Expert Series:

Hurricane Impact Resistance

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Buildings along coastal areas of the United States are prone to hurricane damage. The damage is often related to penetration of airborne debris during a hurricane, leading to breach of building envelope that allows excessive internal pressure and water leakage into the building. This increased internal pressure inside the building can cause failure of the building structure. To protect the building envelope from hurricane damage, building codes in these regions call for hurricane glazing resistance systems, also known as impact systems, for new construction and renovation projects.

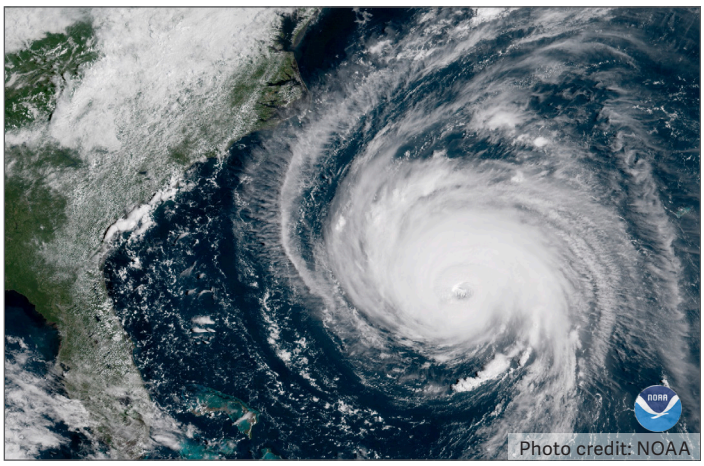


Photo credit: NOAA

Code Requirements

In the US, the International Building Code (IBC) addresses glazed openings in windborne debris regions, specifying that they must be impact resistant or protected with an impact-resistant covering.

Wind-borne debris regions are defined as areas within one mile of the coastal mean high-water line where the basic design wind speed is equal to or greater than 130 mph, or areas where the basic design wind speed is equal to or greater than 140 mph.

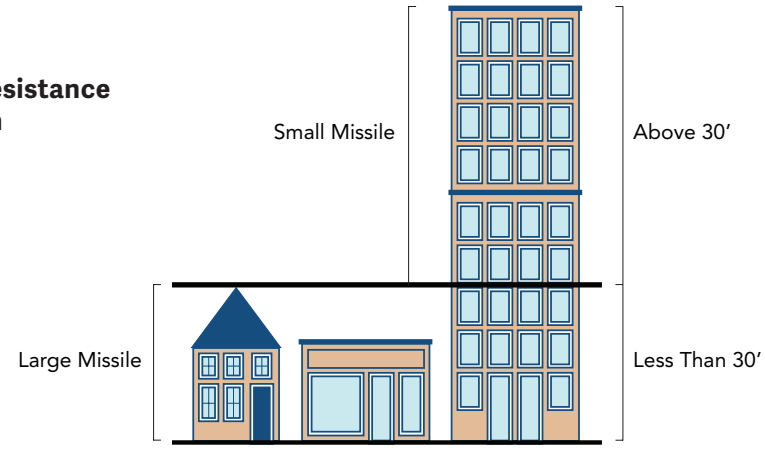
Wind-borne Debris Areas
Gulf and East Coast (approx.)

Because failure of glazing systems has been the leading cause of building envelope breaches by windborne debris, the code requires impact systems – including the glazing, frame, and anchorages – to be successfully tested in accordance with the following standards:

- ASTM E1996: Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
- ASTM E1886: Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials

Large missile impact resistant products are required for glazing located within 30 feet above grade while small missile impact resistant products are required for glazing located more than 30 feet above grade as shown in the following diagram.

Missle Impact Resistance Diagram



While most coastal states reference the IBC and integrate ASTM E1996 and E1886 within their codes, glazing in buildings located within Miami-Dade and Broward Counties in Florida are required to be impact resistant or to be protected with impact-resistant coverings tested in association with the following standards:

- Florida Building Code TAS 201: Impact Test Procedures
- Florida Building Code TAS 202: Criteria for Testing Impact & Nonimpact Resistant Building Envelope Components Using Uniform Static Air Pressure
- Florida Building Code TAS 203: Criteria for Testing Procedures Subject to Cyclic Wind Pressure Loading

Product Testing

For the large missile impact test, a glazing system (glass, frame, and anchorage) must withstand a piece of 2" x 4" (51 mm x 102 mm) timber at a specific weight and impact speed without penetration. After the testing, the glazing system is subjected to cyclic pressure loading to simulate a hurricane windstorm.

For the small missile impact test, a glazing system must successfully handle impact from 2-gram solid steel balls at a speed of 130 feet per second. Similar to the large missile impact test, the glazing system is subsequently subject to cyclic pressure loading.

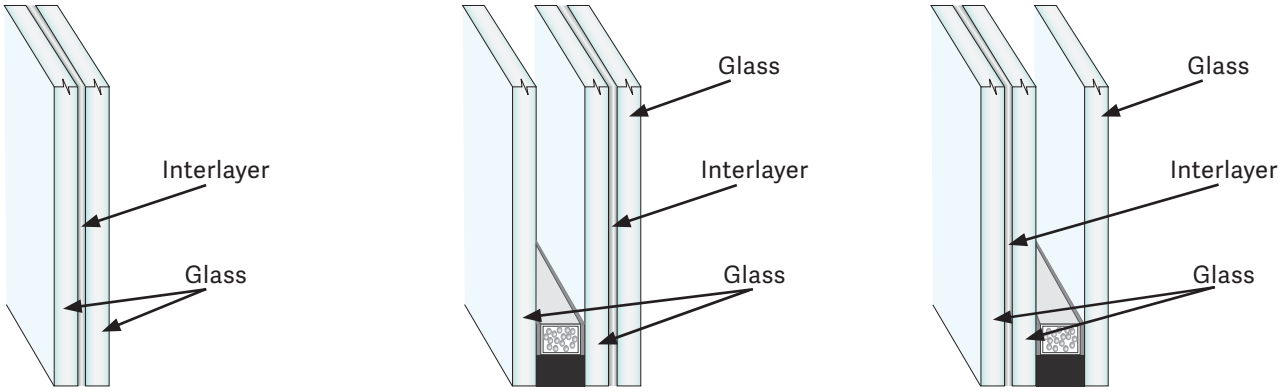
Glazing Solutions

Conventional glazing systems typically use double insulating glass units, that is, two lites of glass separated by a spacer. However, impact systems primarily utilize laminated glass.

Laminated glass typically consists of two glass lites bonded together with a plastic interlayer. Under sufficient impact force, laminated glass will break but the shards will tend to adhere to the interlayer, helping to prevent water and air from entering a building. Monolithic laminated glass or an insulating glass unit (IGU) with a high performance low-e coating on the #2 surface and inboard laminated glass is commonly specified for the application. Inboard laminated glass is preferred for building occupant protection from glass shards upon debris impacts. Yet outboard laminated glass may be chosen to support specific performance of framing systems and impact protection.

In general, a minimum 0.060 inch (1.52 mm) interlayer thickness is commonly specified for small missile impact resistance, and a minimum 0.090 inch (2.29 mm) interlayer thickness is commonly specified for large missile impact resistance.

Common Glass Configurations for Hurricane Imapct Resistance



Monolithic Laminated **Inboard Laminated IGU** **Outboard Laminated IGU**

Most glazing in impact systems commonly incorporates low-e coatings to improve building energy efficiency and tinted glass to achieve specific aesthetic and control heat gain from solar energy. As hurricane debris impact resistance performance relates primarily to the structural capacity of the glazing, the use of low-e coatings and tinted glass does not influence this functionality.

High-performance low-e coatings are comprised of microscopically thin layers of metal oxide and are widely used to improve energy performance of glazing by reflecting direct solar radiation as well as energy in the far infrared part of the spectrum.

Tinted glass is made by adding colorants to batch material during the float glass manufacturing process to create a desired color. Tinted glass has lower solar transmittance than standard clear float glass. It is often used to reduce solar heat gain from entering the building and achieve specific aesthetic intents.

Conclusion

Hurricane-related performance is established by physically testing a glazing system relative to impact forces and cyclic pressures. A glazing composition that is approved with a specific framing system for hurricane-related performance must satisfy all code requirements applicable to the project.

Learn More About Hurricane Impact Resistance

If you need more information, Guardian's Technical Services group is available to assist with questions about hurricane impact resistance. Please contact Guardian at https://www.guardianglass.com/us/en/contact or call 855-58-GLASS (45277).

Please note: This information is provided as a convenience and is not to be construed as an assumption of responsibility or liability for design and application choices, which remain the responsibility of the design professionals involved in any project. It is the responsibility of the design professionals to ensure that the intended application is appropriate and complies with all relevant laws, regulations, standards, codes of practices, processing guidelines and other requirements. It does not constitute legal advice, a modification of Guardian's standard warranties, or an additional warranty of any kind.

