals in a small part of the country, but it does not promote more efficient low-e glass options that seem to be readily available.

EPA Response:

EPA thanks the commenter for their concern. While EPA reviewed criteria used by the Regional Technical Forum, those criteria were only part of the justification for the Draft 1 proposal. EPA also considered research and analysis from a variety of sources cited in the CAR and conducted further analysis to evaluate the proposed criteria. As stated in response to previous comments, EPA has concluded that ≤ 0.22 emissivity is cost-effective and would provide clear differentiation between low-e storm windows and clear glass storm windows. EPA does not believe that more stringent criteria are justified for this initial product specification.

[Safety / Structural](#)

EPA received several comments regarding compliance with certain safety and structural standards for storm windows and has addressed these specific concerns below.

[ASTM E1300](#)

Two commenters suggested that EPA require storm windows to comply with ASTM E1300 to ensure glass strength. One commenter also suggested that ENERGY STAR storm windows meet the glass tempering requirements in local building code.

EPA Response:

EPA thanks the commenters for their suggestions. EPA closely reviewed the need for ASTM E1300 certification in the proposed criteria. EPA found that E1300 is a commercial glazing strength standard and, therefore, is not widely used for residential fenestration applications. EPA is reluctant to assign product design requirements that are not widely used, do not directly affect the energy performance of the product, and may increase product costs. EPA is requiring manufacturers to provide a reference to safety requirements defined in local building codes in their installation instructions, and on the ENERGY STAR Web site, they will encourage consumers to consider safety and local building codes when installing storm windows.

North American Fenestration Standard/Specification (NAFS)

Two commenters suggested that EPA should require NAFS for air, water and structural certification as part of the ENERGY STAR specification for storm windows. One commenter stated that requiring NAFS was consistent with the ENERGY STAR guiding principle of maintaining or enhancing overall product performance. The commenter referenced a DOE Volume Purchase Program (VPP) for storm windows that required a minimum NAFS Performance Grade. Another commenter stated that hung storm windows could be a safety concern if they have not been tested per the safety drop testing protocol defined in NAFS.

In contrast, one commenter suggested that the certification requirements be limited to energy performance, and that requiring compliance with NAFS would unnecessarily increase the cost of storm windows to homeowners without increasing the effectiveness of the program.

EPA Response:

EPA thanks the commenters for their suggestions and feedback. EPA closely reviewed the need for NAFS certification in the proposed criteria. The ENERGY STAR guiding principles state that energy efficiency improvements should maintain or enhance product performance; however, EPA is reluctant to assign product design requirements that are not widely used, do not directly affect the energy performance of the product, and may increase product costs. Although DOE's VPP for storm windows required a minimum performance grade, the program was designed for commercial applications. To date, EPA has not received evidence that full NAFS certification is necessary to maintain product performance for low-emissivity storm windows. The feedback from another commenter cited above supports EPA's conclusion that NAFS would unnecessarily increase the cost of storm windows to homeowners.

EPA acknowledges that elements of NAFS may be relevant to the energy performance of the product. For example, in the CAR (p. 11), EPA indicated that it would accept NAFS certification (as well as other third-party certifications) for compliance with the air leakage requirement provided that such certification uses the AERC 1.2 test procedure. As with the ENERGY STAR program for windows, doors and skylights, manufacturers may choose to utilize NAFS certification to differentiate their products in the market and provide additional assurances to consumers.

Test Methods

Several commenters expressed support for the proposed test method for air leakage, with one commenter explaining that the proposed method has been vetted openly and accepted in the market. Another commenter stated that it is the most realistic measure of the overall air leakage of the fenestration system after the storm window has been installed. One commenter also stated that the proposed method would align with AERC and help to minimize the testing burden for storm window manufacturers.

In contrast, two commenters asked EPA to provide additional justification for why the proposed test method is appropriate. One commenter specifically asked why it was reasonable to assume 2.0 cfm/ft²

as the baseline air leakage, and an additional commenter expressed concern that the proposed method has not yet been fully established and implemented.

One commenter suggested that EPA rephrase the proposed test method for air leakage to state “AERC 1.2 in accordance with ASTM E283” as opposed to “ASTM E283 in accordance with AERC 1.2.”

EPA Response:

EPA thanks the commenters for raising concerns and providing feedback. EPA acknowledges that AERC 1.2 is a new test procedure; however, multiple commenters have expressed support for this method as a realistic measure of air leakage when installed over a base primary window. AERC developed the test procedure through actual product testing, and it was voted on and adopted by AERC membership. As a result, EPA believes that AERC 1.2, including the use of a baseline air leakage of 2.0 cfm/ft², is a reasonable test procedure. EPA will evaluate the appropriateness of this test procedure on an ongoing basis by reviewing the air leakage performance data for certified storm windows.

EPA thanks the commenter for raising the issue of the proposed test method name and will revise the language in the specification document.

Third-Party Certification

Several stakeholders expressed concern over the third-party certification process as it relates to the proposed Draft 1 specification. EPA thanks the commenters for their input and has addressed their comments more specifically below.

General

Two commenters suggested that it was essential to have a third-party testing, certification and labeling procedures for ENERGY STAR storm windows. One commenter noted that such a program is needed to ensure confidence in the ENERGY STAR brand.

EPA Response:

EPA thanks the commenters for raising this issue. To ensure consumer confidence in the ENERGY STAR label and to protect the investment of ENERGY STAR Partners, EPA requires all ENERGY STAR products to be third-party certified. Products must be tested in an EPA-recognized laboratory and reviewed by an EPA-recognized certification body (CB) before they can carry the label. CBs must be independently accredited to International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) 17065. CBs must verify that test results are from an EPA-recognized laboratory, maintain open correspondence with EPA, and cooperate with their accrediting body for ongoing accreditation. CBs are also responsible for administering verification testing and challenge testing.

For the ENERGY STAR storm windows program, EPA is proposing the following minimum certification requirements:

1. The manufacturer shall apply for certification with a recognized CB and confirm that their selected test laboratory is recognized by EPA.

2. The manufacturer shall submit an application to a recognized laboratory with the following: a sample product, product characteristics, installation instructions, test results (per NFRC 300 and 301) for the glass option from a laboratory participating in LBNL Inter-Laboratory Comparison, and a separate sample of the low-e glass used in the product.
3. The laboratory shall confirm that the properties of the submitted storm window product match the properties of the submitted low-e glass sample. The laboratory may perform this check using EDTM Glass Check PRO, EDTM Solar Spectrum Meter or a variety of other equipment of similar or better performance.
4. The laboratory shall also test for air leakage performance per AERC 1.2 in accordance with ASTM E283.
5. The laboratory shall fill out a lab report with the required submission data and submit the report to the CB.
6. The CB shall review all test data and submit the certified product data to EPA. All certified product data shall be available for consumers on the ENERGY STAR Web site.

Independent Verification Program

Two commenters suggested that ENERGY STAR storm windows should be subject to an independent verification program with a specific percentage of products randomly selected and tested on an annual basis. The commenters requested that EPA provide additional details for how verification testing of emissivity, solar transmittance and air leakage would work for ENERGY STAR storm windows.

EPA Response:

EPA thanks the commenters for raising these issues. In addition to requiring third-party certification for all ENERGY STAR products, EPA also requires that ENERGY STAR products be subject to ongoing after-market verification testing. This testing of a prescribed sample of ENERGY STAR certified products helps to maintain consumer confidence in the ENERGY STAR label and protect the investment of ENERGY STAR Partners.

For the ENERGY STAR storm windows program, EPA plans to include the following minimum verification requirements:

1. On an annual basis, EPA will work with certification bodies to identify a certain percentage of certified product lines, initially set at 10 percent.
2. From the agreed upon verification list, the CB will request a sample product from the manufacturer that is properly labelled and includes the installation instructions.
3. The laboratory will confirm that the glass properties of the submitted storm window product match the properties of the previously submitted low-e glass sample. The laboratory may perform this check using EDTM Glass Check PRO, EDTM Solar Spectrum Meter or a variety of other equipment of similar or better performance.
4. The laboratory will also test for air leakage performance per AERC 1.2 in accordance with ASTM E283.
5. The laboratory will fill out a lab report with the required submission data and submit the report to the CB.
6. The CB will review all test data and let EPA know whether any product does not meet the prescribed verification requirements using an establish protocol.

Certification Requirements for Storm Windows Same as for Primary Windows

One commenter suggested that EPA require the same certification rules for storm windows as are required for primary windows. The commenter suggested that allowing different rules or reduced stringency created a market advantage.

EPA Response:

EPA thanks the commenter for their suggestion. EPA has developed certification and verification requirements for storm windows that are appropriate for the proposed ENERGY STAR criteria. The research cited in the CAR supports the conclusion that these criteria clearly differentiate energy-efficient low-e storm window products from less efficient clear glass storm windows. The proposed criteria are different from the criteria used to certify ENERGY STAR windows; therefore, the same performance tests are not appropriate. However, all ENERGY STAR products are subject to the same third-party certification and verification standards, as defined by ISO/IEC.

Implementation Timeline

One commenter suggested that EPA not finalize and implement a new program for storm windows until a third-party testing, rating and labeling certification program was firmly established.

EPA Response:

EPA thanks the commenter for their concern. EPA has developed a certification process based on ISO/IEC standards that have been successfully applied to more than 70 product categories. Often, certification and labeling processes for new product categories are developed concurrently with the product specifications. Furthermore, the proposed test methods for glass properties (NFRC 300 and 301) are well established within the industry, and the air leakage test procedure (AERC 1.2 in accordance with ASTM E283) has been voted on and accepted by the AERC membership. Therefore, EPA believes that the testing, certification and labeling procedures for this product category will be properly established at the time of implementation.

Plant Inspections

One commenter suggested that plant inspections are critical for a third-party certification and verification program, and asked whether EPA will require plant inspections.

EPA Response:

EPA thanks the commenter for their suggestion. EPA requires certification and verification based on product testing, not on plant inspections. Certification bodies may independently choose to require plant inspections or other requirements as part of their own certification and verification procedures.

Certification Process for Stakeholder Review

One commenter requested that third-party certification procedures be subject to public review and comment prior to EPA approval. The commenter asked whether EPA would offer a process for stakeholders to comment on the eligible organizations and their procedures.

EPA Response:

EPA thanks the commenter for their concerns. EPA has an established process for soliciting and recognizing certification bodies and test laboratories for the ENERGY STAR program, and working with those organizations to develop their certification procedures. This process is well established and is available on the ENERGY STAR Web site at www.energystar.gov/3rdpartycert. A list of these organizations is also available on the ENERGY STAR Web site. In response to stakeholder comments, EPA has provided additional details on the certification and verification process for storm windows in the Draft 2 specification. Stakeholders are welcome to provide comment on these details.

Appendix A – Consumer Checklist

Consumer Checklist for ENERGY STAR Storm Windows

Note: EPA plans to make this Consumer Checklist available on the ENERGY STAR Web site to help consumers make informed decisions about purchasing low-e storm windows. EPA has incorporated suggestions from stakeholders on the first draft of the Consumer Checklist, which was released with the Draft 1 specification.

Are ENERGY STAR Certified Storm Windows right for you?

ENERGY STAR certified low-e storm windows can be an affordable way to help reduce energy costs.

What is a “low-e” storm window? The glass on a low-e (low emissivity) storm window has a microscopically thin, almost invisible, very durable coating that reduces heat loss through the window glass when it is cold outside, saving on heating bills. Some low-e glass also has a low solar transmittance (Tsol) rating that blocks heat coming in from the outside and can help to keep your house cooler in the summer, saving on air conditioning bills. Some types of durable plastic storm windows may also have low-e characteristics.

Why are ENERGY STAR certified storm windows better than other storm windows? The ENERGY STAR label makes it easy to select low-e storm windows that are designed to deliver cost-effective energy savings in your area. ENERGY STAR certified storm windows are tested and certified to meet the program requirements and are subject to additional routine performance verification testing.

Which ENERGY STAR certified storm windows are best for my location? The climate where you live affects which low-e storm window product is best in your location. Therefore, every ENERGY STAR certified storm window has a label with a map to indicate which part of the country that product is designed for. Look for the label to determine whether the storm windows you are considering are ENERGY STAR certified in your location.

How much energy can I save with ENERGY STAR certified storm windows? Your energy savings can vary greatly depending on where you live, the size and efficiency of your home, and the performance of your existing window system. You can find average annual energy cost savings estimates for typical homes on the ENERGY STAR storm windows Web page.

How do ENERGY STAR certified storm windows differ from ENERGY STAR certified windows? Storm windows are installed as attachments to existing primary windows. Exterior storm windows are installed on the outside of your primary windows, and interior storm windows are installed on the inside of your primary windows. On the other hand, ENERGY STAR certified primary windows have a full frame and at least two layers of glass, which may also have low-e coatings. Consumers completely replace their

existing primary windows when installing ENERGY STAR certified primary windows. See the Web page for ENERGY STAR certified windows, doors and skylights for more information about the benefits of full window replacement.

What else should I consider in my purchasing decision? Before purchasing storm windows, consider these questions:

- ✓ **Are your current windows still in good condition?** Storm windows work best when installed over working primary windows that are in good condition. If your current windows are rotted or damaged beyond repair, adding low-e storm windows may not be appropriate. Instead, consider replacing them with new ENERGY STAR certified windows.
- ✓ **Are your current windows single-pane or double-pane with clear (not low-e) glass?** Low-e storm windows offer the most savings potential when installed over single-pane windows and double-pane windows that have only clear glass.
- ✓ **Do your current windows have metal frames?** It is very important to use thermal breaks (small non-metal separators) when installing ENERGY STAR certified primary windows over metal-framed primary windows. Storm windows typically have aluminum frames, and this can conduct outside heat or cold through the metal frame of the primary window, diminishing the expected comfort and energy savings.
- ✓ **Is your home historic?** Low-e storm windows can be a good option if you live in a neighborhood with historic preservation requirements or you like the historic look of your original windows. Check to make sure that the historic preservation requirements in your neighborhood (if any) allow the use of storm windows.
- ✓ **Are your current windows tinted?** If your current windows already have tinted glass, adding a low-e storm window may reduce the visible light transmitted through the window, making them even darker. Some people prefer tinted glass to reduce glare, while others prefer more daylight.
- ✓ **Do your current windows open and close?** Interior and exterior storm windows are available in both operable and fixed models. Choose a storm window that matches the operability of your current windows. This is especially important when installing storm windows in bedrooms and other places where an emergency exit (or egress) may be needed in the event of a fire. Local building codes may require egress in certain locations.
- ✓ **Are your current windows difficult to clean?** Adding storm windows to older, difficult-to-open windows may make cleaning windows more difficult. Consider operable storm windows with multiple tracks that allow the glass to drop down for cleaning.
- ✓ **Is your neighborhood or street noisy?** Adding storm windows can be an inexpensive way to significantly reduce noise from outside, making your home more peaceful.

- ✓ **Do I need my storm windows to have safety glass?** Safety glass is stronger than regular glass and is designed to shatter into little pieces (instead of larger, more dangerous shards) when broken. There may be state or local residential building codes that require safety glass in storm-prone regions or more accident-prone locations in the home (near stairs, for example) to reduce the likelihood of injury. Check your local building code requirements for more information.

- ✓ **Do you live in a place where the temperature gets extremely hot (above 115 degrees Fahrenheit)?** In very hot climates and under certain conditions, low-e storm windows can trap heat between the original window and the storm window. If you already have double-pane or low-e coated windows **and** you live in a hot, sunny climate where the temperature frequently goes above 115 degrees Fahrenheit, you should consider awnings, solar screens or full replacement with ENERGY STAR certified low-SHGC windows as an alternative to storm windows.

- ✓ **Should you have a professional install your ENERGY STAR certified storm windows?** If your ENERGY STAR storm windows are not installed correctly, you may not realize all of the possible energy savings benefits. Professional installers can correctly install storm windows and inform you of local building code requirements and other considerations. Installing storm windows is typically easier than installing full replacement windows, but still requires skill and patience to get a proper fit. All ENERGY STAR storm windows are required to include (or have a Web link to) detailed installation instructions.