

## Component Substitution for Hurricane Impact Fenestration

### Introduction

Thousands of impact resistant windows, doors, and skylights have been tested and certified since Hurricane Andrew ravaged South Florida in 1992, causing billions of dollars in property damage. As a consequence of the damage inflicted by Hurricane Andrew, more stringent standards for window and door systems were adopted which required testing full systems. Changes to any component--including framing materials, glazing, sealants, weather stripping, hardware and anchors typically necessitated retesting and recertification.

In order to reduce the cost to the consumer of this retesting as window and door systems were improved, rules were developed by Miami-Dade Product Control on what component changes required re-testing and what that testing needed to be. Miami Dade component substitution rules are not contained in a single document and are therefore not addressed in this document

ASTM International developed a formalized system of component substitution which is similar to the Miami-Dade rules. ASTM E1996 *Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes* contains an appendix with this substitution criteria. This document should be read in conjunction with that Appendix.

### How Does Component Substitution Get Determined?

The appendix of ASTM E1996 covers various types of fenestration and window systems, general substitution principles and detailed substitution allowances for glazing and framing systems. The basic objective of the substitution criteria is to balance reliability, safety and the need for feasible testing regimes. There are four substitution categories:

1. Automatic – requiring no additional testing;
2. Engineering Analysis – requiring demonstrated or documented performance through a review of materials that predicates a minimum of equivalent performance; and
3. Single Specimen – requiring one specimen, identical to the original specimen qualified with the only difference being the element to be substituted (i.e. interlayer type for laminated glass).
4. Not allowed, which means a complete retest of the fenestration with changes is required.

Full qualification is defined as a minimum of three new specimens being qualified with no credit given for any past test specimens. *This document covers the basic substitution information for glazing only. The full guidelines can be found in ASTM E1996.*

### General Rules for Substitution

General premises for substitution require that three initial specimens out of four have passed all the appropriate criteria in ASTM E1996 and that the original specimens are identical in every way, including anchorage and mounting. The general premises that apply to any substitution are:

- Large size qualifies smaller as long as dimensions do not exceed dimensions of tested width or height.
- Small missile – all elements that are not infill elements shall be allowed automatically.
- Automatically substituted elements shall be allowed to be combined into a system without requiring engineering analysis or testing.
- New components shall be equal to or stronger than the components originally tested.
- Substitution shall not raise the design pressure above that at which the three initial specimens were qualified.
- Substitution not allowed if a failure occurs for ANY reason.
- No more than THREE substituted elements may be combined before a full retest is required.
- Glazing tapes, sealants, adhesives & back bedding substitution requires a single specimen test.
- Glazed products must be impacted twice per unit (even if initial panels only had one impact per unit).

#### **Glass Infill Panels Rules:**

- Color change is automatic, no additional testing is necessary.
- Substitution of a glass coating (reflective, coated, low-e, frit, etc. ...) is allowed when supported by engineering analysis that the product is durable and compatible with all the components of the system.
- Individual non-sacrificial glass ply thickness increase shall require the testing of one additional specimen. A substitution with a decrease in glass ply thickness shall not be allowed.
- A non-sacrificial glass type change from annealed to heat strengthened or chemically strengthened shall require the testing of one additional specimen.
- Glass type change from heat strengthened to annealed or heat-strengthened to chemically-strengthened shall not be allowed.
- Glass type change “To” or “From” fully tempered shall not be allowed.
- Glass decorative surface (sandblasted, acid etch etc.) substitution shall require a single test specimen.

#### **Rules for Interlayers**

- Any substitution of interlayer manufacturer or type shall require the test of one additional specimen that is identical to the initial three qualified with the only change being the interlayer type or brand.
- Decrease of the interlayer thickness of more than 10% for the same type interlayer as was originally qualified shall not be allowed.
- A decrease of interlayer thickness up to 10% for the same type or brand interlayer as was originally qualified shall require one test.

- Increase of the interlayer thickness of the same manufacturer and type as was originally qualified is automatically accepted.
- A change of interlayer color of the same manufacturer and type as was originally qualified is automatically accepted.
- Interlayer decorative treatment of the same manufacturer and type as was originally qualified is automatically accepted provided the decorative treatment does not contact the glass or plastic glazing. (Is located between two layers of interlayer)

### **Rules for Insulating Glass Units**

Rules for IG units involve recognizing a couple of concepts and some pre-conditions before substitutions are considered. These are:

- In an IG unit, one lite typically provides the impact resistance (usually a laminated lite) and the other lite is considered to be sacrificial.
- The impact resisting lite shall be the same type and treatment, with equal or greater ply thickness, and equal or greater interlayer thickness
- Glazing details need to be the same as originally tested (including glazing sealants, adhesives, stops, etc.) other than to accommodate any variations in overall glazing thickness.
- The impact resistant lite must be structurally adhered to the sash or frame
- Some glazing systems have removable stops that are non-structural. These can be removed for testing and have different requirements for substitution.

Once these pre-conditions are met, the requirements are divided based on whether all stops are in place when tested or non-structural stops are removed.

IG substitutions for systems tested with the non-structural stops removed:

- Single lite to insulating glass changes are allowed automatically. Changing from insulating glass to single lite is not allowed.
- Sacrificial lite changes in glass thickness and type are allowed automatically.

IG substitutions for systems with all stops in place for testing:

- Single lite to insulating glass changes requires one additional specimen. Changing from insulating glass to single lite is not allowed.
- Sacrificial lite changes from annealed to heat-strengthened, annealed to fully tempered, and heat-strengthened to fully tempered are allowed automatically, provided the above preconditions are met.
- Increase in Sacrificial lite thickness shall be allowed automatically; however, reduction of sacrificial lite thickness shall require a single test specimen.
- Sacrificial lite changes from a monolithic to a laminated lite are automatic

Insulating Glass Unit Spacers:

- A change in spacer type, shape, or dimension shall require a single test specimen if the approved system was originally tested as an insulated glass unit

- If the resisting lite is structurally adhered to the sash or frame, a change in spacer type, shape, or dimension is allowed automatically.

### **Conclusion**

Complete systems must be designed and tested for hurricane impact glazing. Hurricane component substitution rules allow manufacturers to reduce costs in certifying new glazing components if they are tested in an already approved system. This can translate into lower product development costs and allows manufacturers to widen their product offerings more rapidly in an effort to respond to changing market or project needs, all while offering the customers the best glazing solution possible.

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