**WEB BASED APPLICATION SPECIFIC INSTALLATION INSTRUCTIONS**

# Wind and Storm Protection

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# Specifying the Proper Product

## Five steps to Design, Specify and Install storm-resistant windows.

**1. Consider Wind Zone and Exposure**
Building codes contain maps detailing basic wind speeds that can be expected in any area of the United States over a 50-year mean recurrence interval. These are the starting point for calculating an exterior opening's exposure to pressures from high winds. In addition to design wind speed, a building is rated with an exposure classification which indicates the level of sheltering around the building. Exposure classifications range from A (city center with tall buildings surrounding) to D (flat, unobstructed area exposed to wind flowing over open water).

Because vast expanses of open land or water allow unobstructed wind movement, the best practice is to site windows on walls where natural landscape features, like tree buffers or dunes, protect them from direct wind. If tree buffers are created, plantings should be located farther away from the structure than their expected height at maturity.

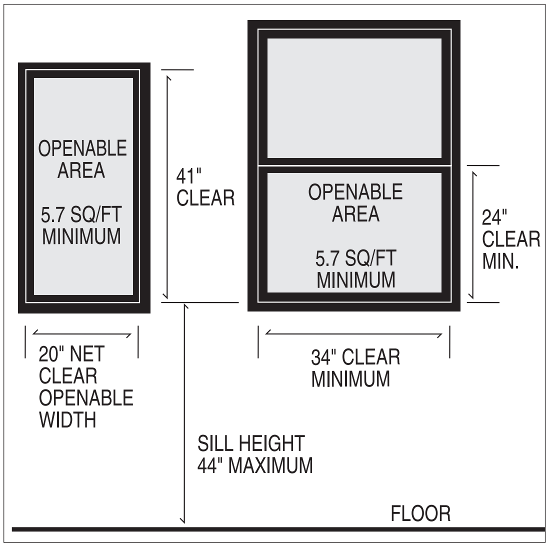
Obstructions on a building's façade, like bay windows and cantilevered decks, create vortexes for wind movement. Where these architectural features are present, builders should ensure that cladding and structural attachments have been properly designed and attached.

**2. Identify Products That Work for the Region**
**A. Performance Classification**
The building codes require all windows to meet wind-driven rain conditions under the testing standard "Voluntary Specifications for Aluminum, Vinyl (PVC), and Wood Windows and Glass Doors," AAMA/NWWDA 101/I.S.2. The standard establishes five classes of windows based on the (wind) design pressure (DP) that the window was tested to, as detailed in the specifications. A DP of 40 is equal to a 155-mph wind. You can determine necessary design pressures from the Table of Equivalent Wind Velocities.

**B. Impact Resistance**
In addition to the force of wind and wind-driven rain, homes are often struck by airborne debris from compromised structures and landscaping during storms. Therefore, building codes also require that window and door products installed in homes in areas where winds exceed 110 miles per hour meet tests for impact resistance. The tests mimic the window, door, curtain wall, or protective covering being struck by gravel traveling at 80 feet per second (called small missiles) or a 2x4 stud traveling at 50 feet per second (called a large missile) and undergoing repeated strikes. The Florida Building Code (FBC) requires that windows in high wind zones located within 30 feet of the ground meet the large missile test criteria and those higher than 30 feet from ground level meet the small missile test criteria.

**C. Energy Efficiency**
In addition to resistance to high wind, windows should be selected for energy efficiency and function. The easiest way to select the most energy-efficient window for a climate is to choose one bearing the ENERGY STAR© logo. In the absence of that designation, windows can be selected based on their thermal and other properties. The National Fenestration Rating Council (NFRC) operates a voluntary labeling program which provides efficiency information to consumers.

**3. Size Windows for Egress**
Bedrooms and habitable sub-grade basements require windows sized for escape or entry (by rescue personnel) in the event of a fire. The International Residential Code (IRC) requires a minimum opening width of 20 inches with 5.7-sqft minimum free area at a sill no higher than 44 inches from the floor.




Depending on the manufacturer, this requirement can usually be met with a 26x48 or larger double-hung unit. It is important to consider that inoperable hurricane shutters, like homemade plywood coverings that are applied from the exterior, will impede quick exit or entry when in place, as will shutters that require power to operate if the power source goes out during a storm.

**4. Follow Manufacturer's Installation Instructions**
Ultimately the day-to-day and disaster mitigating performance of window and door components depends on competent installation. Manufacturers provide detailed installation instructions. This and trade contractor quality assurance programs assure builders that the units have been professionally installed.

**5. Consider Installing Shutters**
Shutters or other temporary coverings can provide impact resistance to windows and other openings. Miami-Dade County has a searchable database of products that comply with FBC.

**Code Considerations**
The International Residential Code (IRC) requires exterior windows and doors to be designed to resist the design wind loads specified in Table R301.2(2) adjusted for height and exposure per Table R301.2(3) and that they be tested and labeled.

Labels must include manufacturer, performance characteristics, approved inspection agency, and compliance with the requirements of either AAMA/NWWDA 101/I.S.2, or the new version, AAMA/WDMA 101/I.S.2/NAFS, Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.

Ten years after Hurricane Andrew caused an estimated $26 billion in property damage that displaced 250,000 people, Florida became the first state in the nation to create building codes that addressed the extreme wind conditions experienced during tropical storms in coastal regions. The Florida Building Code (FBC) requires that buildings be designed to withstand design pressures (DP) that are a function of wind zones mapped for mainland Florida and the height and exposure of the structure.

The International Residential Codes (IRC) of 2000 and 2003 and some Gulf Coast states' adoption of the IRC, as well as the pending FBC addition of additional wind zones in the Florida Panhandle, will place all coastal states under similar wind design prescription.

Per the FBC, protection of exterior windows and glass doors from windborne debris in buildings located in hurricane-prone regions is required in Miami-Dade and Broward Counties.

A Miami-Dade County Notice of Acceptance (NOA) for impact-resistant products is one way to ensure that a window has been tested and meets all the requirements for hurricane protection in the highest wind velocity zones. The Florida Building Commission recognizes Miami-Dade NOAs as approved products.

**Impact-Resistant Doors**
Impact-resistant doors have been tested and labeled for their ability to withstand wind-born projectiles. They often include impact resistant glass, although the method of attachment also affects a door's impact-resistance. Make sure to look for appropriate labels designating the tested characteristics of an impact-resistant door.
Sliding glass doors are larger and more vulnerable to wind and debris than most doors and windows. Use impact-resistant glazing where possible, or at the very least install hurricane shutters.

**Reinforced Garage Doors or Single-Car Openings**
Often, due to its large size and the relatively weak materials of its construction and hardware, the weakest opening point in a home is a garage door. Garage doors can now be constructed, tested, and rated for impact and wind resistance. The marginal cost of a rated garage door is only $200 to $300 over a door without wind-resistant features.

A retrofit kit to strengthen an existing two-car garage door will cost about $300. A kit usually consists of a vertical post that is placed between the roof and the concrete floor, although other systems also exist.

**Cost Comparison of Impact-Resistant Materials:**
**Based on Figures for 2,250 sq. ft Home**

| | |
|---|---|
| Plywood Shutters | $ 743 |
| Temporary Panel Shutters | $ 4,084 |
| Accordion Shutters | $ 5,940 |
| Swinging Shutters | $16,707 |
| Electric Roll-up Shutters | $22,275 |
| Impact Resistant Glass | $14,850 |

Single-car openings are more resistant to strong winds than two-car garage doors.

Hurricane Shutters or Impact-Resistant Glass Shutters can be made of many materials like wood sheathing, acrylic, or steel panels, which have passed the appropriate tests and are properly fastened to structural frames.

Metal hurricane shutters are easily installed on most existing homes. In some designs, hurricane shutters can be electrically rolled down to protect the home.

**Window Glass and Impact Resistance**

Impact-resistant glass is optimal for windows not easily fitted with hurricane shutters or those that are hard to reach. Impact-resistant windows are made from glass laminated with composites that provide enough strength to allow windows to withstand high winds, projectiles, or even bullets.

This impact-resistant glazing can reduce the risk of window failure and personal injury or property loss during tornadoes, hurricanes, and explosions. When struck, laminated glass may crack or shatter, but the glass fragments tend to adhere to a plastic layer and stay in place.

**Window Glass and Energy Efficiency**

Windows comprise by far the largest single portion of the cooling load everywhere in Florida. In this example they comprise about 26% of the cooling load. They may be controlled by shading, either by external overhangs or by the physical properties of the glazing used in the window. The thermal insulating property (U-value) of a window has virtually no impact on its ability to control cooling loads in buildings.

On the other hand, the shading characteristics of the window have a major impact. This is caused by two facts:

- The cooling load arising from windows derives almost exclusively from solar energy passing through the glass, being absorbed by materials within the home and being transformed into heat that must be removed by the air conditioner, and
- The average daily temperature difference (what the U-value protects against) between the outside and inside of the building is small during the cooling season.

Long exterior roof overhangs (porches) on the east and west faces of a home can significantly reduce the cooling load impact of windows.

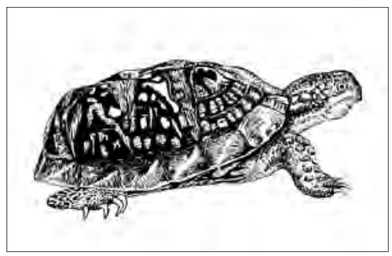
Overhangs, however, are not nearly as effective on the north and south faces of the building because direct sunlight strikes the south facing windows at a very high angle in summer and the large majority is reflected, and there is very little direct sunlight that falls on north facing windows.

The other approach to controlling window cooling loads is to use better windows. What's best are "solar control" windows, explicitly designed for southern climates. These products work by allowing light to enter the window but at the same time keeping heat out. This is possible because over half of the energy content of sunlight is in wavelengths that are not visible to the human eye. Thus, these windows and doors have been specifically designed to "selectively" admit only the visible portion of the sunlight that strikes the window. They are referred to as spectrally selective glazing because they admit only the beneficial part (visible light) of the sunlight spectrum.

To determine which window is best, consider a new term - the "coolness ratio." The coolness ratio is the ratio of the visible light transmittance (VLT) of the window divided by the solar heat gain coefficient (SHGC) of the window. The greater this coolness ratio, the lower the cooling load caused by each unit of window - it's as simple as that.

The typical double-glazed, clear windows used in this example have a VLT around 0.57 and an SHGC around 0.61, so they have a coolness ratio around 0.93. Typical "solar control" (spectrally selective) windows on the market today might, for example, have a VLT near 0.54, an SHGC near 0.28 and a coolness ratio of about 1.9, meaning that they are twice as efficient cooling as the conventional clear, double-glazed windows used in the example home.

**Turtle Glass**



In March 1993, the Florida Department of Natural Resources adopted the Model Lighting Ordinance for Marine Turtle Protection to protect marine turtles. Specifically, the statute requires local governments to establish guidelines to control beachfront lighting to protect hatching sea turtles from the adverse effects of artificial lighting. It also provides an overall improvement in nesting habitat degraded by lighting pollution to increase successful nesting activity and production of hatchlings.

The standards for artificial lighting sources on all new coastal construction, in addition to location, positioning and wattage of lighting fixtures, includes the use of tinted glass on all windows and doors of single or multi-story structures within line-of-sight of the beach. Tinted glass means any glass treated to achieve an industry-approved, inside-to-outside visible light transmittance value of 45% or less (visible spectrum = 400 to 700 nanometers) and is measured as the percentage of light transmitted through the glass.

Such tinted glass shall be installed on all windows and glass doors of a single or multi-story structure within line-of-sight of the beach.

The standards for fenestration products in existing beachfront construction shall reduce or eliminate the negative effects of interior light emanating from them. Several suggestions include applying window tint or film that meets the criteria established for tinted glass in new construction, rearranging lamps and other moveable light sources away from windows, or use of window treatments (e.g. blinds, curtains, shutters) to block light

### Specifying Windows

Windows and doors are usually selected for their structural performance characteristics based on local or state building code requirements. The primary consideration is structural integrity of the window or door, to keep it intact and prevent the pressure of high-velocity wind from entering the building and causing catastrophic structural damage.

In tropical storms and hurricane wind-driven rain conditions the product selected to meet the state and local code requirements may still experience water leakage because these extraordinary conditions exceed the rated/code requirements for water penetration.

### Testing Requirements

To meet building codes, windows and doors within hurricane areas must pass certain requirements, such as impact resistance and wind pressure tests. These requirements vary by area, so consult your builder or contractor for specific criteria. Different testing results are required in each of the four wind-borne debris regions.

### Wind Pressure

The wind that blows at a window or door, and the wind that blows past a window or door creates a pressure. The pressure created by the wind blowing at the window or door is specified by a positive DP (Design Pressure) number. The amount of pressure created by wind that blows past or by a window or door is specified by a negative DP number.

### Design Pressure ratings

Homes in any of the wind-borne debris regions must also have windows and doors with specific design pressure (DP) ratings, which include positive and negative numbers. Positive corresponds to pressure created by wind blowing at a window and door. Negative represents vacuum pressure on the inner side of the window or door. DP rating requirements are site specific, so consult the architect or contractor for the ratings needed for your area.

### Wind Zones

**ZONE 1** Areas within 1 mile of the mean high tide line with winds 110 mph and up to 120 mph

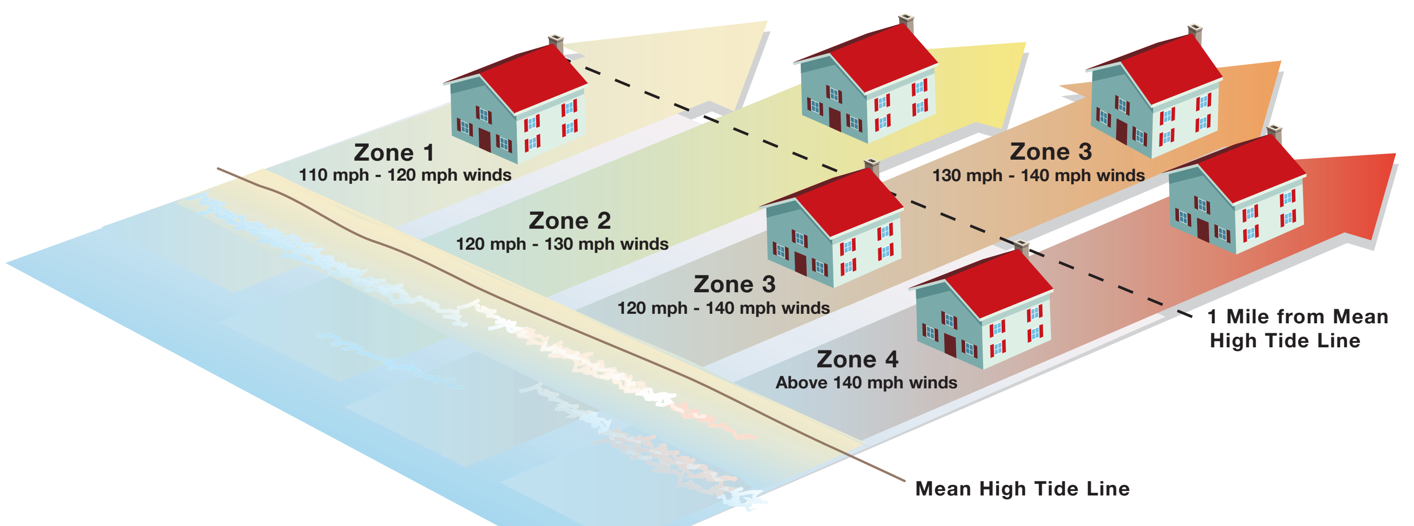
**ZONE 2** Areas more than 1 mile from the mean high tide line with winds 120 mph up to 130 mph

**ZONE 3** Areas with winds 130 mph and up to 140 mph; or 120 mph and up to 140 mph within 1 mile of the mean tide line

**ZONE 4** All areas with winds in excess of 140 mph (high-velocity wind zones)

### Confirming Qualified and Tested Products

On the Internet: *http://www.miamidade.gov/buildingcode/pc-search_app.asp*




**WIND BORNE DEBRIS REQUIREMENTS**

| Wind-borne debris region | Impact resistance requirement | Wind pressure requirements |
|---|---|---|
| ZONES 1&2 | Must withstand a 4-foot-long 2x4 at 40' per second (27 mph) | Hurricane loads up to 9,000 wind cycles |
| ZONE 3 | Must withstand an 8-foot-long 2x4 at 50' per second (34 mph) | Hurricane loads up to 9,000 wind cycles |
| ZONE 4* | Must withstand an 8-foot-long 2x4 at 50' per second (34 mph) | Hurricane loads up to 9,000 wind cycles |

*Impact resistance testing for Zone 4 may also include multiple hits per test unit and mullions.

The storm resistant window requirement headed north when the new International Residential Code began mandating them all the way up the eastern seaboard, but not all areas need the same windows as South Florida.

Windows must meet a “design pressure” requirement that’s determined by a number of factors, the most important of which is the geographic wind speed zone the house is in.

As we have discussed, windows in high wind areas need to be able to stand airborne debris and window driven rain. While the toughest conditions and therefore the toughest standards are in South Florida, the IRC has defined high wind areas all up and down the East Coast as the map below shows.

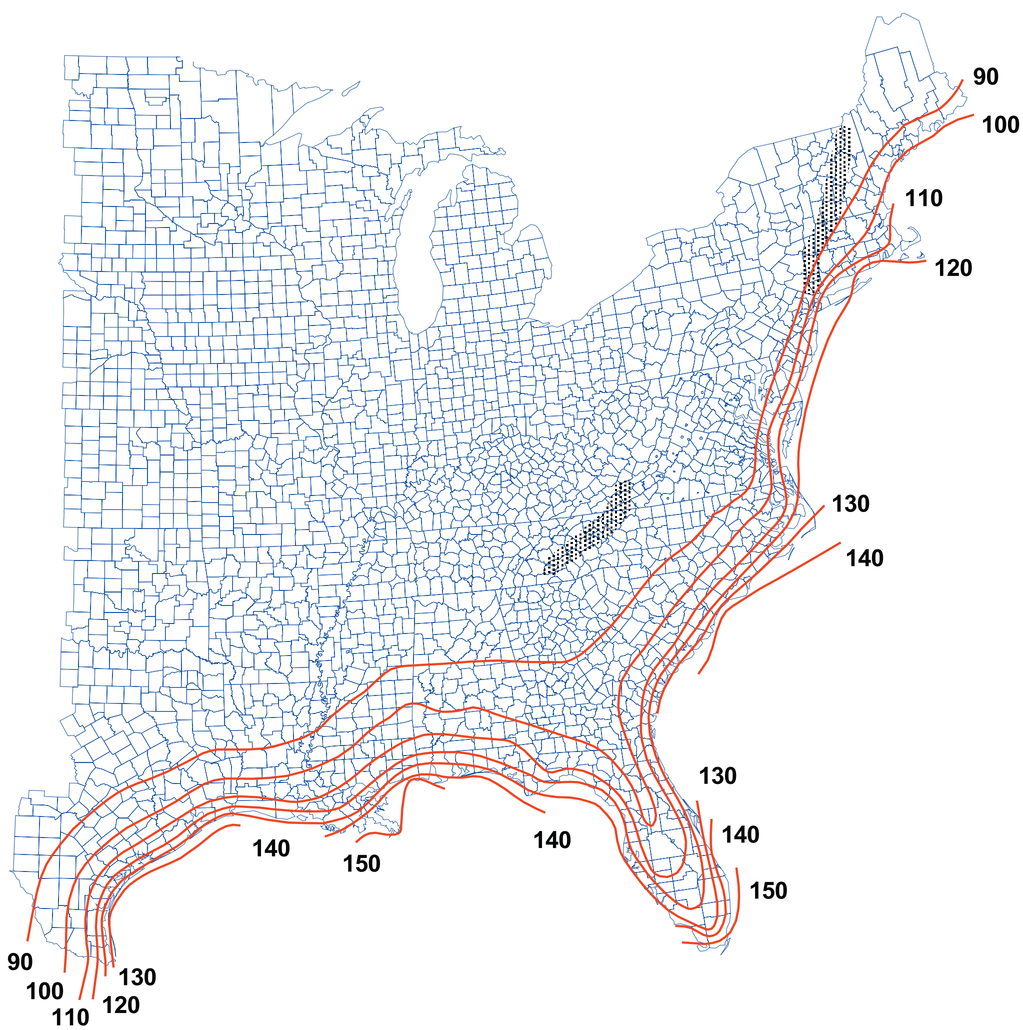
Design pressure is the determining factor, and the wind zones dictate that pressure. As we have learned from recent storms, all damaging hurricanes are not necessarily limited to Florida. Coastal installations are applicable to all coastal regions.

While the geographic wind speed map is the starting place, other variables come into play. Structures right on the beach (as shown in our diagrams) have the toughest requirements because they bear the brunt of any storm.

Homes a few miles inland generally have a lower design pressure, because the code assumes that surrounding structures will provide some shelter from the wind.

Downtown urban areas might get an additional break because of the shelter provided by tall buildings. The heights of the structure and the surrounding structures also come into play, as does the size of the opening. Buildings that are critical to the community, such as fire stations and hospitals, have tougher requirements than other structures in a particular zone. Local codes will usually be specific. Many regions use Dade-County as default, for example.

Design pressure calculations can get extremely complex. Most manufacturers are happy to provide help in determining qualifications of their products for certain applications. However, you should confirm the product’s performance ratings with the local building department if you are charged with specification and/or ordering.




**Coastal Wind Load Considerations**

The Map Shows the Wind Load Design considerations for States and Counties subject to the Coastal Weather that brings higher windows and moisture from storms.

*Source: IRC*

# Window Types and Labels

## Everything you need to know is on the window label

**Permanent Window Labels**
The permanent labels allows 1) manufacturer and product information and 2) the performance rating to be tracked for the life of the fenestration product. These labels are placed on certified products and are usually affixed on and interior part of the product between the frame and sash or the frame and door. The label should be visible after the products have been installed. Three types of permanent labels can be found on fenestration: AAMA, NWWDA or NAMI/AAMA Labels.

The American Architectural Manufacturers Association (AAMA) certification label serves the purpose of identifying fenestration products that conform within specific tolerances. The design and fabrication of fenestration models are tested in accordance with the procedures established by the AAMA Certification program and have met the requirements of the specification printed on the label. The fenestration products include windows, doors and skylights manufactured from aluminum, vinyl, fiberglass, composites and a combination of these materials with wood.

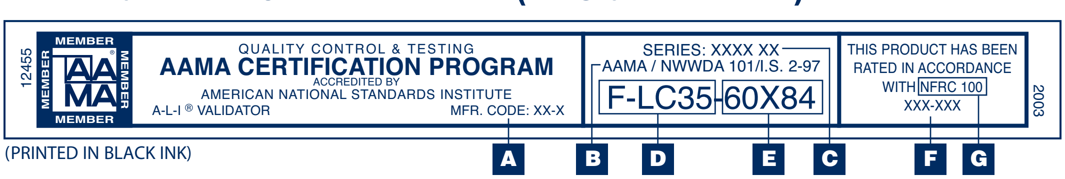
AAMA certification is third party certification. The third party is and outside organization not under the control of influence of AAMA. This third party is responsible for the validation and administrative functions for the program.

AAMA accredits independent third party laboratories that test the performance of the manufacturer's products.

The most important function of certification is the assurance that products bearing the label do, in fact, meet the requirements of the standard. AAMA rates the window's ability to withstand wind loads, water resistance and the air infiltration rate.

The higher the grade, the better the window's performance.

### PRIME & REPLACEMENT LABEL (AWS & THERMAL)

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- **A** Manufacturer's Code Number. Code number is required, but manufacturer may also show company name
- **D** Product Type, Performance Class (design pressure), and Performance Grade
- **B** Air, Water, Structural Specification Identification
- **E** Maximum Size Tested
- **G** Thermal Specification Identification
- **C** Manufacturer's Series Number
- **F** NFRC – assigned manufacturer's code and product line number

**Product Designation**
AAMA certified window and door products are designated by a four-part code, which includes product type, performance class, performance grade, and maximum size tested. A typical code will look like this: **HS - R - 25 - 48x76**

In this example, HS is the product type, R is the performance class, 25 the performance grade and 48x76 the maximum size tested (width x height).

**Product Type**
The AAMA permanent labels are placed on sixteen different window product types. These products type designations and the abbreviated forms are shown here.

| | |
|---|---|
| **AP** | = Awning, Hopper or Projected Windows |
| **BW** | = Basement Windows |
| **C** | = Casement Windows |
| **DA** | = Dual Action Windows |
| **DA-HGD** | = Dual Action Hinged Glass Doors |
| **F** | = Fixed Windows |
| **GH** | = Greenhouse Windows |
| **H** | = Hung Windows (Single, Double, Triple) |
| **HE** | = Hinged Egress |
| **HGD** | = Hinged Glass Doors |
| **HS** | = Horizontal Sliding Windows |
| **J** | = Jalousie Windows |
| **JA** | = Jalousie-Awning Windows |
| **SHW** | = Side Hinged In swing Windows |
| **TA** | = Tropical Awning Windows |
| **TH** | = Top Hinged Windows |
| **VP** | = Vertically Pivoted Windows |
| **VS** | = Vertical Sliding Windows |

**Performance Class**
The AAMA permanent labels are affixed the five different classes of window and door products shown below.

**R = Residential** **LC = Light Commercial**
**C = Commercial** **HC = Heavy Commercial**
**AW = Architectural**

**Performance Grade**
Performance is designated by a number that follows the type and class designation. For example, Double-Hung Residential window may be designated HR15. The number establishes the design pressure, in this case 15 psf. The structural test pressure for all windows and doors is 50% higher than the design pressure which, for the example HR15 window, would have been successfully tested at 22/.55 psf structural test pressure. Minimum design pressure, structural test pressure, and water resistance test pressures for the five classes in pounds per square foot are shown here.

| Window and Door Classes | Design Pressure | Structural Test Pressure | Water Resistance Test Pressure |
|---|---|---|---|
| Residential | 15 | 22.5 | 2.86 |
| Light Commercial | 25 | 37.5 | 3.75 |
| Commercial | 30 | 45.0 | 4.50 |
| Heavy Commercial | 40 | 60.0 | 6.00 |
| Architectural | 40 | 60.0 | 8.00 |

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