AIA Florida Spring Series Webinar

Designing Glazing for Windborne Debris Protection

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Marketing Manager – Americas

trosifol™ world of interlayers

kuraray

Who is Kuraray, Trosifol® & SentryGlas?

Kuraray = Our company name - HQ in Japan

Trosifol® = Our business name & PVB product name

The broadest product portfolio of laminated glass interlayers

Safety

- Trosifol® Clear
- Trosifol® UltraClear
- SentryGlas®

Decorative

- Trosifol® Color
- Trosifol® Tints
- Trosifol® Black & White

Acoustic

- Trosifol® Sound Control
  - Trosifol® SC Monolayer
  - Trosifol® SC Multilayer

Structural & Security

- Trosifol® Structural
  - SentryGlas®
  - SentryGlas® Natural UV
  - SentryGlas® Xtra™
  - SentryGlas® Translucent White
  - Trosifol® Extra Stiff
- Hurricane Glazing

Specialized Applications

- Trosifol® Specialized
  - Trosifol® HR
  - Trosifol® UV Extra Protect
  - Trosifol® Natural UV
  - Trosifol® XT
  - SentryGlas® Natural UV
  - Spallshield® CPET

Auto/Trans-portation

- Trosifol® Clear
- Trosifol® Shadeband
- Trosifol® Color
- Trosifol® Spallshield® CPET
- SentryGlas®
- Trosifol® Acoustic
- Trosifol® The Wedge

Recycled

- Butacite® G

- SentryGlas® used to be called SentryGlas® Plus (“SGP”). DuPont dropped the “Plus” and now it is called SentryGlas®.
- You may also see SentryGlas referred to as SG or Sentry. Ionoplast is the generic name for laminated glass ionomers.

Kuraray AIA 1-hr Lunch & Learns

Program Number and Title

1. KUR2004.21 Introduction to Laminated Glass
2. KUR2008.21 Designing with Structural Laminated Glass Interlayers
3. KUR2011.21 Enhancing Security with Laminated Glass
4. KUR 2012 Enhancing School Security with Laminated Glass
5. KUR2013.21 Designing Safer Glass Railings with Laminated Glass
6. KUR 2015 Decorative Laminated Glass
7. **KUR 2018 Designing Glazing for Windborne Debris Protection**
8. KUR 2019 Laminated Glass for Sound Control

Length: 60 minutes
Credits: 1.0 learning credit
HSW: yes

Online-training also available by Florida AIA and Hanley Wood University.

1. https://aiafla.org/courses/Register-Online-Course_100.cfm
2. http://www.hanleywooduniversity.com/course/3524/aia-glass-glass-block/aia/designing-with-laminated-glass

Best Practice

- *Kuraray America is a Registered Provider with The American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members are available on request.*
- This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product. Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Copyright Materials

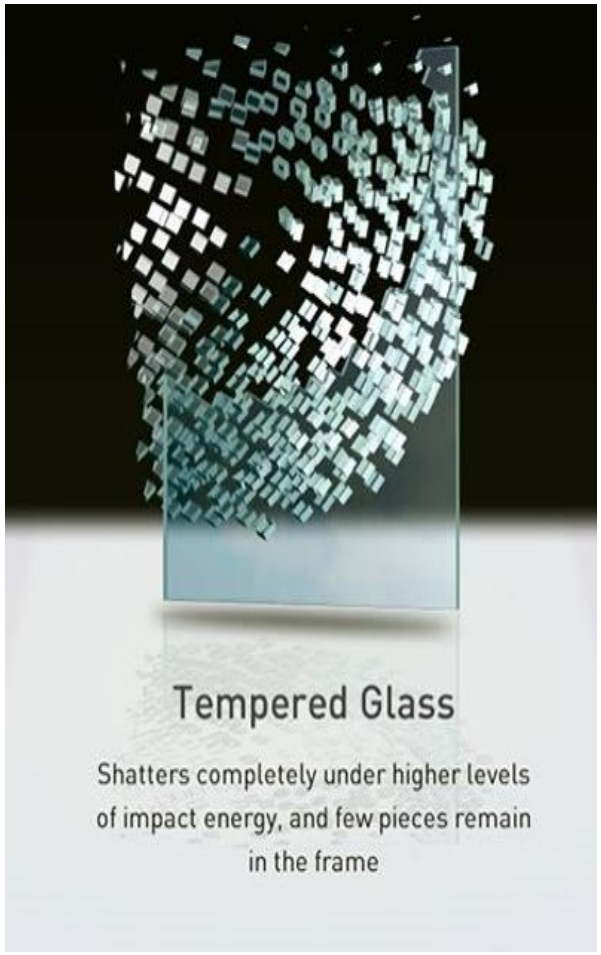
Learning Objectives

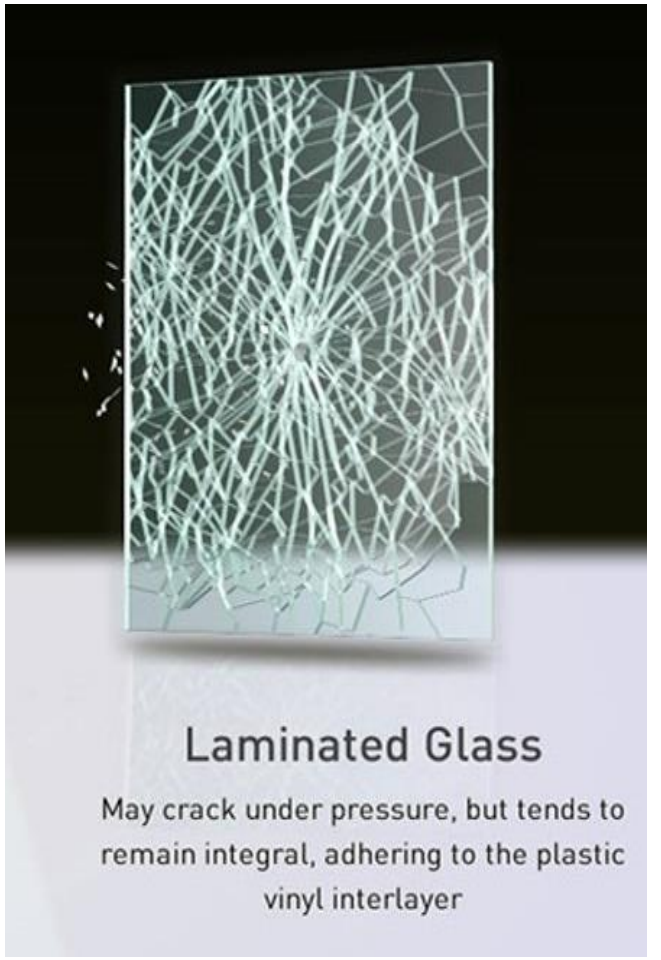
- Learn about the key building codes and standards that regulate glazing in wind-borne debris regions
- Identify wind-borne testing requirements, including missile impact and pressure cycling for fenestration systems
- Learn about the benefits of wet vs. dry glazed systems
- Learn about the glass railing requirements
- Become aware of other considerations, including energy performance, acoustics, intrusion, bomb blast, and tornado resistance
- Recognize the performance attributes of laminated glass interlayers used in impact systems and how they can make buildings resilient
- Learn how laminate glass can contribute to the health, safety, welfare, happiness of the inhabitants of the building.

Program topics

- Laminated glass interlayers
- Building code requirements
  - Florida Building Code (FBC) and Miami Dade County (MDC)
  - International Building Code (IBC)
  - Texas Department of Insurance (TDI)
- Standards that address wind-borne debris protection
  - ASTM E1886 (American Society for Testing and Materials)
  - ASTM E1996
- Testing requirements
  - Small & large missile impact
  - Pressure cycling
- Wet vs. dry-glazed systems
- Additional considerations
  - Energy
  - Security Intrusion resistance
  - Blast resistance
  - Tornado resistance

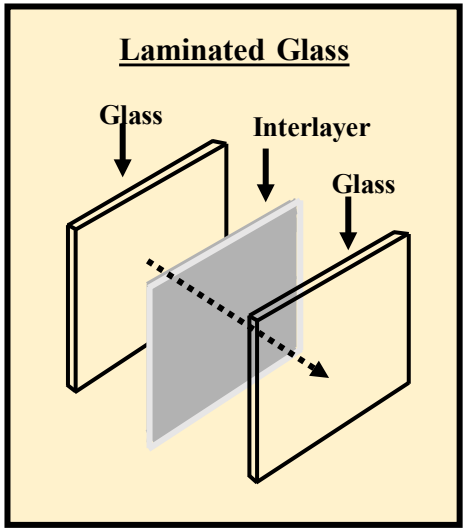
From annealed glass to safety glass: Failure mode improvement

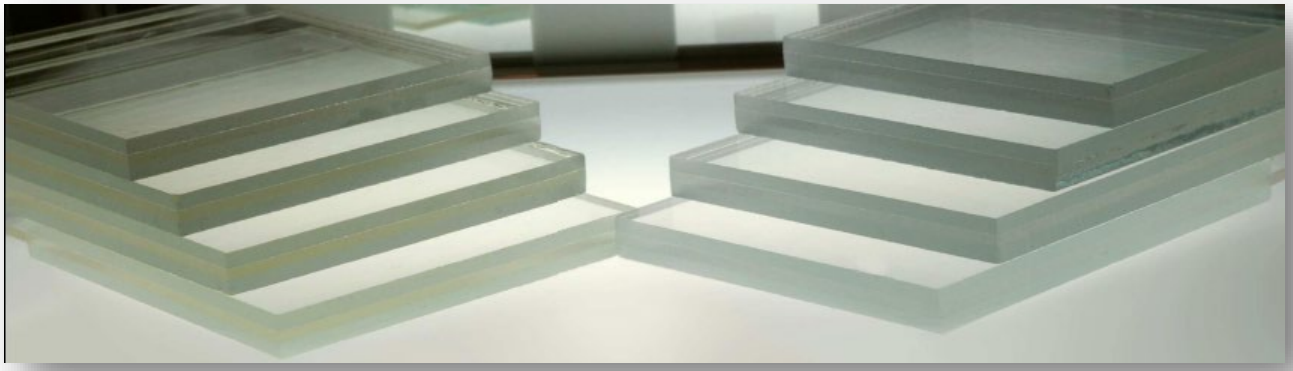




Laminated Glass

- Two or more pieces of glass with an interlayer sandwiched in between the glass
- Laminated glass retains the glass fragments after breakage
- Helps to minimize flying glass-related injuries
- Multi-ply laminates for higher levels of performance
- Flexible and stiff/structural interlayers available

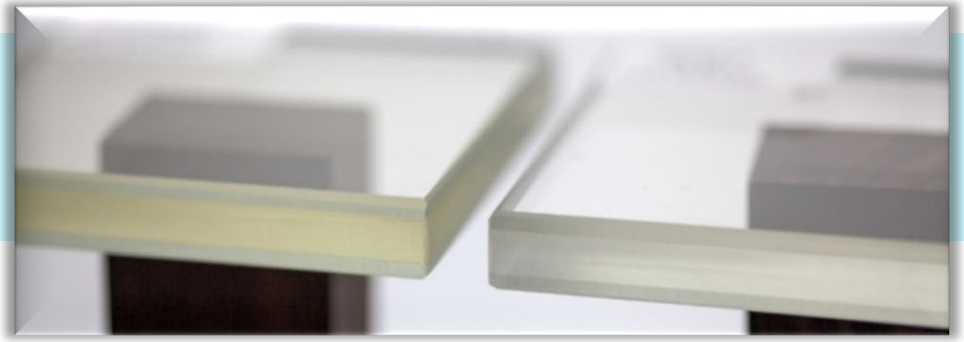




Polyvinyl Butyral (PVB) Interlayer

- Flexible polymer interlayer
- Invented in 1930's for cars
- 99% UV filtration up to 380 nm
- Noise reduction due to "dampening" properties
- Specially formulated acoustical PVB +2 to +3 STC/Rw Higher
- Variety of colors and tints
- Can be printed on

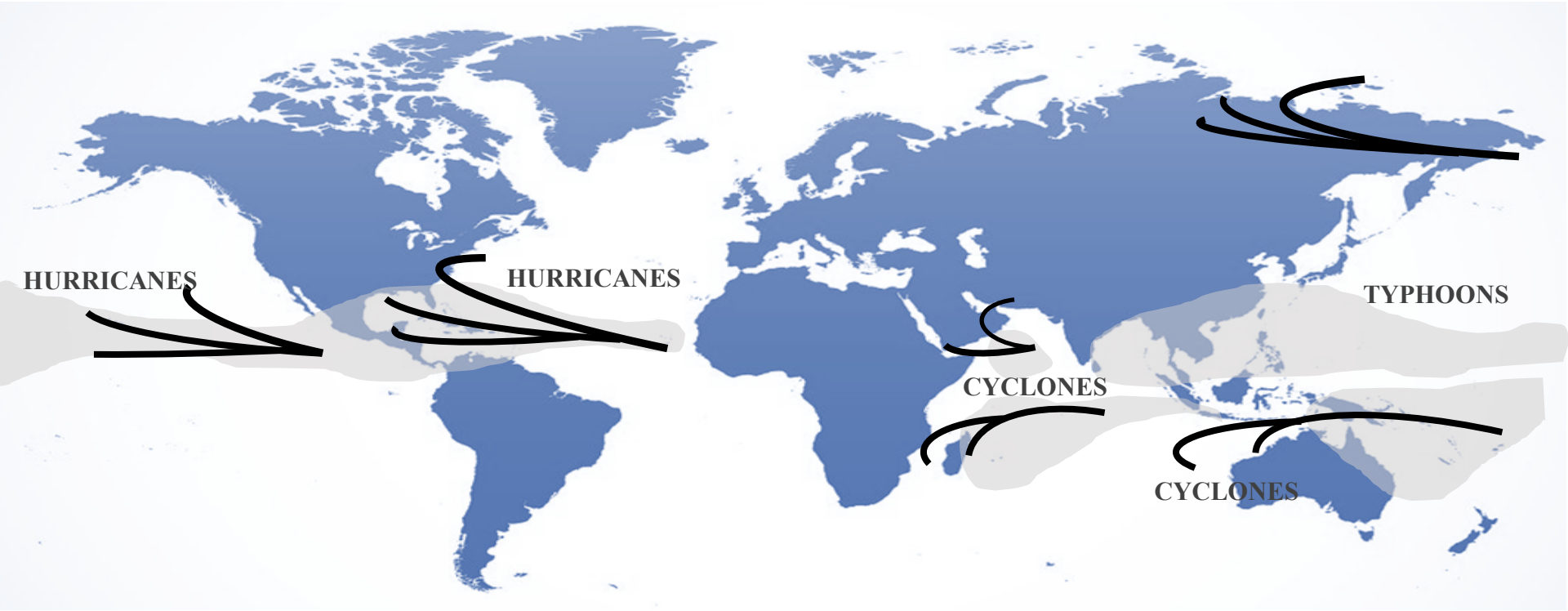
Ionoplast Interlayer



- Invented in the 1990s for hurricane windborne debris regions
- Up to 100x stiffer & 5x more tear resistant than PVB
- Available in UltraClear or Translucent White
- Excellent exposed edge performance
- Enhanced post breakage performance
- Filters up to 99% UV below 380 nm
- Excellent properties for the structural glass market

Hurricanes vs. Cyclones vs. Typhoons

- The only difference between a hurricane, a cyclone, and a typhoon is the location where the storm occurs.
- Hurricanes, cyclones, and typhoons are all the same weather phenomenon; we use different names for these storms in different places.
- In the Atlantic and Northeast Pacific, the term “hurricane” is used.



Wind-borne debris

- Varies based on wind speed, height above ground, terrain, surrounding structures and other sources of debris.
- Typical debris in a hurricane
  - Missiles
  - Roof gravel
  - Roof tiles
  - Signage
  - Portions of damaged structures
  - Framing lumber (2x4)
  - Sheet metal
  - Other construction debris

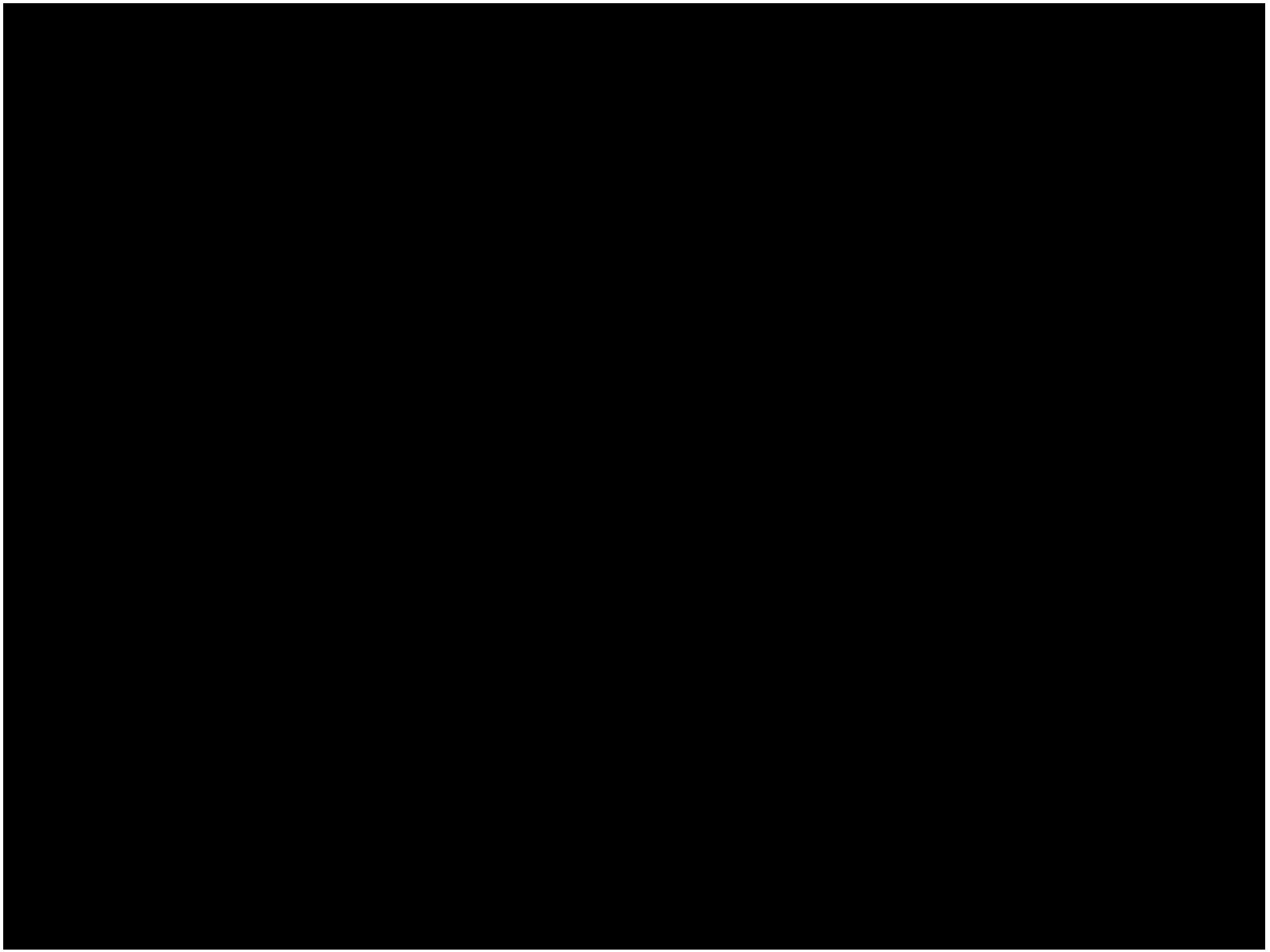
Why protect openings from wind-borne debris?

Greenburg Building in downtown Miami

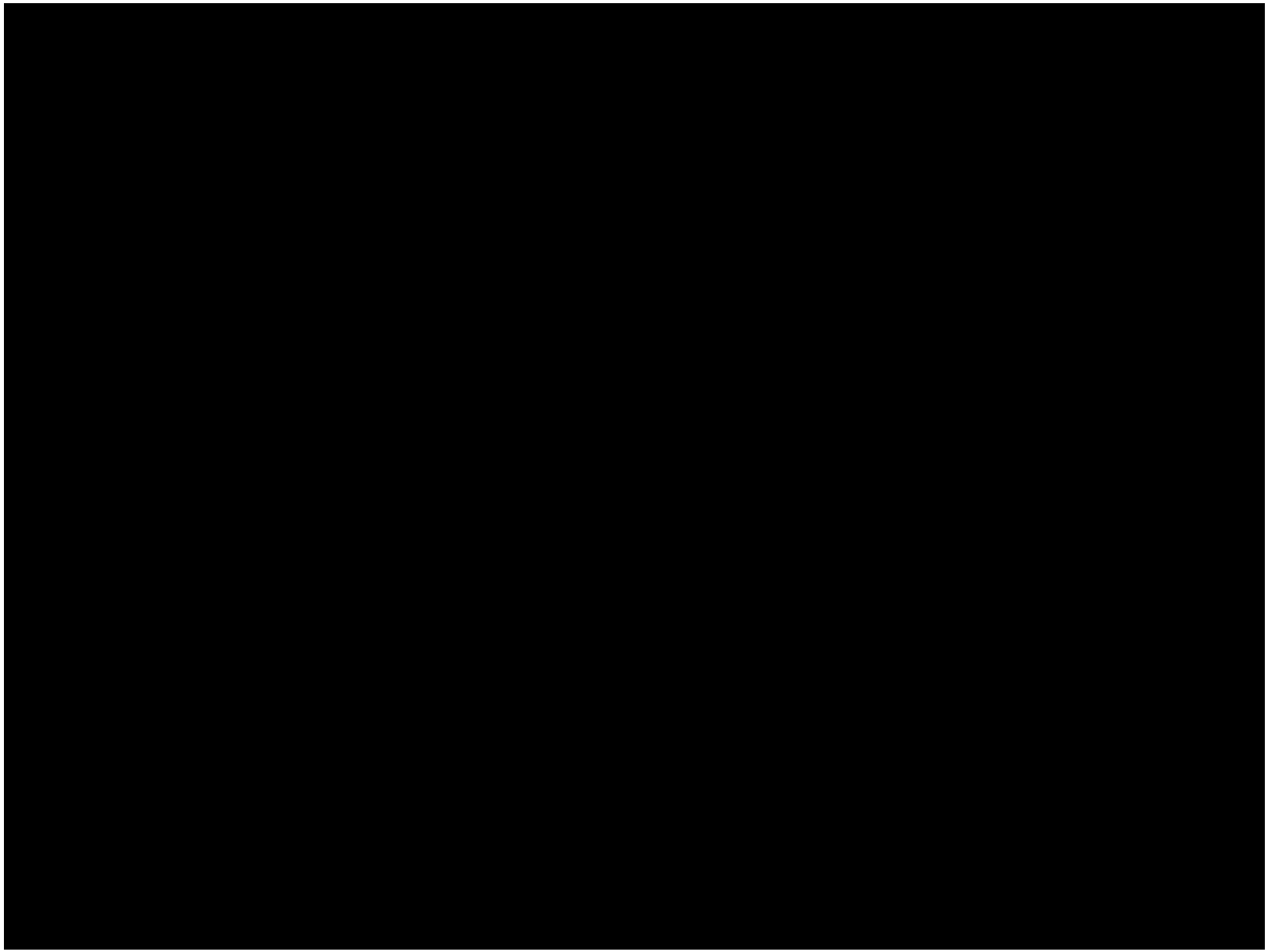
Broken glass that is not retained can result in:

- Costly board up until glazing can be replaced
- Interior damage
- Potential mold problem
- Interruption of business
- Internal pressurization, resulting in catastrophic failure
- Potential for injury from broken glass

Why protect openings from wind-borne debris?



Why protect openings from wind-borne debris?



Effect of Hurricane Andrew (1992)

- Many insurance companies left the state of Florida
- Miami Dade County developed new performance requirements for windows, doors, storefronts, curtain walls, and skylights, as well as storm shutters based on testing
- Certification program adopted to qualify systems

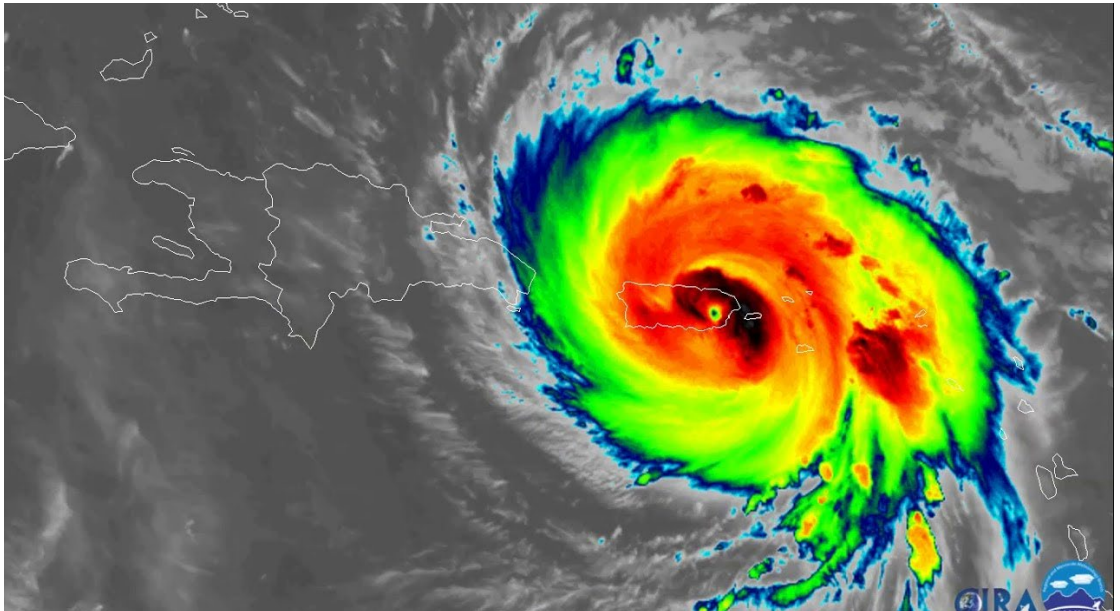
Hurricane Andrew aftermath

Hurricane Andrew estimated damage $27.3 billion

Hurricane Maria (2017) – Puerto Rico

- Hurricane Maria was a deadly Category 5 hurricane that devastated Dominica, the U.S. Virgin Islands, and Puerto Rico in September 2017.
- It is regarded as the worst natural disaster in recorded history to affect those islands and was also the deadliest Atlantic hurricane since Mitch in 1998.
- The tenth-most intense Atlantic hurricane on record and the most intense tropical cyclone worldwide in 2017

Hurricane Maria (2017) – Puerto Rico



Hurricane Michael (October, 2018) – FL Panhandle

- Michael made landfall as a high-end Category 4 hurricane, with maximum sustained winds of 155 mph (250 km/h) on October 10, in **Mexico Beach, Florida**, and near Tyndall Air Force Base.
- Hurricane Michael was the third-most intense Atlantic hurricane to make landfall in the United States in terms of pressure.

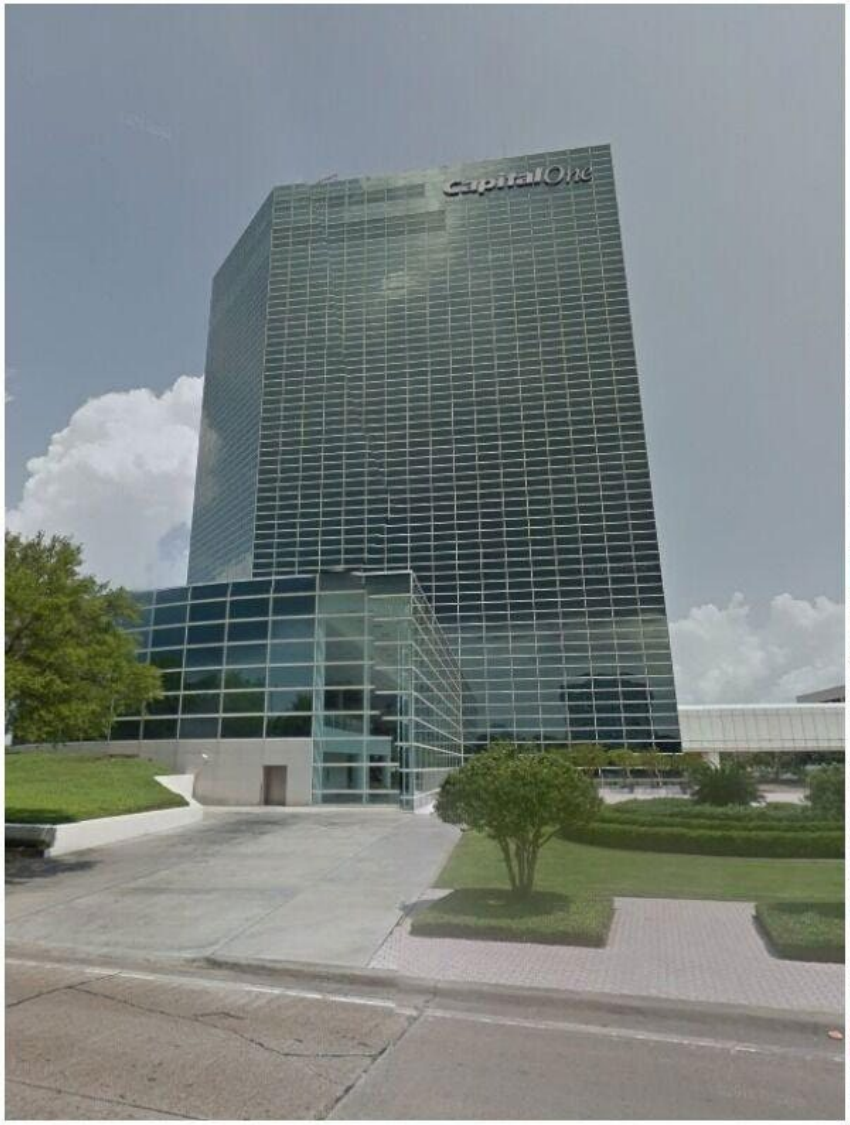
Hurricane Michael (October, 2018) – FL Panhandle
"Home still standing" - Cat 5 Hurricane resilience

This home had 0.090" ionoplast in all the doors & 0.090" PVB in the small windows.

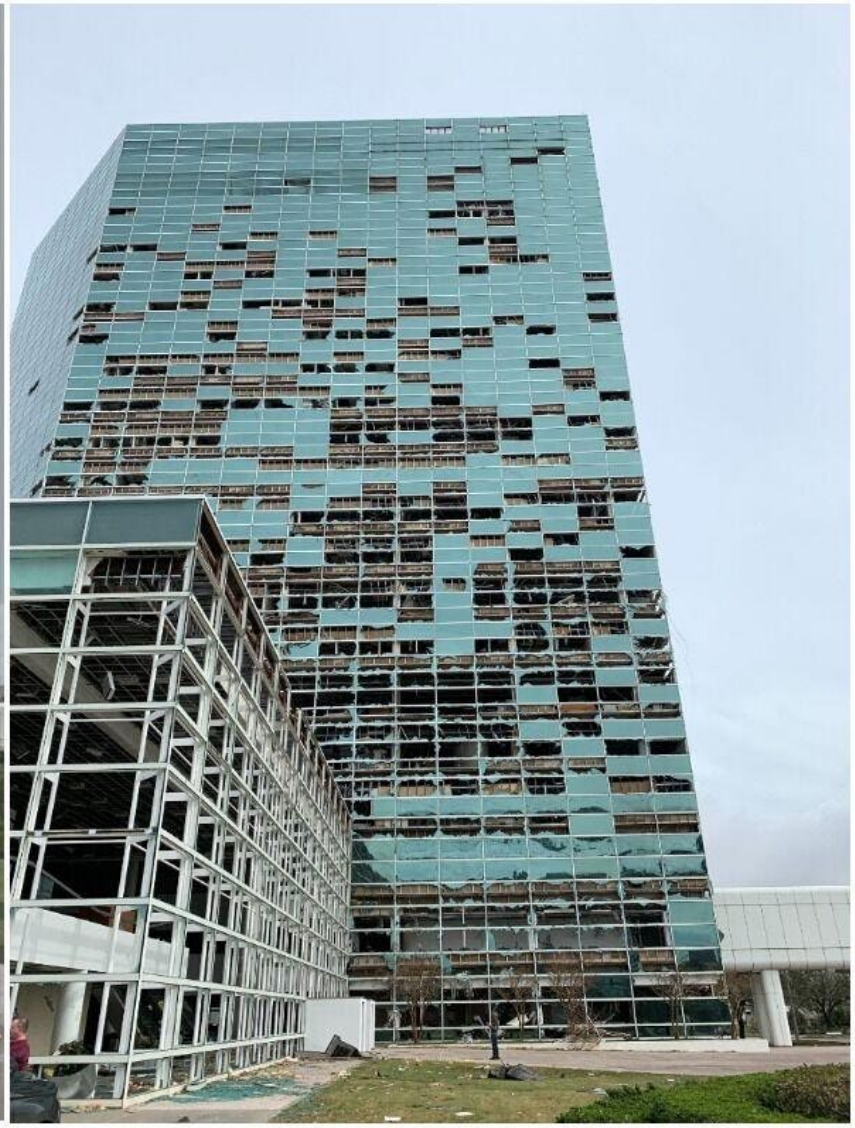
See our case study link below:
https://www.trosifol.com/business/media/laminated-glass-news/2019/sand-palace-of-mexico-beach/

Hurricane Dorian (August, 2019) – Bahamas

Hurricane Laura (August, 2020) – Louisiana

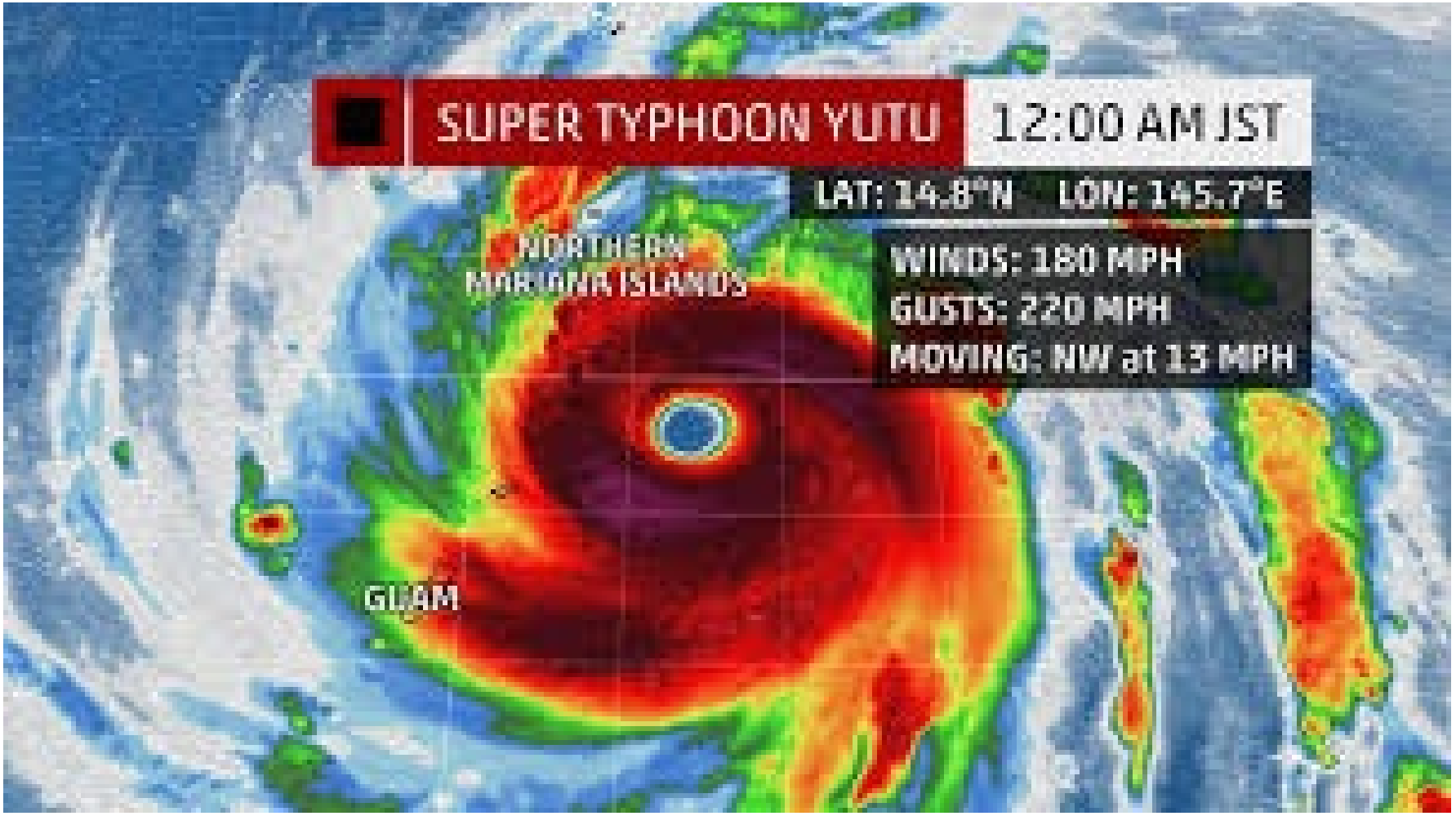


Before



After

Typhoon Yutu (2018) – Northern Mariana Islands



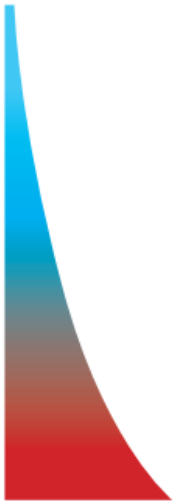
Typhoon Yutu (2018) – Northern Mariana Islands

- Caused catastrophic destruction on the islands of Tinian and Saipan in the Northern Mariana Islands, and later impacted the Philippines.

- It is the strongest typhoon ever recorded to impact the Mariana Islands, as well as the second-strongest tropical cyclone to strike the United States and its unincorporated territories by both wind speed and barometric pressure (180 mph).

Saffir-Simpson Hurricane Wind Scale

Classification	Wind speed [km/h]	[mph]	Storm surge [m]	[ft]	Damage level
Tropical depression	63	< 39		N/A	None
Tropical storm	63-118	39-73	0.3-0.9	1-3	Minimal
Category 1	119-153	74-95	1.2-1.5	4-5	Minimal
Category 2	154-177	96-110	1.8-2.4	6-8	Moderate
Category 3	178-208	111-129	2.7-3.7	9-12	Extensive
Category 4	209-251	130-156	4.0-5.5	13-18	Catastrophic
Category 5	> 252	> 157	> 5.5	> 18	Catastrophic



Strongest Cyclones, Hurricanes, Typhoons

Cyclone	Season	Peak Classification	Peak 1-min sustained winds	Pressure
"Cuba"	1924	Category 5	270 km/h (165 mph)	910 hPa (26.87 inHg)
"Cuba"	1932	Category 5	280 km/h (175 mph)	915 hPa (27.02 inHg)
"Labor Day"	1935	Category 5	295 km/h (185 mph)	892 hPa (26.34 inHg)
Janet	1955	Category 5	280 km/h (175 mph)	914 hPa (26.99 inHg)
Esther	1961	Category 5	260 km/h (160 mph)	919 hPa (27.14 inHg)
Hattie	1961	Category 5	270 km/h (165 mph)	914 hPa (26.99 inHg)
Camille	1969	Category 5	280 km/h (175 mph)	900 hPa (26.58 inHg)
Allen	1980	Category 5	305 km/h (190 mph)	899 hPa (26.55 inHg)
Gloria	1985	Category 4	230 km/h (145 mph)	919 hPa (27.14 inHg)
Gilbert	1988	Category 5	295 km/h (185 mph)	888 hPa (26.22 inHg)
Hugo	1989	Category 5	260 km/h (160 mph)	918 hPa (27.11 inHg)
Opal	1995	Category 4	240 km/h (150 mph)	916 hPa (27.05 inHg)
Mitch	1998	Category 5	285 km/h (180 mph)	905 hPa (26.72 inHg)
Isabel	2003	Category 5	270 km/h (165 mph)	915 hPa (27.02 inHg)
Ivan	2004	Category 5	270 km/h (165 mph)	910 hPa (26.87 inHg)
Katrina	2005	Category 5	280 km/h (175 mph)	902 hPa (26.64 inHg)
Rita	2005	Category 5	285 km/h (180 mph)	895 hPa (26.43 inHg)
Wilma	2005	Category 5	295 km/h (185 mph)	882 hPa (26.05 inHg)
Dean	2007	Category 5	280 km/h (175 mph)	905 hPa (26.72 inHg)
Irma	2017	Category 5	285 km/h (180 mph)	914 hPa (26.99 inHg)
Maria	2017	Category 5	280 km/h (175 mph)	908 hPa (26.81 inHg)
Michael	2018	Category 5	260 km/h (160 mph)	919 hPa (27.14 inHg)
Dorian	2019	Category 5	295 km/h (185 mph)	910 hPa (26.87 inHg)
Iota	2020	Category 5	260 km/h (160 mph)	917 hPa (27.08 inHg)

Category 5 < 156 mph

Source: Wikipedia

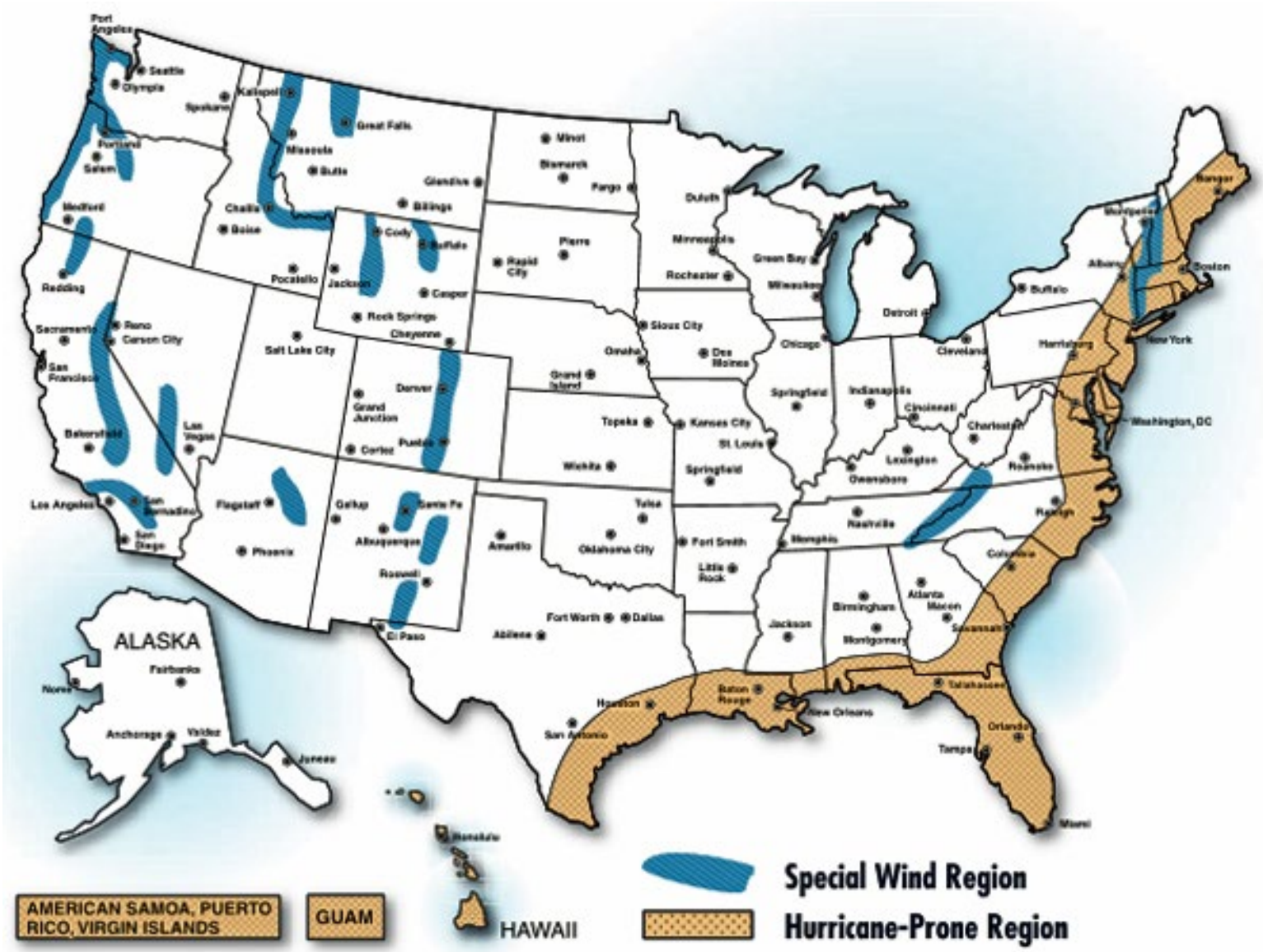
Costliest Atlantic hurricanes

Name	Name	Nominal damage (Billions USD)	Normalized damage (Billions USD)	Season	Storm classification at peak intensity	Areas affected
1	Katrina	$125.00	$116.90	2005	Category 5	Louisiana, Miss, Bahamas, US Gulf Coast
2	Harvey	$125.00	$62.20	2017	Category 4	Texas, Louisiana, Carribean
3	Maria	$91.60	N/A	2017	Category 5	Puerto Rico, Lesser/Greater Antilles, Caribbean
4	Irma	$77.20	$31.00	2017	Category 5	Lesser/Greater Antilles, Caribbean, Eastern US
5	Sandy	$68.70	$73.50	2012	Category 3	The Caribbean, US East Coast
6	Ike	$38.00	$35.20	2008	Category 4	Greater Antilles, Texas, Louisiana
7	Wilma	$27.40	$31.90	2005	Category 5	Greater Antilles, Florida
8	Andrew	$27.30	$106.00	1992	Category 5	The Bahamas, Florida, Louisiana
9	Ivan	$26.10	$25.90	2004	Category 5	The Caribbean, US Gulf Coast
10	Michael	$25.50	N/A	2018	Category 5	Florida, Georgia, US Gulf Coast
11	Florence	$24.20	N/A	2018	Category 4	Bermuda, Eastern US
12	Laura	$19.10	N/A	2020	Category 4	Puerto Rico, Dominican, Louisiana, Texas
13	Rita	$18.50	$14.90	2005	Category 5	Texas, Louisiana

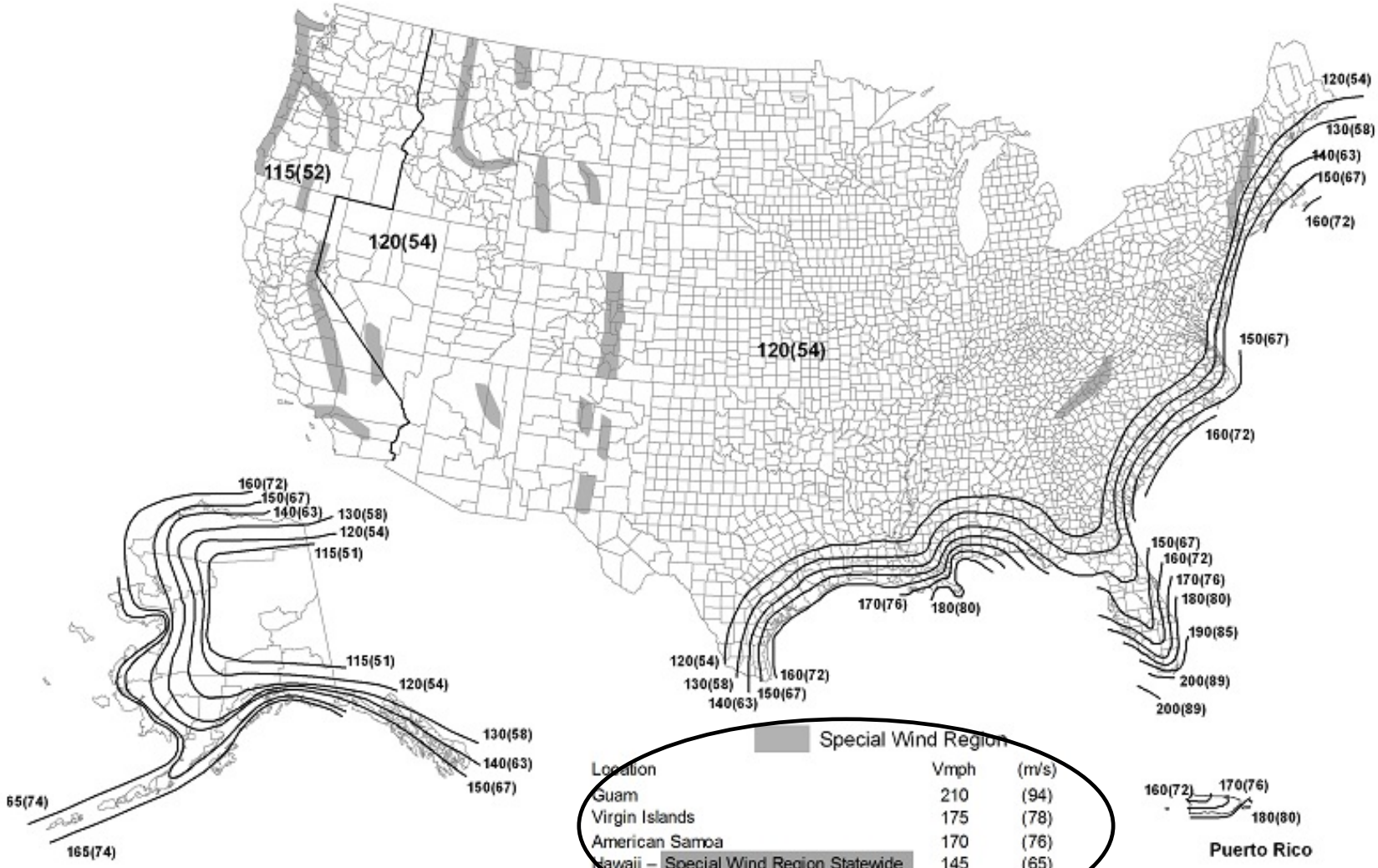
Nominal value is measured in terms of money, whereas real value is measured against goods or services.

Source: Wikipedia

ASCE 7-10 Wind Zone Map



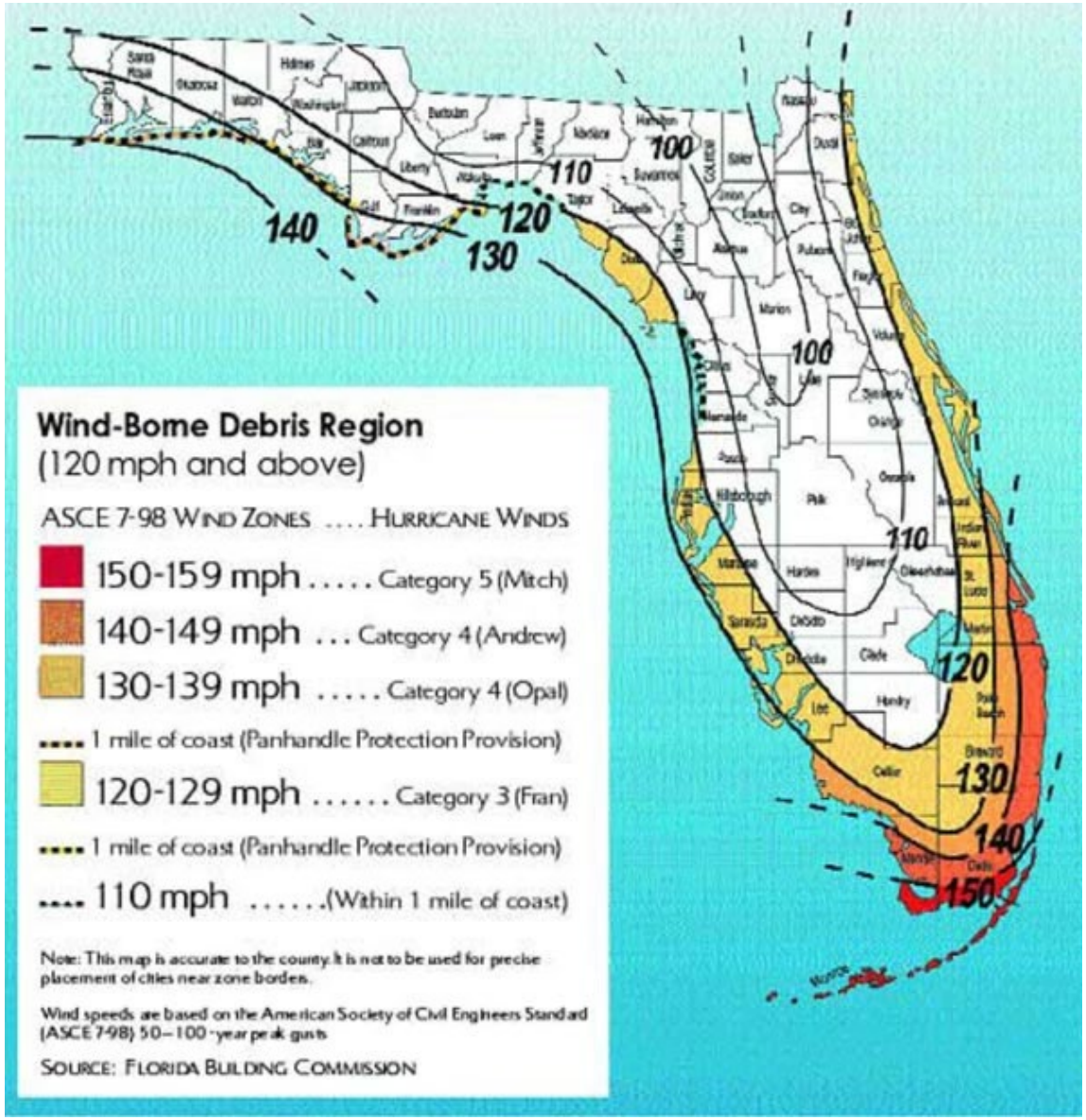
ASCE 7-10 Wind Zone Map



Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) above ground for Exposure C category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years (Annual Exceedance Probability = 0.000588, MRI = 1700 Years).

Wind speeds --- Florida Building Code



Wind Zone 4 by FEMA 85

Wind Zone 4 (150 mph)

- **Florida: Broward, Martin, Miami-Dade, Monroe, Palm Beach**
- Louisiana: Parishes of Cameron, Lafourche, Plaquemines, St. Bernard, St. Mary, Terrebonne,
- Vermillion
- Mississippi: Jackson
- North Carolina: Brunswick, Carteret
- Texas: Cameron
- **The U.S. Territories of Guam, Northern Mariana Islands, Puerto Rico, Trust Territory of the Pacific Islands, and the United States Virgin Islands**

Building code requirements

- Miami Dade County (MDC) Building Code
  - Issues Notices of Acceptance (NOA)
  - Reference TAS 201, 202, 203
- Florida Building Code (FBC)
  - Regulates impact protection according to wind zone
  - References SSTD 12, ASTM E1886/E1996, TAS 201, 202, 203
  - Product approval program
- International Building Code (IBC) regulates areas in 130 mph wind zones and higher
  - IBC references ASTM standards and determines debris missile resistance by building height
  - ASTM E1996 Standard Specification
  - ASTM E1886 Standard Test Method
  - 2009 impact resistance provisions added for exterior balustrades

Standards

- Early development by Miami-Dade County
  - TAS 201 Large and Small Missile impact Test Standards
  - TAS 202 Air, Water, & Uniform Structural Load Standards
  - TAS 203 Uniform Cyclic Pressure Test Standards
  - Notice of Acceptance (NOA)

- 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

- ASTM E1996
  - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

Key Differences in Test Procedures

TAS 201/203

- Only for High Velocity Wind Zone – Miami Dade & Broward County
- Large Missile - 2 impacts per specimen
- Small Missile – 3 impacts per specimen
- Pass/ Fail – no penetration or opening larger than 1/16” x 5”
- Impact on the mullion or cross bar

* Risk category IV – essential facilities glazing above 30ft requires level D large missile impact

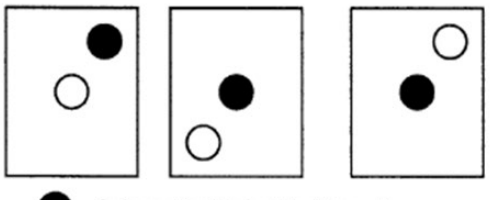


FIG. X4.1 Additional Large Missile Impact Locations in Wind Zone 4

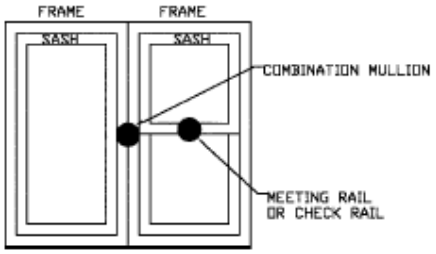


FIG. X4.3 Combination Mullion with Meeting or Check Rail

ASTM E1886/1996

- Large Missile - 1 impact per specimen
- Small Missile – 3 impacts per specimen
- Pass/Fail – no tear formed larger than 5” or wider than 1/16”, **OR** no opening through which a 3” sphere can freely pass through
- No impact of the mullion

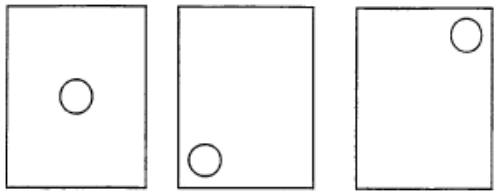


FIG. 1 Impact Locations for Large Missile Test (Each Type of Infill)

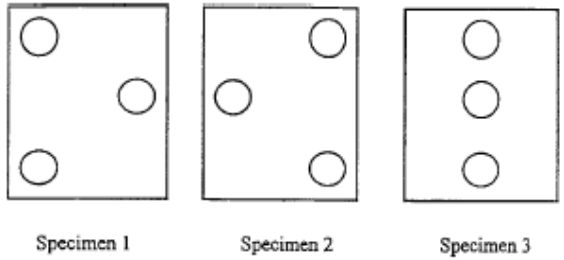


FIG. 2 Impact Locations for Small Missile Test (Each Type of Infill)

Hurricane Missile Tests

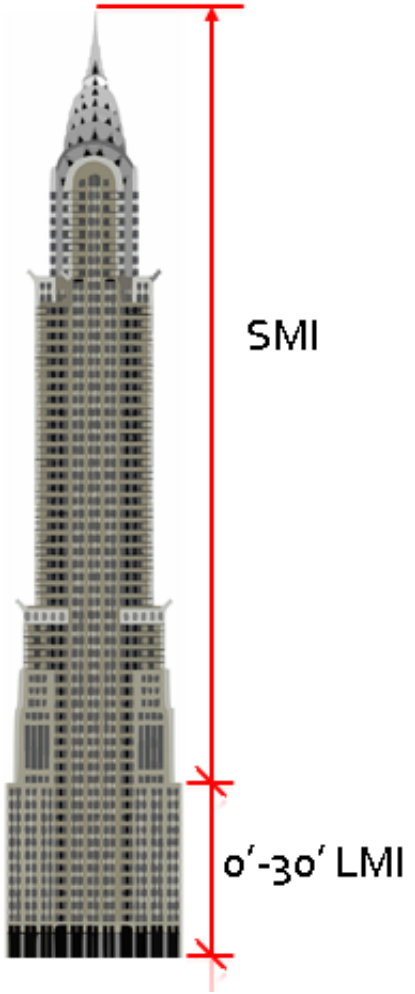
- Based on your project wind zone, use ASTM E1996 to determine the applicable missile test based on building type and location of products within the building
- The first 30’ are considered “large missile” and above tha is considered “small missile”

TABLE 3 Description Levels

NOTE 1—For Missiles B, C, D, and E, also use Missile A for porous impact protective systems (see 8.5).

Level of Protection	Enhanced Protection (Essential Facilities)		Basic Protection		Unprotected	
Assembly Elevation	≤9.1 m (30 ft)	>9.1 m (30 ft)	≤9.1 m (30 ft)	>9.1 m (30 ft)	≤9.1 m (30 ft)	>9.1 m (30 ft)
Wind Zone 1	D	D	C	A	None	None
Wind Zone 2	D	D	C	A	None	None
Wind Zone 3	E	D	D	A	None	None

Level of Protection	Enhanced Protection (Essential Facilities)		Basic Protection		Unprotected	
Assembly Elevation	≤9.1 m (30 ft)	>9.1 m (30 ft)	≤9.1 m (30 ft)	>9.1 m (30 ft)	≤9.1 m (30 ft)	>9.1 m (30 ft)
Wind Zone 4	E	D	D	A	None	None



ASTM E1996 Basic vs Enhanced Protection

- Buildings designed as Essential Facilities require enhanced protection. These include:
  - Hospitals and health care facilities
  - Police stations, Fire rescue stations
  - Emergency shelters, Communications centers
  - Jails and detention centers
  - Buildings critical to the national defense
- Level E Impact may be required first 30 feet elevation
- Impact = 9 lb 2x4 traveling 80 fps
- 180-mil Ionoplast needed for impact

Hurricane impact missile levels

Missile Level	MIssile Description	Impact Speed	
		ft/sec	mph
A	Steel ball Weight: 2g ± 5%	130	89
B	2x4 lumber Weight: 2.0 lb. ± 0.25 lb. Length: 1 ft - 9 in. ± 4 in	50	34
C	2x4 lumber Weight: 4.5 lb. ± 0.25 lb. Length: 4 ft - 4 in. ± 4 in.	40	27
D	2x4 lumber Weight: 9.0 lb. ± 0.25 lb. Length: 8 ft. ± 4 in.	50	34
E	2x4 lumber Weight: 9.0 lb. ± 0.25 lb.	80	55

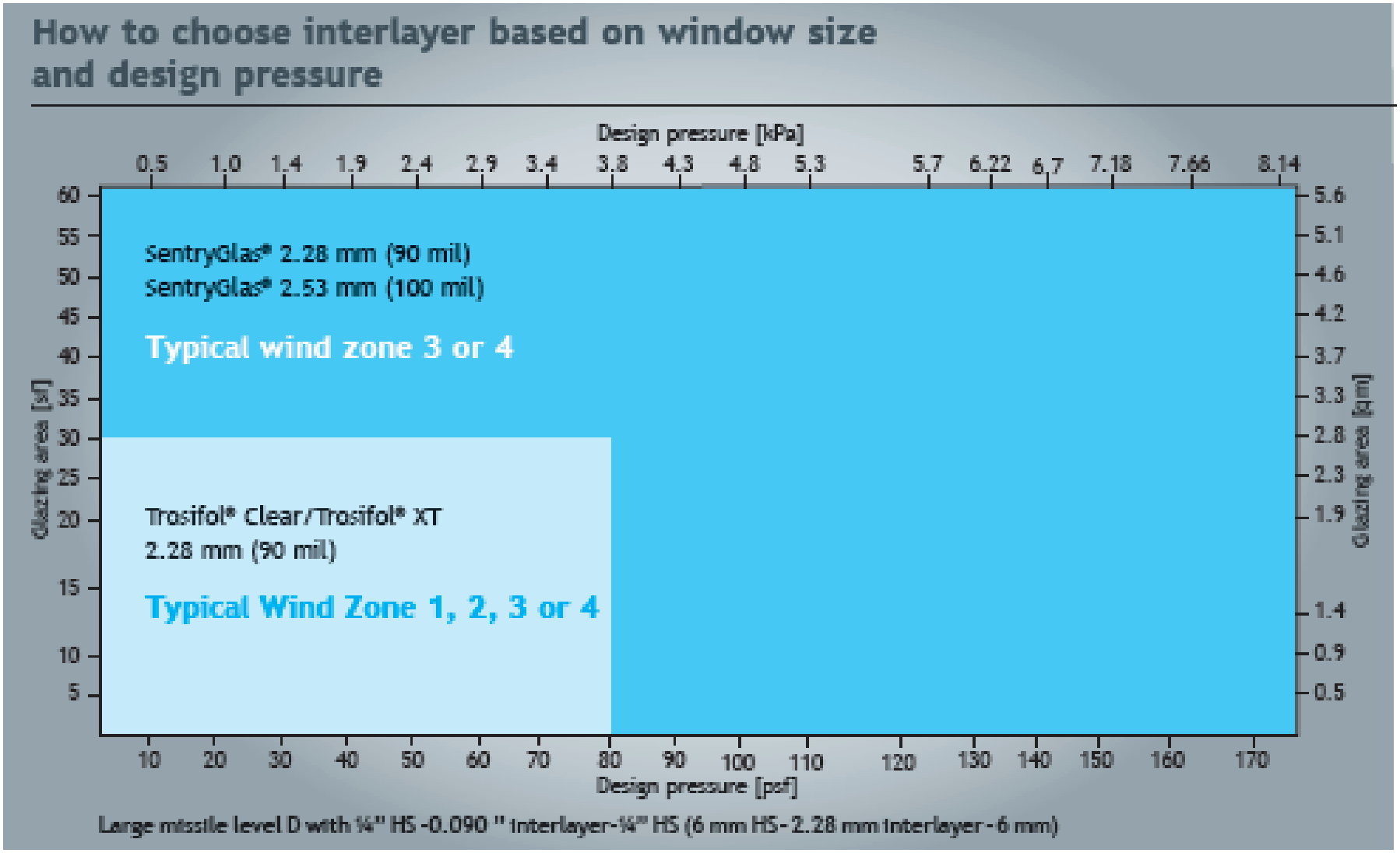
Level	PVB	Ionoplast
A	¼" – 0.060" PVB- ¼"	¼" – 0.035" SG- ¼"
B	¼" – 0.060" PVB- ¼"	¼" – 0.035" SG- ¼"
C	¼" – 0.060" PVB- ¼"	¼" – 0.035" SG- ¼"
D	¼" – 0.090" PVB- ¼"	¼" – 0.090" SG- ¼"
E	N/A	¼" – 0.180" SG- ¼"

- Missile tests range from A through E, increasing in intensity. E missile tests qualify for D missile, D missile qualifies for C missile, and so on.
- "D" missile applies in South Florida for LMI in general. "E" Missile is required for essential facilities.

Kuraray has a new hurricane brochure with additional information

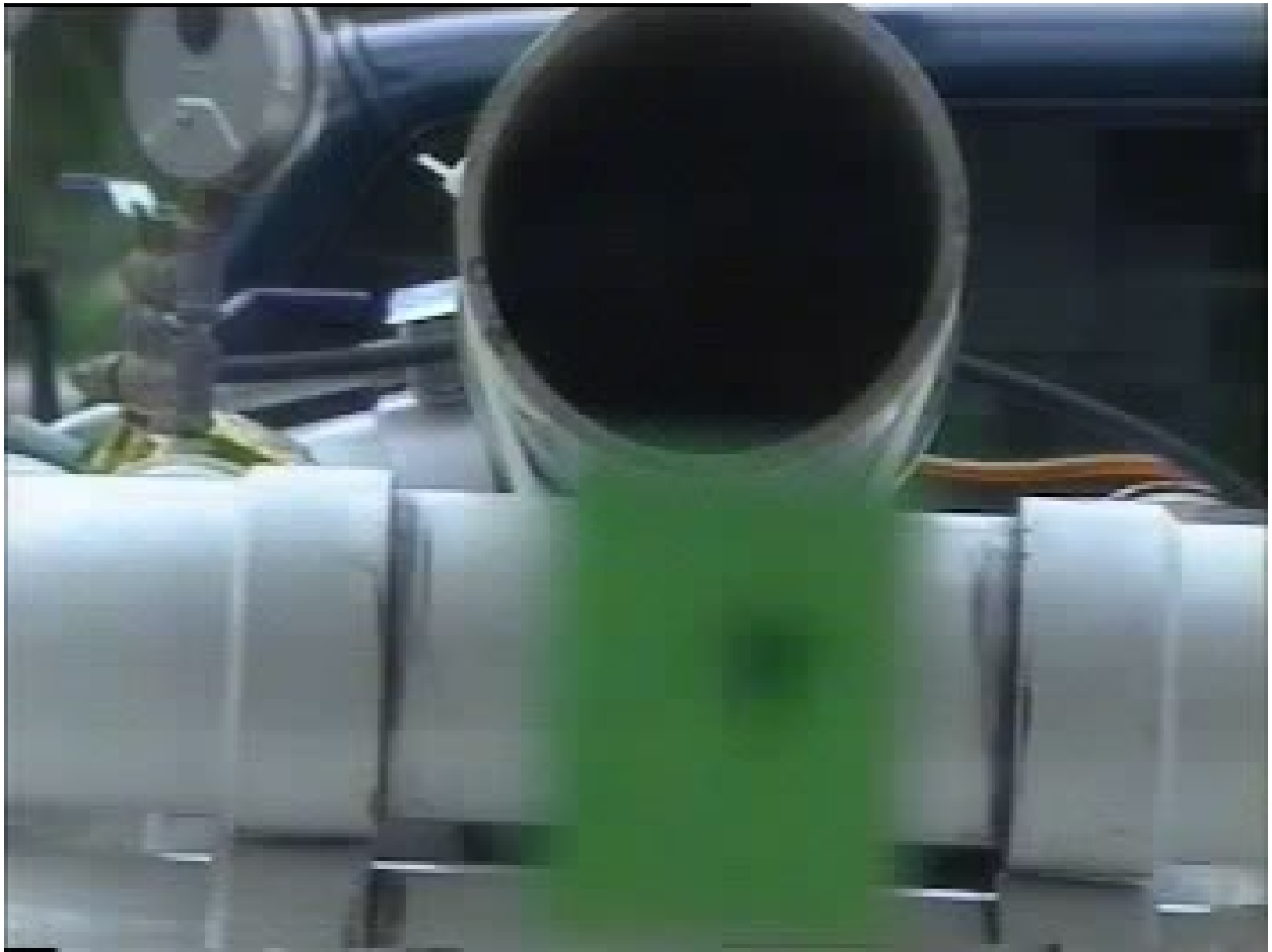
https://www.trosifol.com/fileadmin/user_upload/TROSIFOL/support/downloads/product_brochures/pdf_documents/hurricane_glazing/Lay_Broch_Hurricane_9_2019.pdf

Glazing Design



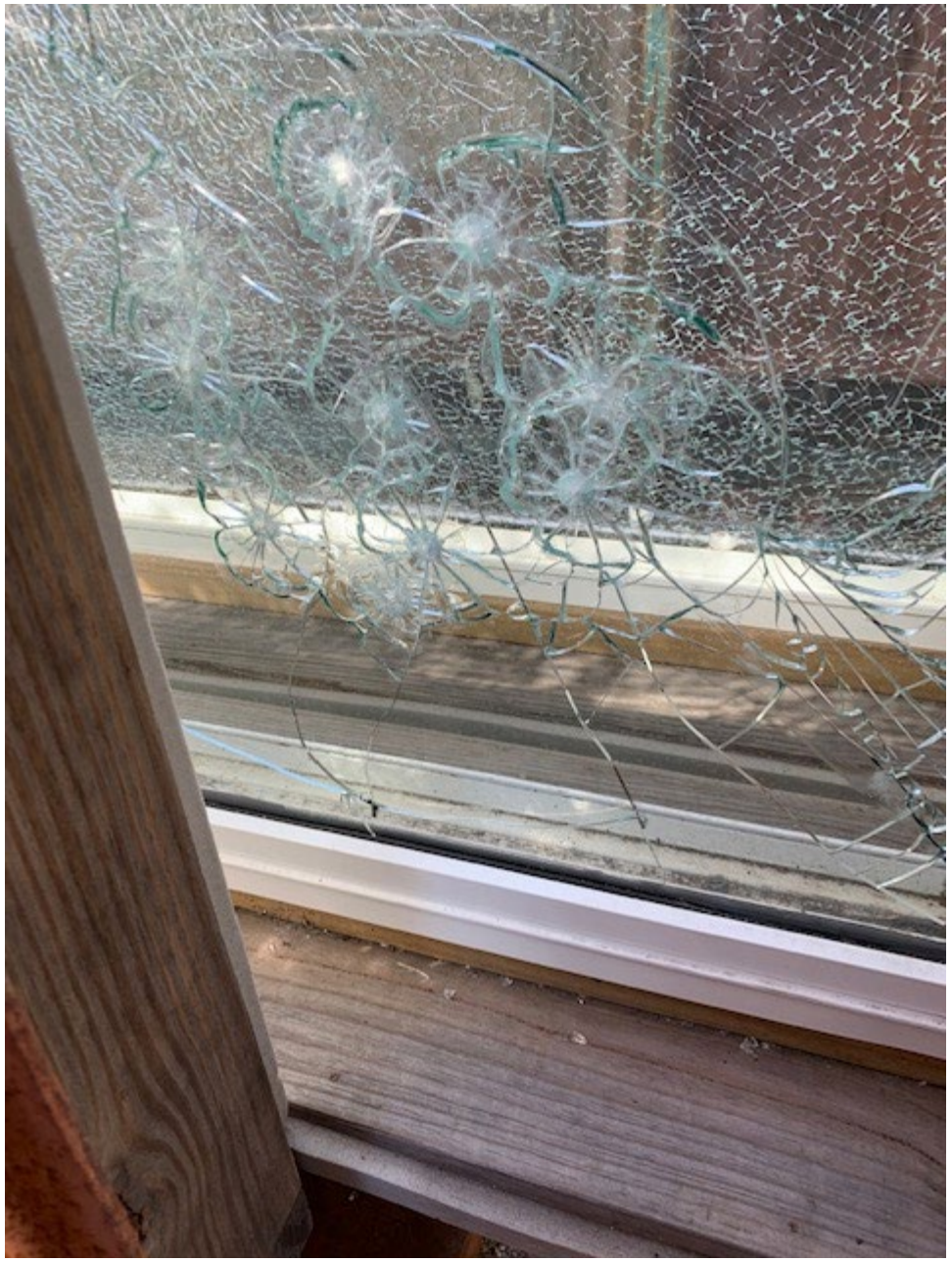
Key factors for glass design: Glass size, Glass edge bite in frame, design pressure, wet/dry glazed

Large Missile Level D Impact Test



Small Missile Impact Test

Ten 2 gram steel balls cannon test at 89 mph – three impacts



Testing Requirements: Pressure Cycling

- Pressure cycling follows impact testing
- Applied to all three specimens
- 4,500 positive, then 4,500 negative pressure cycles; duration of each cycle is 1-3 seconds
- Pmax is design wind pressure (inward and outward) from the building code, based on an unbreached building envelope.

Range	Positive Cycles	Range	Negative Cycles
0.2Pmax-0.5Pmax	3,500	0.3Pmax-1.0Pmax	50
0.0Pmax-0.6Pmax	300	0.5Pmax-0.8Pmax	1,050
0.5Pmax-0.8Pmax	600	0.0Pmax-0.6Pmax	50
0.3Pmax-1.0Pmax	100	0.2Pmax-0.5Pmax	3,350

Pressure Cycling Tests (after impacts)

Flood resistant windows

- Flood Windows are passive systems that are always ready to protect from rising flood water and debris impact.
- They are hurricane impact-rated and tested to withstand more than 10’ of water and large missile collision.
- Hard Body Drop Test & Flood Hydrostatic Testing.
- https://www.youtube.com/watch?v=tWRvdVTR9bk

Glass railings – IBC 2015

- *The 2015 International Building Code calls for laminated glass with limited use of monolithic tempered glass*
- *Laminated glass offers post-breakage glass retention*
- *Improved safety, especially from falling glass*

  "Glass used in a handrail, guardrail or a guard section shall be laminated glass constructed of fully tempered or heat-strengthened glass and shall comply with Category II or CPSC 16CFR Part 1201 or Class A of ANSI Z97.1.

  Glazing in railing in-fill panels shall be of an approved safety glazing material that conforms to the provisions of Section 2406.1.1. For all glazing types, the minimum nominal thickness shall be ¼ inch (6.4 mm)."

IBC 2018 may not require top cap if system has been tested.

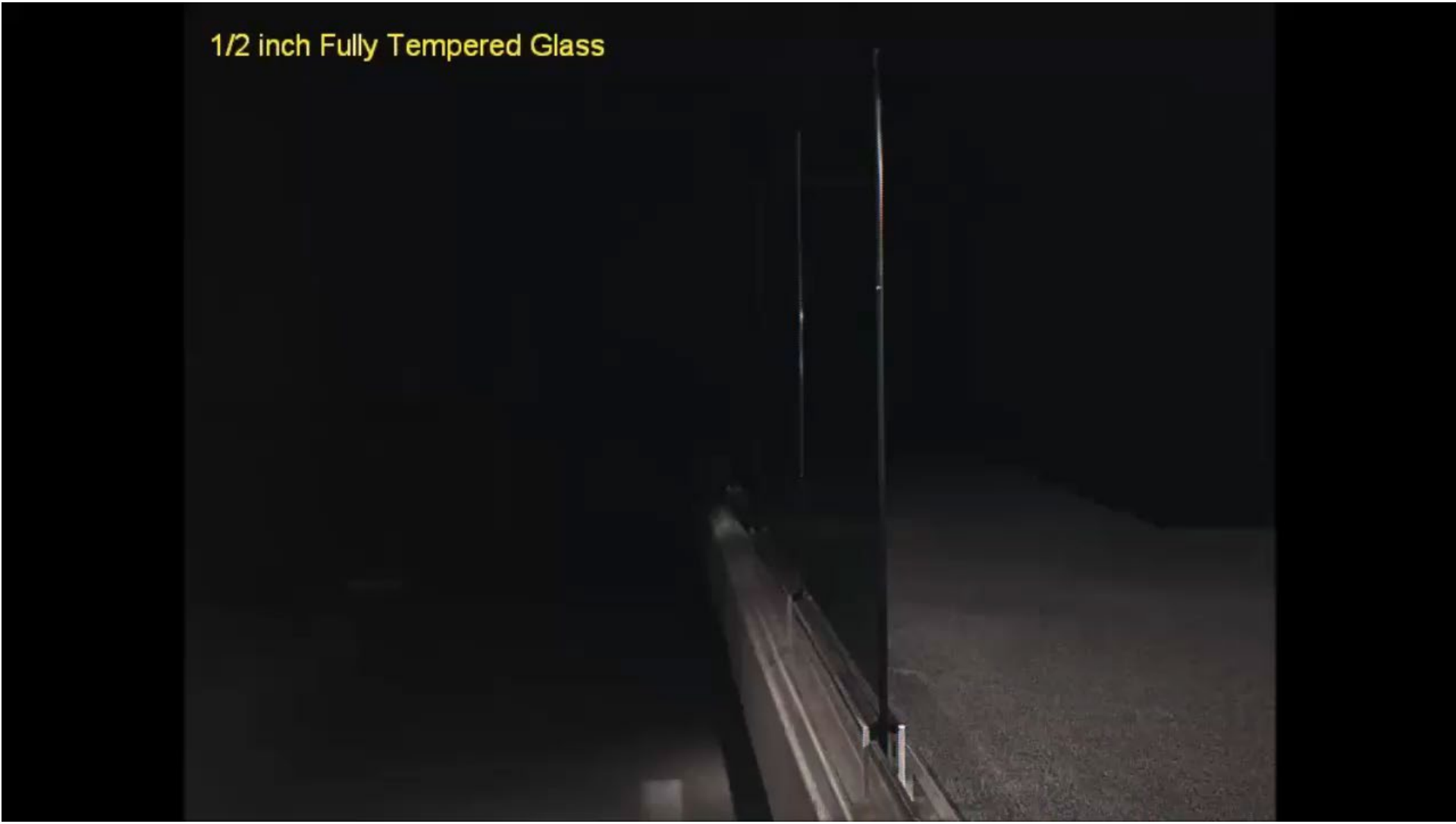
Portland cement-based and gypsum-based products are not compatible with Ionoplast or PVB laminates and should not be used with laminated glass.

Glass Railings in Wind-borne Debris Areas---Florida Building Code

- **2407.1.4 Glazing in wind-borne debris regions.**
- Glazing installed in in-fill panels or balusters in *wind-borne debris regions* shall comply with the following:
- **2407.1.4.1 Balusters and in-fill panels.**
- Glass installed in exterior railing in-fill panels or balusters shall be laminated glass complying with Category II of CPSC 16 CFR Part 1201 or Class A of ANSI Z97.1.
- **2407.1.4.2 Glass supporting top rail.**
- When the top rail is supported by glass, the assembly shall be tested according to the impact requirements of Section 1609.1.2 (HVHZ shall comply with Section 1618.4.6.4). The top rail shall remain in place after impact.

Exterior glass railings

Glass Railing Demonstration



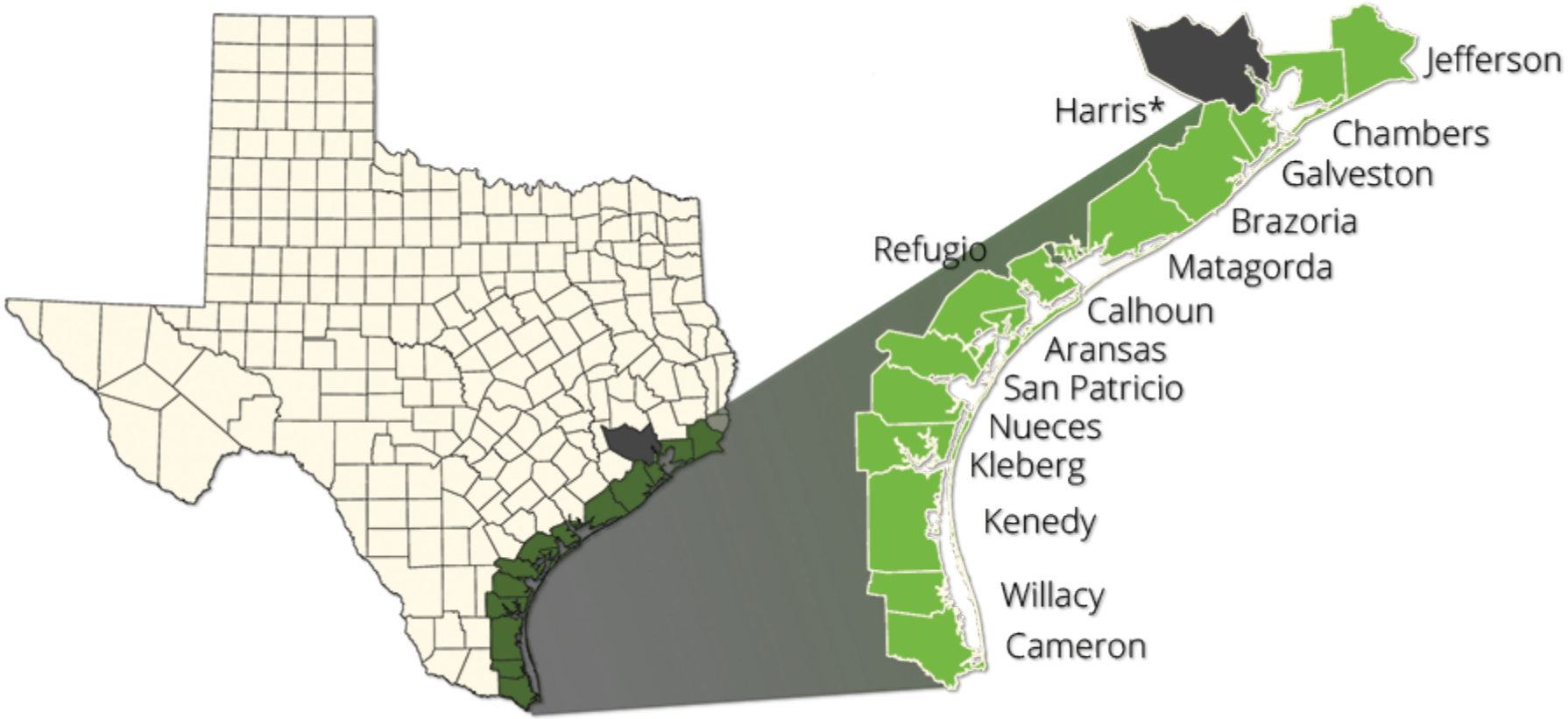
Glass Railing Demonstration

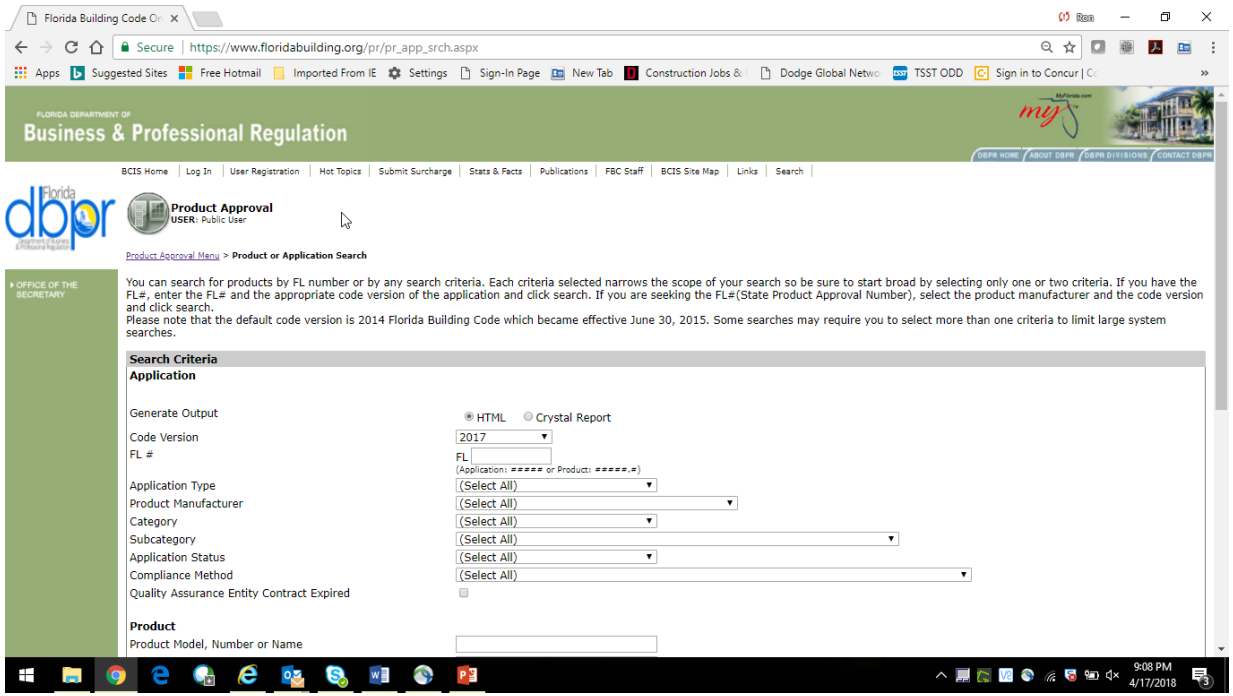
Spontaneous Glass Breakage in Railing

Certification Programs

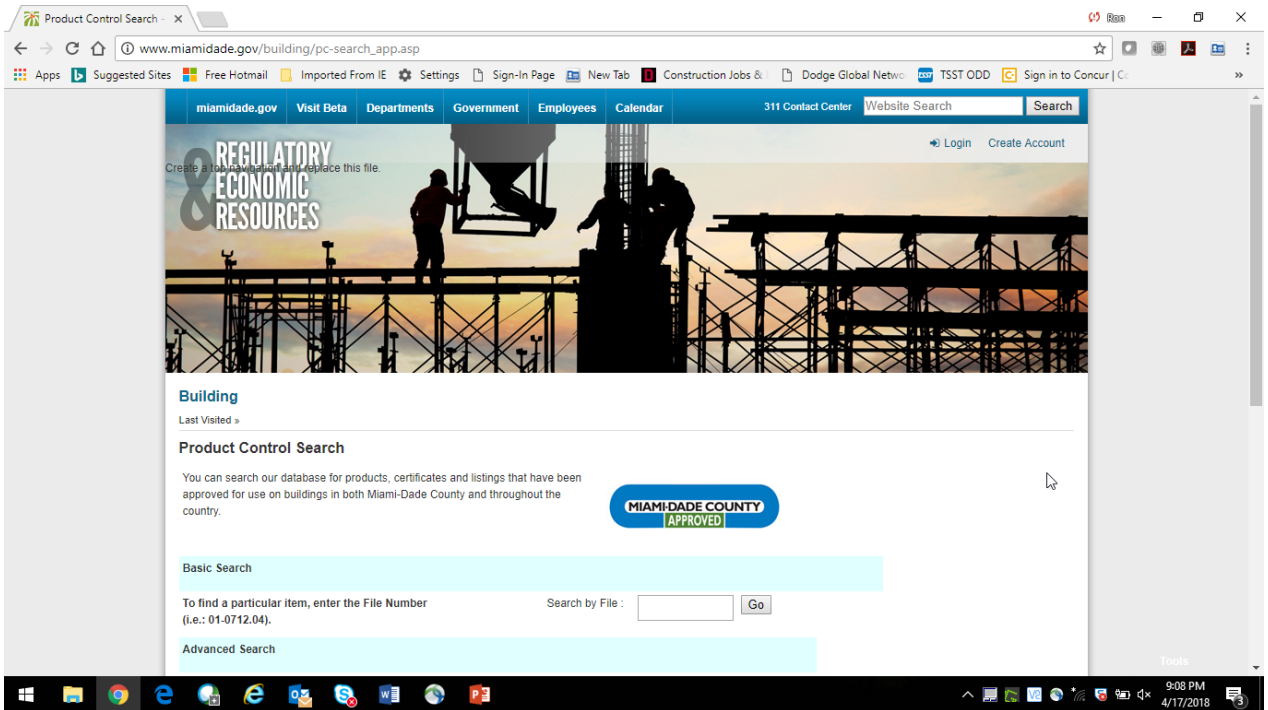
- Miami-Dade County
  - Systems are issued NOAs (Notices of Acceptance)
  - Interlayers are also issued NOAs based on submittal of weathering data
  - http://www.miamidade.gov/building/pc-search_app.asp
- State of Florida
  - Product Approval Program
  - https://www.floridabuilding.org/pr/pr_app_srch.aspx
- Texas Department of Insurance
  - Windstorm Product Evaluations

TDI Designated Catastrophe Areas




Florida Building Code Or
Secure | https://www.floridabuilding.org/pr/pr_app_srch.aspx
Apps Suggested Sites Free Hotmail Imported From IE Settings Sign-In Page New Tab Construction Jobs & Dodge Global Netwo TSST ODD Sign in to Concur
FLORIDA DEPARTMENT OF
Business & Professional Regulation
BCIS Home | Log In | User Registration | Hot Topics | Submit Surcharge | Stats & Facts | Publications | FBC Staff | BCIS Site Map | Links | Search
Florida dbpr
Product Approval
USER: Public User
Product Approval Menu > Product or Application Search
OFFICE OF THE SECRETARY
You can search for products by FL number or by any search criteria. Each criteria selected narrows the scope of your search so be sure to start broad by selecting only one or two criteria. If you have the FL#, enter the FL# and the appropriate code version of the application and click search. If you are seeking the FL#(State Product Approval Number), select the product manufacturer and the code version and click search.
Please note that the default code version is 2014 Florida Building Code which became effective June 30, 2015. Some searches may require you to select more than one criteria to limit large system searches.
Search Criteria
Application
Generate Output
HTML
Crystal Report
Code Version
2017
FL #
FL
(Application: ##### or Product: #####.#)
Application Type
Product Manufacturer
Category
Subcategory
Application Status
Compliance Method
(Select All)
Quality Assurance Entity Contract Expired
Product
Product Model, Number or Name
9:08 PM
4/17/2018

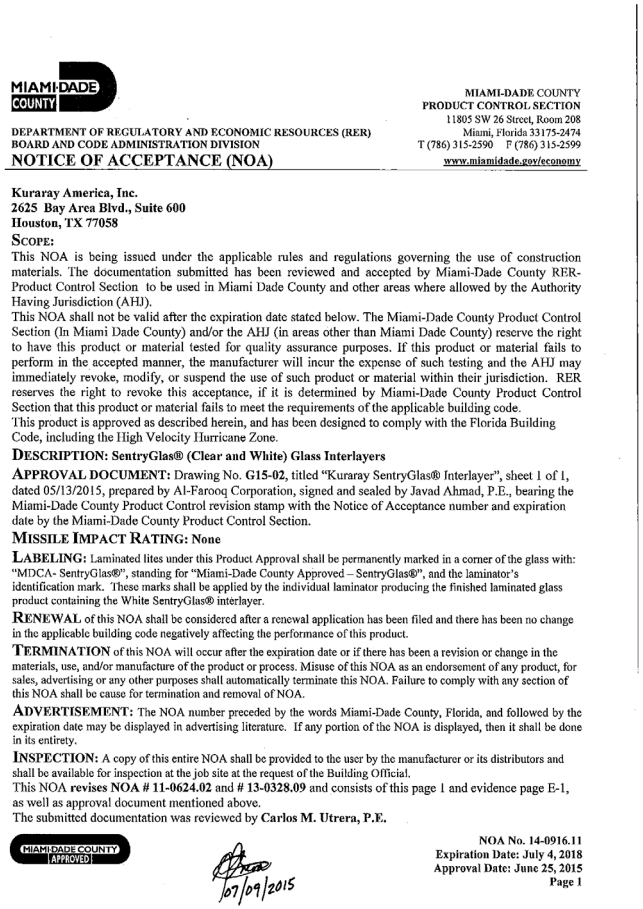

FBC
Florida Building Commission


Product Control Search
www.miamidade.gov/building/pc-search_app.asp
Apps Suggested Sites Free Hotmail Imported From IE Settings Sign-In Page New Tab Construction Jobs & Dodge Global Netwo TSST ODD Sign in to Concur
miamidade.gov Visit Beta Departments Government Employees Calendar 311 Contact Center Website Search Search
Login Create Account
REGULATORY & ECONOMIC RESOURCES
Building
Last Visited »
Product Control Search
You can search our database for products, certificates and listings that have been approved for use on buildings in both Miami-Dade County and throughout the country.
MIAMI-DADE COUNTY APPROVED
Basic Search
To find a particular item, enter the File Number (i.e.: 01-0712.04).
Search by File :
Go
Advanced Search
Tools
9:08 PM
4/17/2018


MIAMI-DADE COUNTY
APPROVED

Notices of Acceptance (NOA) on Interlayers

- Information included for the interlayers NOA
  - Self ignition temperature
  - Flash ignition temperature
  - Average extent of burning
  - Smoke developed index
  - Flame spread index
  - Xenon weathering (4500 hours)
  - Average modulus of rupture



MIAMI-DADE COUNTY

MIAMI-DADE COUNTY
PRODUCT CONTROL SECTION
11805 SW 26 Street, Room 208
Miami, Florida 33175-2474
T (786) 315-2590 F (786) 315-2599
www.miamidade.gov/economy

DEPARTMENT OF REGULATORY AND ECONOMIC RESOURCES (RER)
BOARD AND CODE ADMINISTRATION DIVISION

NOTICE OF ACCEPTANCE (NOA)

Kuraray America, Inc.
2625 Bay Area Blvd., Suite 600
Houston, TX 77058

SCOPE:
This NOA is being issued under the applicable rules and regulations governing the use of construction materials. The documentation submitted has been reviewed and accepted by Miami-Dade County RER-Product Control Section to be used in Miami Dade County and other areas where allowed by the Authority Having Jurisdiction (AHJ).
This NOA shall not be valid after the expiration date stated below. The Miami-Dade County Product Control Section (In Miami Dade County) and/or the AHJ (in areas other than Miami Dade County) reserve the right to have this product or material tested for quality assurance purposes. If this product or material fails to perform in the accepted manner, the manufacturer will incur the expense of such testing and the AHJ may immediately revoke, modify, or suspend the use of such product or material within their jurisdiction. RER reserves the right to revoke this acceptance, if it is determined by Miami-Dade County Product Control Section that this product or material fails to meet the requirements of the applicable building code.
This product is approved as described herein, and has been designed to comply with the Florida Building Code, including the High Velocity Hurricane Zone.

DESCRIPTION: SentryGlas® (Clear and White) Glass Interlayers

APPROVAL DOCUMENT: Drawing No. **G15-02**, titled "Kuraray SentryGlas® Interlayer", sheet 1 of 1, dated 05/13/2015, prepared by Al-Farooq Corporation, signed and sealed by Javad Ahmad, P.E., bearing the Miami-Dade County Product Control revision stamp with the Notice of Acceptance number and expiration date by the Miami-Dade County Product Control Section.

MISSILE IMPACT RATING: None

LABELING: Laminated lites under this Product Approval shall be permanently marked in a corner of the glass with: "MDCA- SentryGlas®", standing for "Miami-Dade County Approved – SentryGlas®", and the laminator's identification mark. These marks shall be applied by the individual laminator producing the finished laminated glass product containing the White SentryGlas® interlayer.

RENEWAL of this NOA shall be considered after a renewal application has been filed and there has been no change in the applicable building code negatively affecting the performance of this product.

TERMINATION of this NOA will occur after the expiration date or if there has been a revision or change in the materials, use, and/or manufacture of the product or process. Misuse of this NOA as an endorsement of any product, for sales, advertising or any other purposes shall automatically terminate this NOA. Failure to comply with any section of this NOA shall be cause for termination and removal of NOA.

ADVERTISEMENT: The NOA number preceded by the words Miami-Dade County, Florida, and followed by the expiration date may be displayed in advertising literature. If any portion of the NOA is displayed, then it shall be done in its entirety.

INSPECTION: A copy of this entire NOA shall be provided to the user by the manufacturer or its distributors and shall be available for inspection at the job site at the request of the Building Official.
This NOA **revises NOA # 11-0624.02** and **# 13-0328.09** and consists of this page 1 and evidence page E-1, as well as approval document mentioned above.
The submitted documentation was reviewed by **Carlos M. Utrera, P.E.**

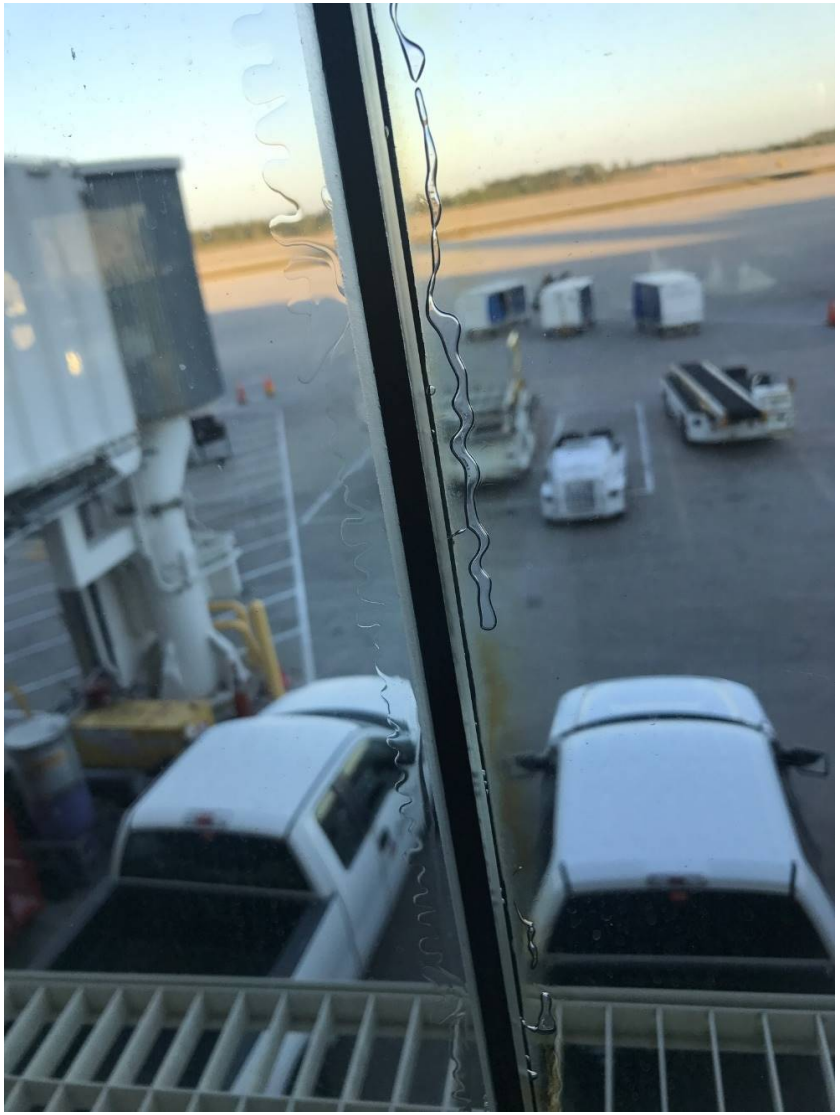
MIAMI-DADE COUNTY APPROVED

07/09/2015

NOA No. 14-0916.11
Expiration Date: July 4, 2018
Approval Date: June 25, 2015
Page 1

Laminated Glass Interlayers –Edge Defects

Laminated Glass Interlayers – Edge Defects



Make sure the sealant and interlayers are compatible

Laminated Glass Interlayers – Edge Defects

Project Types

- Residential
- Commercial
- Retail
- Institutional
- Educational
- Health care
- Hospitality
- Cultural

Wet vs. Dry glazed Systems

- Wet glazed systems
  - Often used for shop glazed fenestration products
  - Commonly used for the High Velocity Hurricane Zone (Wind Zone 4)
  - PVB based interlayers must be wet glazed to pass the required cycling test

- Dry glazed systems
  - Especially suitable for job site glazed fenestration systems
  - Dry glazing eliminates the use of wet sealants and more closely replicated the as tested conditions
  - Cost savings in terms of labor and materials
  - Time savings in replacing broken glass
  - Assurance that system is properly glazed
  - Ionoplast allows higher dP's

Dry-glazed projects

Southern Wines project

Cornerstone project

Valpak project

Additional considerations

Wilkie D. Ferguson Federal Building, Miami, FL

- Energy
- Acoustics
- Intrusion resistance
- Bomb blast
- Tornadoes

Energy Solutions

- U value and solar heat gain coefficient requirements specified in the International Energy Conservation Code
- Trend to incorporate coatings and insulating glass
- Low e coating normally on #2 glass surface

Florida Hospital Waterman

Façade Retrofit Example

- Façade glazing brought up to building code impact requirements for wind-borne debris protection
- Improved thermal performance

Forced Entry & Security

Large Missile Intrusion resistance Storefront

Intrusion resistance

Security & Forced Entry Testing

ASTM F1233				
Sequence	Test Implements	Impacts	Minutes	Class Achieved
1	Ball Peen Hammer	10		1.0
2	Ball Peen Hammer	10		1.1
3	1-1/2" Diameter Pipe	25		1.2
4	Extinguisher, CO2		1	1.3
5	Sledge Hammer	25		1.4
6	Propane Torch Flame		5	1.5
7	Ripping Bar	10		2.0
8	Ram	10		2.1
9	4" Diameter Pipe/Sledge	25		2.2
10	Sledge Hammer	25		2.3
11	Propane Torch Flame		5	2.4

Pass Criteria
Contraband – no opening that allows the passage of an 1/8" (3.175 mm) diameter rod.
Body - No opening that allows the passage of an 8" x 8" x 5"
(203 mm x 203 mm x 127 mm) block

5-aa1				
Sequence	Test Implements	Impacts	Minutes	Time to Pass
1	Shot 7.62mm Round	5		
2	Bricks	20		
3	Kicks with Steel Toe	10		
4	Tools Set #1		2	2 min
5	Tool Set #2		3- ½	5.5 min
6	Sledge Hammer		6	11.5 min

Tools set #1 – wrench, small 2x4 wood, claw hammer
Tools set #2 – 3lb hammer, aluminum baseball bat

Pass Criteria
No opening that allows the passage of a 4" (102 mm) diameter ball – without touching!
Report time to failure

ASTM F1233 Test Results

ASTM F1233		Class Achieved										
Interlayer	Thickness	1.0	1.1	1.2	1.3	1.4	1.5	2.0	2.1	2.2	2.3	2.4
PVB	0.060” w/o Ballistics											
	0.090” w/o Ballistics											
	0.180” w & w/o Ballistics											
	0.270” w & w/o Ballistics											
Ionoplast	0.060” w/o Ballistics											
	0.090” w/o Ballistics											
	0.180” w & w/o Ballistics											
	0.270” w/o Ballistics											
	0.270” w/ Ballistics											

Ballistics – 3 shots from a 9mm

5-aa1 Test Results

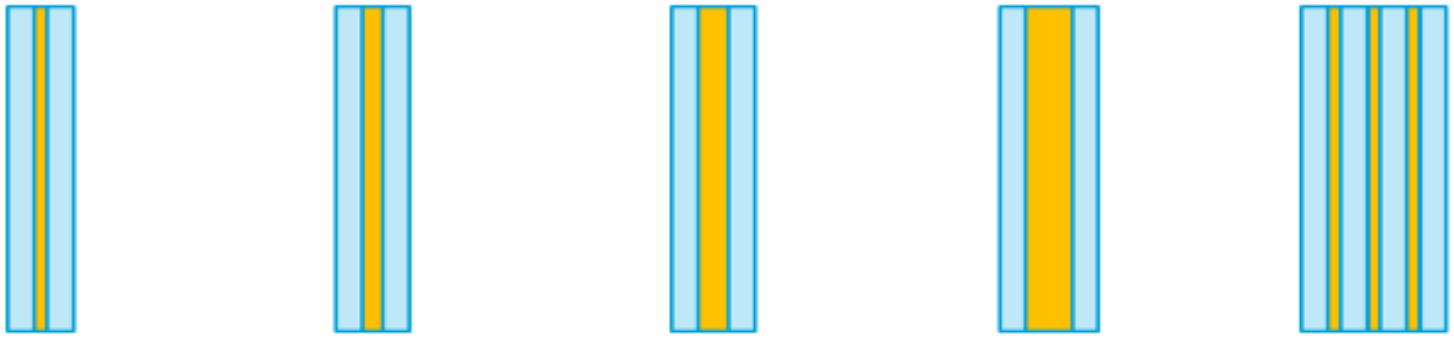
HP 5-aa1 - School Security Testing		Ballistic Impact	Concentrated Assault		Forced Entry			Forced Entry Protocol Time	Notes
Interlayer	Thickness	5 shots 7.62mm	20 Bricks	10 Kicks	Tools 2 min	Tools 3-1/2 min	Sledge Hammer 6 min		
PVB	0.060”	■	■					N/A	
	0.090”	■	■	■				N/A	
	>0.090”	■	■	■	■	■		5 min 30 sec	
	>0.200”	■	■	■	■	■	■	11 min 30 sec	Small Opening
Ionoplast	0.060”	■	■	■				N/A	
	0.090”	■	■	■	■			2 min	
	>0.090”	■	■	■	■	■	■	11 min 30 sec	Small Opening
	>0.200”	■	■	■	■	■	■	11 min 30 sec	No openings

* 2 min tools - a small 2x4, claw hammer, and wrench
** 3-½ min tools – 3lb hammer and Aluminum Baseball bat

<u>Typical Hurricane Interlayer Thicknesses</u>
Small Missile Glass = 0.060” PVB (> 30 ft)
Large Missile Glass = 0.090” Ionoplast or PVB (< 30 ft)
Level E Large Missile Glass = 0.180” Ionoplast (< 30 ft)

Security Glazing (source: NGA Security Glass Technical Paper)

Level	Safety	Enhanced	Forced Entry	Enhanced Forced Entry	Ballistic Protection
Estimated Delay Time	< 1 min	< 3 min	> 3 min	> 6 min	> 11 min
Threat to Glazing	Accidental Human Impact …	Burglary / Smash and Grab	High Risk areas	Very High-Risk Area	Ballistics Protection
Test Method	ANSI Z97.1 EN 12600 ASTM F3006	UL 972 ASTM E2395 EN 356 level 1-5	ASTM F1233 HPW-TP-0500.03 EN356 Level 6-8	ASTM F1233 HPW-TP-0500.03 5-aa1	UL 752 EN 1063 NIJ 0108.01
Example of Configuration	Glass 0.035" SentryGlas Glass	Glass 0.090" SentryGlas Glass	Glass >0.090" SentryGlas Glass	Glass >0.200" SentryGlas Glass	Glass 0.060" SentryGlas Glass 0.060" SentryGlas Glass 0.060" SentryGlas Glass



***** Forced Entry + Ballistics will allow the bullet to penetrate, but the glazing will remain in the frame preventing access

5-aa1 Step 1 – 7.62 mm round

5-aa1 Step 2 – Bricks

5-aa1 Step 3 – Kicks

5-aa1 Step 5: Tool set 2 (aluminum baseball bat, 3 lb. hammer)

Safety glass Vs. Enhanced Forced Entry

Tornado's During Hurricanes 2010-2019

Tropical cyclone	Outbreak dates	Tornadoes	Location of tornado(es)
Hurricane Harvey	August 25 – September 1, 2017	54	Southeastern United States
Tropical Storm Lee	September 3–7, 2011	46	Southeastern United States
Hurricane Isaac	August 21 – September 1, 2012	26	Southeastern, Midwestern, and Eastern United States
Tropical Storm Debby	June 23–27, 2012	24	Florida, United States
Tropical Storm Andrea	June 5–7, 2013	16	Cuba, Florida, and North Carolina, United States
Tropical Storm Hermine	September 7–9, 2010	13	Southern United States
Hurricane Alex	June 30 – July 2, 2010	11	Texas, United States
Typhoon Man-yi	September 15–16, 2013	10	Japan
Hurricane Irene	26-Aug-11	9	United States East Coast

Source: Wikipedia

Tornado Mitigation in Hurricane Regions

- ICC 500-2014 ICC/NSSA Standard for the Design & Construction of Storm Shelters
- Section 305.1.2 Missile criteria for hurricane shelters
  - Missile impactor: 9 lb. 2 x 4 timber
- The speed of the test missile impacting vertical shelter surfaces shall be a minimum of 0.50x the shelter design wind speed.
- The speed of the test missile impact horizontal surfaces shall be 0.10x the shelter design wind speed.

Enhanced F Scale for Tornado Damage

Category	Wind Speed (3 second gust)
EF0	65-85 mph
EF1	86-110 mph
EF2	111-135 mph
EF3	136-165 mph
EF4	166-200 mph
EF5	>200 mph

EF = Enhanced Fujita

Design Wind Speed (mph)	Missile Speed on Vertical Surfaces	Missile Speed on Horizontal Surfaces
130	65 mph (95 fps)	13 mph (19 fps)
160	80 mph (117 fps)	16 mph (23 fps)
200	100 mph (146 fps)	20 mph (29 fps)
250	125 mph (183 fps)	25 mph (36 fps)

Tornado Testing

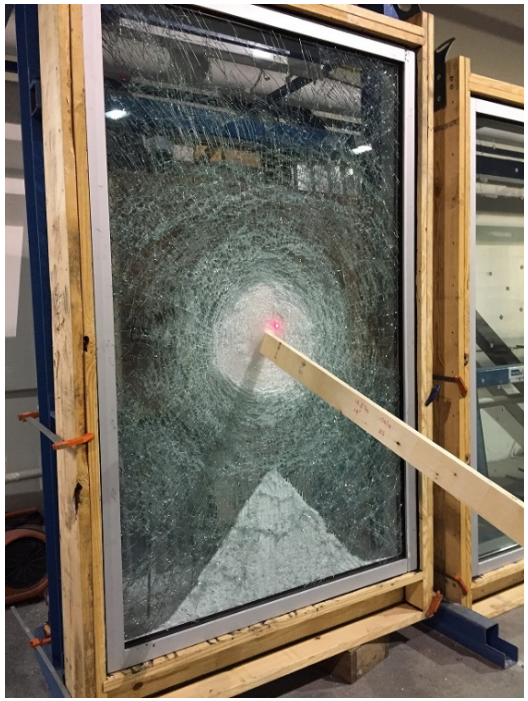
Missile Level	Missile Size	Missile Speed
Hurricane Large Missile Level D	9 lb. 2x4, 8' lumber	34 mph 50 f/s
Hurricane Large Missile Level E	9 lb. 2x4, 8' lumber	54.5 mph 80 f/s
Tornado FEMA 361 – EF2 - 130 mph	15 lb. 2x4, 12' lumber	80 mph 117 f/s
Tornado FEMA 361 – EF3 - 160 mph	15 lb. 2x4, 12' lumber	84 mph 123 f/s
Tornado FEMA 361 – EF4 - 200 mph	15 lb. 2x4, 12' lumber	90 mph 132 f/s
Tornado FEMA 361 – EF5 - 250 mph	15 lb. 2x4, 12' lumber	100 mph 147 f/s

Impact

- 2 hits per specimen (center and corner)
- Pass fail criteria
  - Perforation-component is impact by debris and the debris enters the protected space
  - Note: Perforation is different than penetration (debris does not enter the protected space)
  - Glazing remains attached to frame
  - Glass fragments or shards remain within the glazing unit
- Cycling to ASTM E1886 (if in hurricane zone)

Tested Glazing Configurations

Level	Glazing Configuration
EF2 (80 mph)	¼” HS glass lite – 180 mil SentryGlas® - ¼” HS – ½” Airspace – ¼” HS – 180 mil SentryGlas® - ¼” HS
EF3 (84 mph)	¼” HS glass lite – 270 mil SentryGlas® - ¼” HS – ½” Airspace – ¼” HS – 180 mil SentryGlas® - ¼” HS
EF4 (90 mph)	¼” FT glass lite – 270 mil SentryGlas® - ¼” HS – ½” Airspace – ¼” HS – 180 mil SentryGlas® - ¼” HS – 0.037” Trosifol CPET
EF5 (100 mph)	¼” HS glass lite – 270 mil SentryGlas® - ¼” HS – ½” Airspace – ¼” HS – 180 mil SentryGlas® - ¼” HS – 0.052” Trosifol CPET



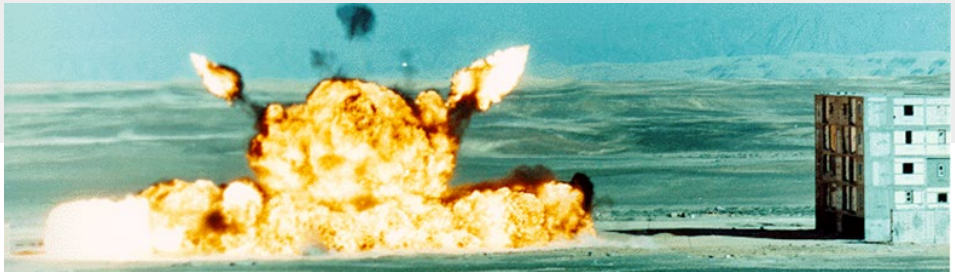
A strong tornado churns south of Dodge City, Kan., on May 24. (Ian Livingston)

Tornado Impact Testing

- Impact test requirements are more severe than for hurricanes
- 130 mph design requirement
  - Impactor 15 lb. 2 x 4
  - Impact speed: 80 mph
- 250 mph design requirement
  - Impactor 15 lb. 2 x 4
  - Impact speed: 100 mph

Bomb Blast ASTM Standards

- ASTM F1642 Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings
- Glass or fenestration test
- Shock tube or open arena testing
- ASTM F2912-11 Standard Specification
  - Several levels of performance
  - 4 psi peak pressure/28 psi-msec (GSA Level C)
  - 6 psi peak pressure/42 psi-msec (DOD)
  - 10 psi peak pressure/89 psi-msec (GSA Level D)



General Services Administration (GSA)

- Interagency Security Committee (ISC) Security Design Criteria adopted by GSA in 2001
- ISC requirements
  - Balanced design of window systems
  - Level C-design up to 4 psi
  - Level D-design up to 10 psi

Condition	Protection Level	Hazard Level	Description of Glazing Response
1	Safe	None	Glass does not break
2	Very High	None	Glass cracks but retained in frame
3a	High	Very Low	Glass cracks. Fragments land on floor no further than 3.3 feet.
3b	High	Low	Glass cracks. Fragments land on floor no further than 10 feet.
4	Medium	Medium	Glass cracks. Fragments land on floor no further than 10 or height no greater than 2 feet above floor at witness 10 feet away.
5	Low	High	Glass cracks and catastrophic failure

Porsche Design Tower, Florida, USA

Laminator:
Cardinal Glass

Developer:
Dezer Developments
Porsche Design Group

Interlayer:
SentryGlas® 2.28 mm / 90 mil

Dali Museum, USA

Architects:
Arquitectonica, Helmut, Obata + Kassabaum (HOK)

Interlayer:
SentryGlas® 1.52 mm / 60 mil

Baha mar resort, Bahamas

Architects:
RMJM Architects

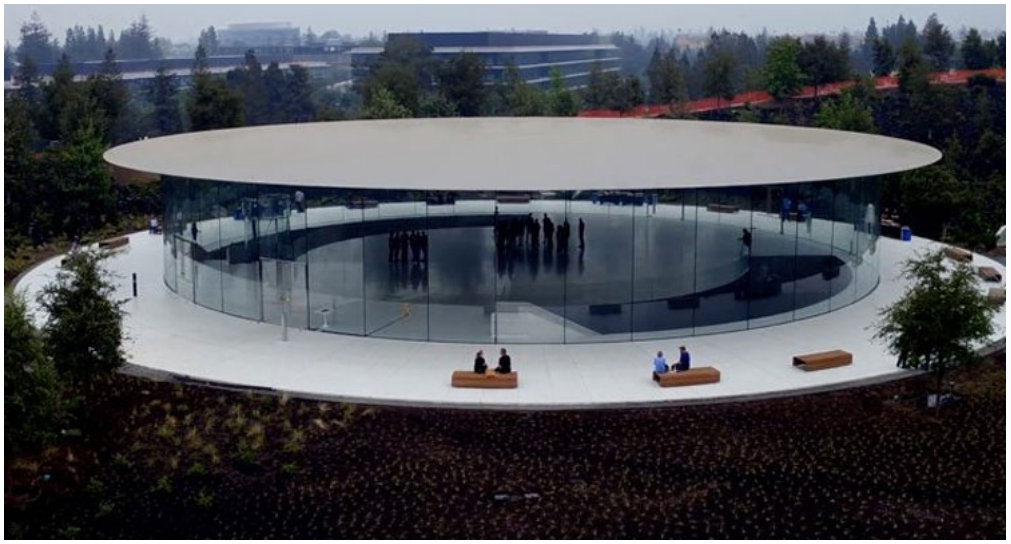
Interlayer:
Ionplast

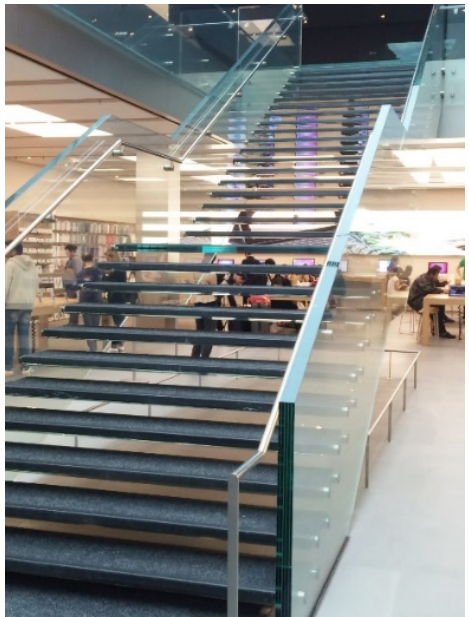
U.S. Federal Courthouse, Miami

- *Glazing provides security and …*

  Complies with building code requirements for hurricane impact, blast and energy performance

Ionoplast Structural Glass Projects

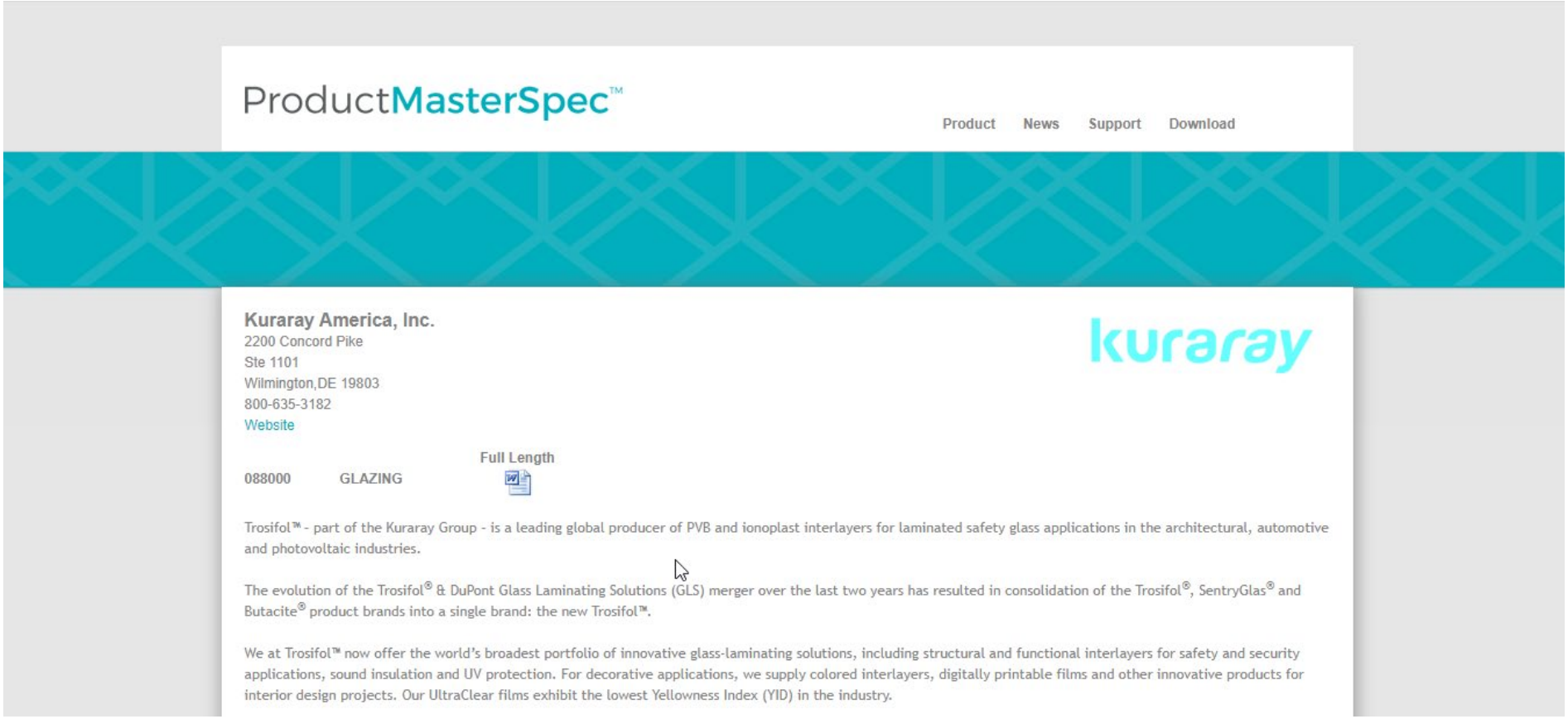




Ionoplast Structural Glass Projects

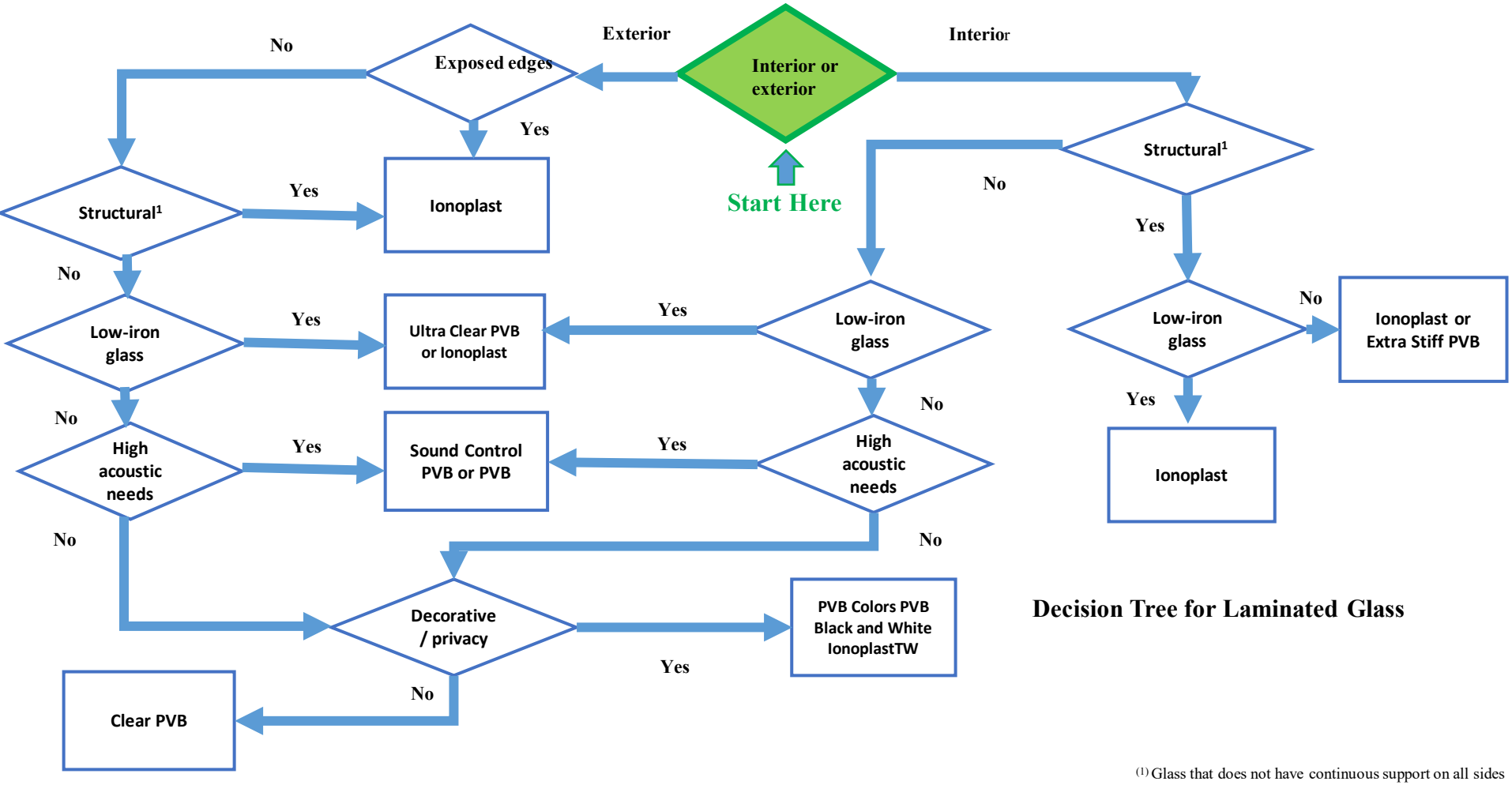
Conclusions

- Building codes and standards are in place to regulate glazing in wind-borne debris regions.
- Testing requirements, including missile impact and pressure cycling for systems, and varies according to the location of the glazing in the building and the wind zone in which the building is located.
- Both wet vs. dry glazed systems are available. Dry glazed systems can save $$$ in terms of labor and materials.
- Both PVB and ionoplast interlayers are used in laminated glass systems.
  - PVB is typically used in smaller glass sizes with lower design pressure requirements for large missile and most small missile applications regardless of panel size.
  - Ionoplast interlayers offer benefits for larger glass panel sizes and areas that have high design pressures for large missile resistant systems.
- Other considerations, including energy performance, acoustics, intrusion, bomb, and tornado resistance will effect glazing design.



Our product specs are now available in a word format for both Product MasterSpec and BSD Speclink - 088000 Glazing

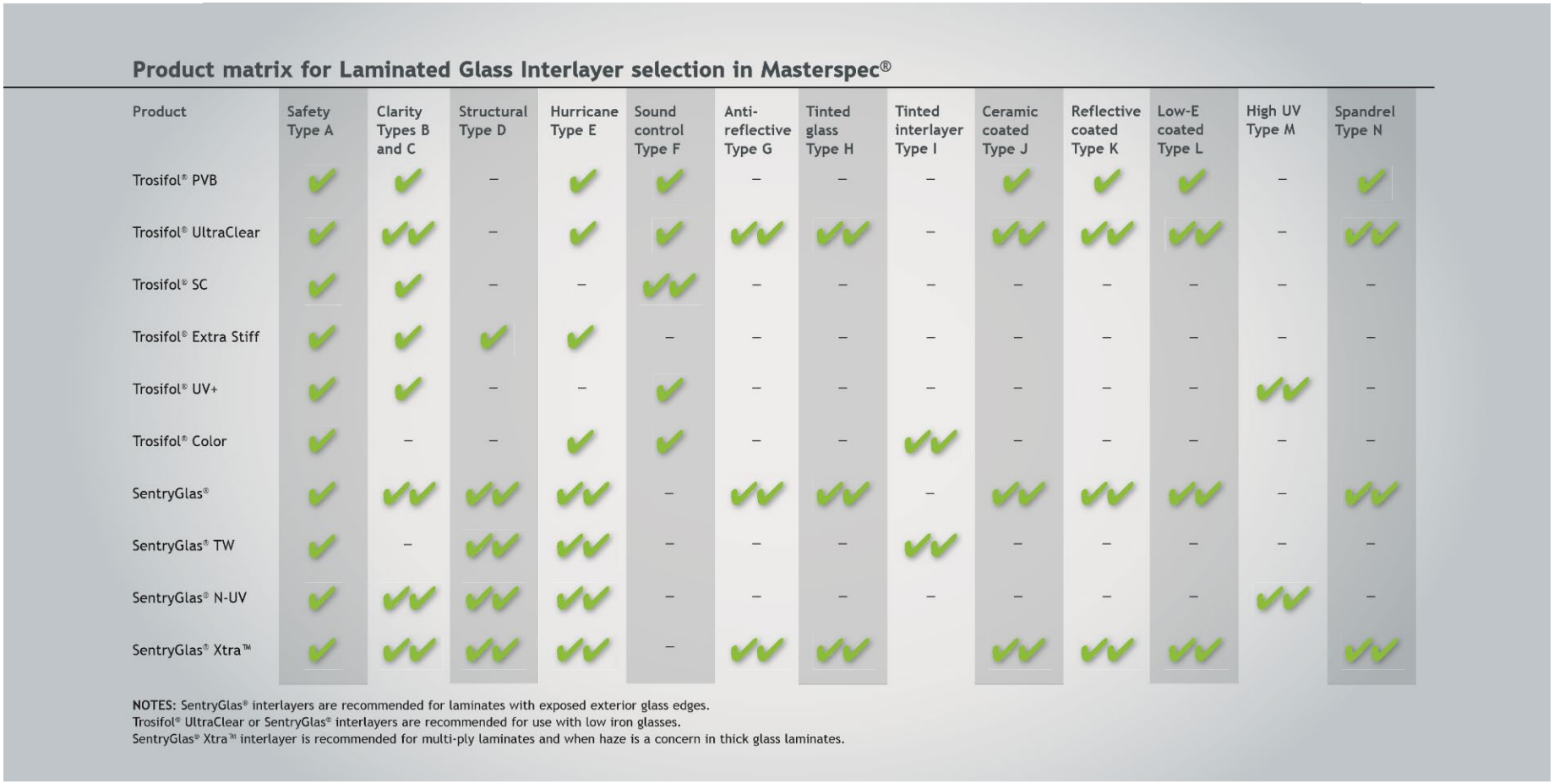
Trosifol Interlayer Decision Tree – How to select the right interlayer



Decision Tree for Laminated Glass

(1) Glass that does not have continuous support on all sides

Product Matrix for Laminated Glass in MasterSpec



Product matrix for Laminated Glass Interlayer selection in Masterspec®

Product	Safety Type A	Clarity Types B and C	Structural Type D	Hurricane Type E	Sound control Type F	Anti-reflective Type G	Tinted glass Type H	Tinted interlayer Type I	Ceramic coated Type J	Reflective coated Type K	Low-E coated Type L	High UV Type M	Spandrel Type N
Trosifol® PVB	✔	✔	–	✔	✔	–	–	–	✔	✔	✔	–	✔
Trosifol® UltraClear	✔	✔✔	–	✔	✔	✔✔	✔✔	–	✔✔	✔✔	✔✔	–	✔✔
Trosifol® SC	✔	✔	–	–	✔✔	–	–	–	–	–	–	–	–
Trosifol® Extra Stiff	✔	✔	✔	✔	–	–	–	–	–	–	–	–	–
Trosifol® UV+	✔	✔	–	–	✔	–	–	–	–	–	–	✔✔	–
Trosifol® Color	✔	–	–	✔	✔	–	–	✔✔	–	–	–	–	–
SentryGlas®	✔	✔✔	✔✔	✔✔	–	✔✔	✔✔	–	✔✔	✔✔	✔✔	–	✔✔
SentryGlas® TW	✔	–	✔✔	✔✔	–	–	–	✔✔	–	–	–	–	–
SentryGlas® N-UV	✔	✔✔	✔✔	✔✔	–	–	–	–	–	–	–	✔✔	–
SentryGlas® Xtra™	✔	✔✔	✔✔	✔✔	–	✔✔	✔✔		✔✔	✔✔	✔✔		✔✔

NOTES: SentryGlas® interlayers are recommended for laminates with exposed exterior glass edges.
Trosifol® UltraClear or SentryGlas® interlayers are recommended for use with low iron glasses.
SentryGlas® Xtra™ interlayer is recommended for multi-ply laminates and when haze is a concern in thick glass laminates.

How can Trosifol support you

Consultancy services

Finite Element Analysis (SJ Mepla, SG Calc…)

- Effective thickness method (ASTM E1300-09)
- Thermal breakage

Windows glass design

Bomb blast performance

- Wingard suite of tools (ARA)

Thermal and energy performance

- Lawrence-Berkeley National Labs (LBNL), optics, window, therm

Test design support

- Miami Dade County…

Laminated glass expertise

Interlayer advice and selection

Kuraray Network of Laminators: glass fabricators capabilities

Glass and lamination training

Building codes monitoring

Technical support and standard tests (Adhesion…)

New applications development and tests

Global technical support team with 3 technical labs in Korea, Germany and USA

Online tools

Trosifol® Strength of glass calculator

- Technical design guide for structural engineers
- list of compatible sealants
- Library of technical papers and test reports
- List of glazing systems tested for hurricane glazing

Trosifol® WinSlt

- Calculation of light and energy tranmission

Trosifol® GlasGlobal

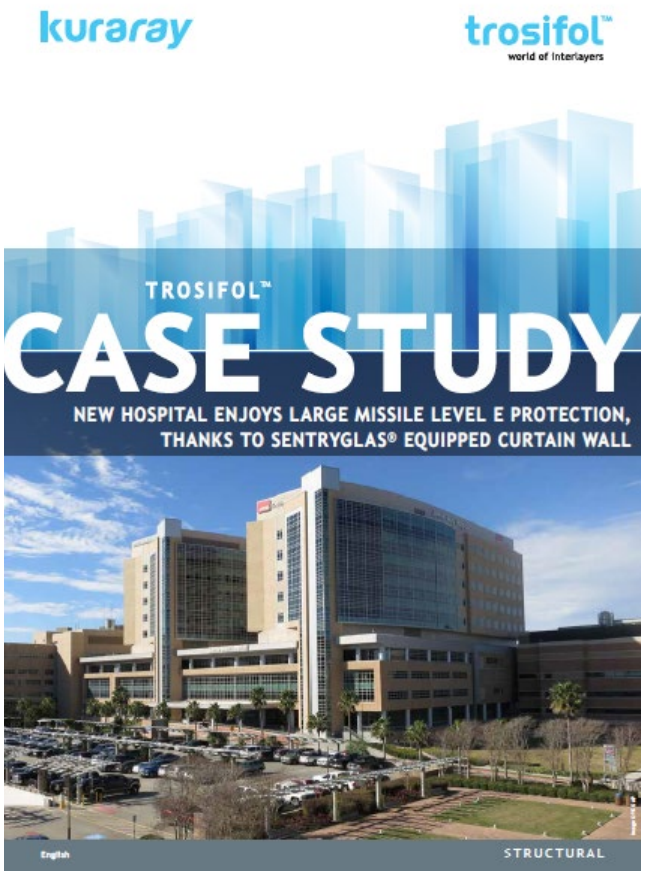
- Static calculation according DIN 18008 and ASTM E.1300
- Taking into account the coupling effect of Trosifol® Extra Stiff and SentryGlas®

Trosifol® SoundLab

- This is a database for determining sound insulation values for glass constructions fabricated using Trosifol® products.

Laminated Glass News (Newsletter)

Case Studies, Brochures & Specifications



Our Products are now included in Product MasterSpec Section and licensed by AVITRU: SECTION 088000 – GLAZING
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https://www.trosifol.com/

Thank you

This concludes the American Institute of Architects
Continuing Education Systems Program

Questions?

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kuraray