

protective
glass
specs & tech

hurricane-resistant
blast mitigating
safety & security defense



protecting people, property and peace of mind from natural disasters and man made threats

It all starts with taking your “what if” questions and turning them into “why not” answers. Chances are, we’ve recommended a protective glazing solution for a similar specialty glass job over the years. And chances are today, we can give you a point of view other fabricators just don’t feel comfortable talking about. Trust, confidence, peace of mind — it’s what protective glass experience, a broad selection of glazing options and the technical expertise to fabricate customized solutions can do for you.

Viracon offers you more than just pure protective glazing options.

You’ll also find a wide selection of protective glass designed to offer acoustical, thermal and aesthetic performance through our complete product offering, including: insulating, laminated, silkscreened, spandrel, heat-treated and high-performance coated glass. After all, the last thing we want is for you to have to make design changes that compromise your vision. And your clients’. It’s simple: when it comes to working with you on protective glazing, we’re high-impact problem solvers. Challenge us, you’ll see.



Espirito Santo Plaza

Miami, Florida

Architect: Kohn Pederson Fox

Glazing Contractor: Permasteelisa

Photographer: Wes Thompson

Viracon Protective Glass incorporates a laminated component capable of resisting threats from hurricanes, tornadoes, seismic events, mitigate against the effects of bomb blasts, ballistic and/or forced entry threats.

**Viracon is the “go to” company
for protective glazing options.**

From imaginative aesthetics to strict environmental and energy issues to state and local code compliance to critical budget requirements, we know how to help you figure out a way to make it all work within budget and on time. That’s what being a leader is all about. Architects, designers, contractors, window companies and visionaries throughout the world have come to rely on our proven experience to make Viracon their “go to” company when it comes to exploring options. And getting answers. The fact is, after 30-plus years, 100,000 buildings and 500,000,000 square feet of glazing installed in some of the world’s most remarkable buildings, you learn a thing or two about what’s the best thing to do. Today, we perform more glass fabricating processes at a single site than any other fabricator. Sit down, tell us your thoughts, challenge us. The sky’s the limit.



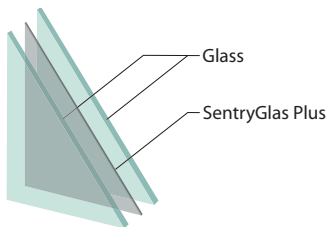
Viracon hurricane-resistant glass options

extreme protection for extreme conditions

There's no ifs, ands or buts about it, Viracon's line of Hurricane-Resistant Glass (HRG) gives you the best chance to stand up to Mother Nature's fury.

All our HRG products meet or exceed stringent code requirements of Florida and other coastal regions.[†] And every product has passed the impact and cyclic wind pressure tests as part of a complete glazing system.

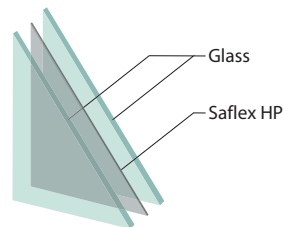
SentryGlas® Plus



Viracon SentryGlas® Plus (SGP) laminate incorporates an ionoplast interlayer bonded directly between two layers of glass for superior protection.

- Rigid interlayer minimizes deflection
- Available interlayer thicknesses: .060", .090", .100"
- The .090" and .100" SGP interlayers are typically used in large missile applications
- Maximum producible size*: 72" x 120" (1829mm x 3049mm) – Lengths to 144" (3658mm) are subject to availability.

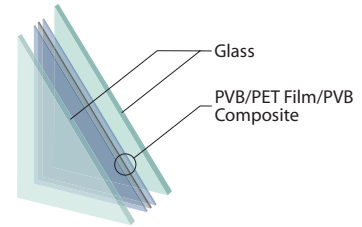
StormGuard™



Viracon StormGuard™ is composed of an enhanced polyvinyl butyral (PVB) interlayer which provides excellent adhesion to glass and optimum performance for large missile applications.

- Less deflection and better tear resistance than standard PVB interlayers
- Available with colored interlayers, i.e.: Vanceva™ Arctic Snow
- Maximum producible size*: 72" x 144" (1829mm x 3658mm)

Vanceva™ Storm



Viracon Vanceva™ Storm laminate consists of a PVB / PET film / PVB composite laminated between two panes of glass. The composition provides the impact resistance of polyvinyl butyral and the tear resistance of polyethylene terephthalate (PET) film, providing you with the ultimate in hurricane protection.

- Less deflection than standard pvb
- Tear resistance of PET film
- Maximum producible size*: 60" x 144" (1524mm x 3658mm)

[†]Building code requirements vary by geographic region. Contact the building code officials of the project location for the applicable standard.



Waterford Business Park Office Building

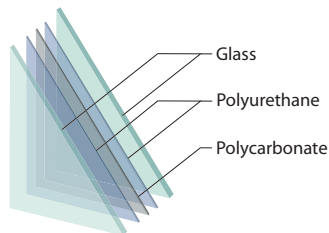
Miami, Florida

Architect: Thompson, Ventulett, Stainback, and Associates

Glazing Contractor: R.C. Aluminum

Photographer: Wes Thompson

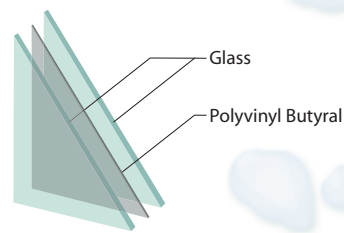
HRG-2



Viracon HRG-2 encompasses a polycarbonate core laminated between two plies of glass, which provides the highest level of hurricane protection.

- Tested to the highest design pressures Viracon has documented
- Rigid interlayer minimizes deflection
- Important glazing recommendations, reference page 10
- Maximum producible size*: 60" x 120" (1524mm x 3048mm)

PVB Laminated Glass



Viracon PVB laminates, consisting of a standard architectural polyvinyl butyral interlayer laminated between two panes of glass, have proven suitable for varying degrees of hurricane protection.

- .060" pvb thickness has qualified for small missile impact requirements
- .090" pvb thickness has qualified for large missile impact requirements – performance is generally limited to lower design pressures and smaller glass sizes

Did you know?

Viracon's protective glass laminates provide several other benefits in addition to storm protection:

- *Acoustical performance* – Laminated glass reduces noise transmission due to the sound damping characteristics of the interlayer
- *Safety* – Laminated glass meets national safety standard ANSI Z97.1 and the Federal Safety Standard CPSC 16 CFR 1201
- *Ultraviolet/Solar protection* – Provides 99% UV light blockage at the wavelength range of ~300 - 380 nanometers
- *The abrasion-resistance* surface of glass
- *Thermal performance* and pleasing *aesthetics*, when incorporated with Viracon Solarscreen™ coatings, in insulating units, with silkscreen patterns, etc.

Depending upon your climate, if you upgrade a clear glass laminate to an insulating unit with a laminated inboard ply, and incorporate a Solarscreen 2000 coating on the #2 surface, you can optimize the thermal performance by approximately 50% and earn a cost payback within four years!

When choosing the right hurricane resistant glass for your application, the following points must be evaluated:

- Determine the applicable building code and test method†
- Determine the required design pressure/wind load
- Qualify the missile requirement – large and/or small missile
- Identify the largest glass size
- If using a tested or certified framing system, confirm the laminated glass qualified with the particular manufacturer's product
- If not using a tested or certified frame, evaluate system design details, such as:
 - Glazing method: conventional or structurally glazed
 - Glass bite – Often large missile applications require a minimum edge engagement of 5/8" to augment performance
 - Anchorage and hardware requirements – Typically large missile applications require an enhanced design

Viraconsulting™

We offer complete design assistance through our Field and Account Representatives, or you can contact our Viracon Techelp services at 800-533-2080.

*Maximum producible size does not imply that the product will pass hurricane testing at the stated size. The minimum size for the heat treated laminated glass is 12" x 36" (305mm x 914mm).

Viracon blast mitigating glass keeps it all together

The threat of terrorism is ever-present in our society today. Explosives are recognized as the weapon of choice by terrorists to make their statements. As a result, both active and passive security measures are becoming the standard in current building designs. And more and more architects, contractors and blast consultants are turning to Viracon for help with glazing solutions.

Viracon provides laminated glass options that help mitigate the effects of bomb-blast attacks. Because many critical factors must be considered when designing for blast mitigation, Viracon offers expertise to help you every step of the way. The fact is, when installed into a glazing system, Viracon laminates can be designed to meet the requirements of the Department of State, Department of Defense, General Services Administration (GSA) and other government or industry standards.

Laminated glass is considered a component of the overall system. Therefore, the blast mitigating performance is also dependent upon being installed into an adequately designed frame. Viracon recommends the involvement of a blast consultant to verify the performance of the glass and glazing system combination.



*St. Louis County Justice Center
Clayton, Missouri
Architect: Sverdrup CRSS/
Hellmuth, Obata & Kassabaum, Inc.
Glazing Contractor: NGG Ltd., Inc.
Photographer: Wes Thompson*



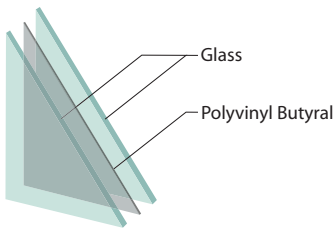
*Las Vegas Courthouse
Las Vegas, Nevada
Architect: Dworsky Associates
Glazing Contractor: Enclos Corp.
Photographer: Wes Thompson*

Many factors must be considered when evaluating which laminated glass product is suitable for a specific blast mitigating application:

- Blast Load including the Pressure (psi), Duration (msec) and Impulse (psi*msec) OR the TNT load equivalent and Standoff Distance
- ISC/GSA or ASTM F1642 Injury Hazard Classification Levels
- Glass Size
- Framing Design including Anchorage, Glass Bite, Hardware, etc.



Tests prove that when windows glazed with laminated glass are subjected to a blast impulse, broken glass fragments tend to adhere to the plastic interlayer rather than spraying building occupants.



Low to Medium Performance

Blast Mitigating Laminates for low to medium performance could include:

- PVB Laminated Glass: .030", .060", .090" interlayer thicknesses
- Insulating Laminates (with laminate to interior/protected side)

(Performance dependent upon factors as stated on page 6)

Medium to High Performance

Blast Mitigating Laminates for medium to high performance could include:

- Double Laminated Insulating Glass (two laminates separated by air spacer)
- Enhanced Interlayer Laminates, i.e.: StormGuard, SentryGlas Plus, Vanceva Storm
- Multi-ply Laminates
- Glass-Clad Polycarbonates
- Custom Glazing Configurations

(Performance dependent upon factors as stated on page 6)

Viraconsulting™

Viracon's expertise and proven performance is visible on projects throughout the world. We can assist in offering custom glazing options for specific threat levels and performance requirements. Contact our Technical Service Department at 800-533-2080 for assistance.

Viracon safety & security ballistic and forced-entry glass

Viracon offers Glass-Clad Polycarbonates (GCP) for protection against ballistic and prolonged physical attack threats. These laminates are supplied for exterior glazing of commercial and government buildings where severe threats are high.

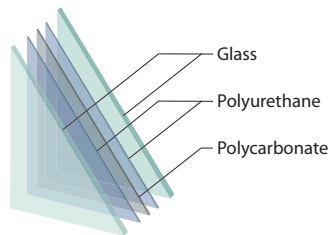
These products offer superior performance over the capabilities of standard PVB or conventional laminates, which can protect against “smash and grab” threats and provide lower threat performance.

Glass-clad polycarbonates are often used in conjunction with other Viracon design features to achieve thermal and aesthetic benefits.



Viracon glass-clad polycarbonates carry test certifications for specific threat levels per Underwriters Laboratory (UL), H.P. White and WMFL standards. They can also be constructed to qualify for additional standards, such as: NIJ, Department of State (DOS) and others. Keep in mind that you may be able to achieve *multiple threat protection* with a single glazing product! Viracon will work with you to determine the appropriate product for specific threat levels to meet your safety and security performance needs.

Glass Clad Polycarbonates



GCP laminates are composed of a polycarbonate core laminated between two panes of glass. For no-spall criteria, a spallshield film is laminated to the inner most surface.

Checklist:

- Identify the protection criteria needed, i.e. ballistic, forced-entry, blast, etc.
- Determine the test standard and/or threat level required
- If multiple threat protection is required, determine the priority
- Confirm the thermal and aesthetic values desired

As with all protective glazing, the framing system plays a vital role in the performance and must be adequately designed.



FIELD SALES REPRESENTATIVES

We're here to help with design assistance, budget costing, return on investment costing, specification writing and review as well as act as a liaison between architects and glazing contractors. We also work closely with the glazing contractor to offer assistance with initial costs, final pricing negotiations, product information and job site inspections. Just ask.

ACCOUNT REPRESENTATIVES & CUSTOMER SUPPORT

Call on us to help with quoting, product performance data, pricing, project coordination, samples and mockups. All it takes is a phone call.

techelp

Need an answer – fast? Our Architectural Technical Services group, along with our Architectural Design group, can assist you with specification and design solutions, performance and environmental analysis, structural calculations and energy payback for hurricane-resistant, blast-mitigating and security threat level requirements. No problem.

specs & tech

what you need to know

Glazing Guidelines

All protective glass products must be supported on two silicone or silicone compatible setting blocks. The blocks should have a durometer hardness of 85 ± 5 . They should also be centered at quarter points and be $1/16"$ (1.6mm) less than the channel width (see Figure 1). For glass-clad polycarbonate laminates, ensure that the setting blocks are manufactured of santoprene, silicone, EPDM or any polycarbonate compatible material. Avoid neoprene, since it can be incompatible with polycarbonates.

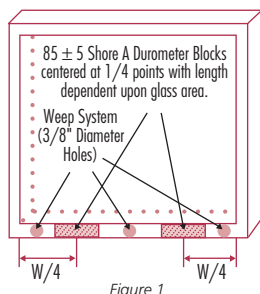


Figure 1

Adequate clearances must be maintained to prevent glass damage or breakage as a result of glass-to-frame contact. Provide uniform face clearance by installing a cushioning material between the framework and the glass components. Viracon recommends a minimum face clearance of $1/8"$ (3mm) and a minimum edge clearance of $1/4"$ (6mm) (see Figure 2).

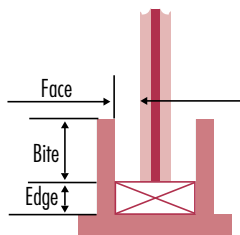


Figure 2

Edge Engagement

Normally the edge engagement or bite of a protective glass laminate is required to be deeper than traditional applications not intended to mitigate against man-made threats or threats of nature. This requirement is to augment performance of the glazing and framing system. For hurricane and blast application, the required edge engagement is dependent upon such factors as the design load, the glazing system and the glass product. For ballistic and forced-entry application, most test standards specify a 1" (25mm) edge engagement. Engagements less than 1" can be used; however, test certifications may no longer be applicable.

Avoid excessive edge clamping pressure since it can result in glass breakage or premature delamination.

Weep Systems

Do not expose the edges of laminated or insulating laminated glass to standing water. This can cause premature seal failure or delamination. Viracon requires either impervious weather seals or an adequate weep system to prevent this from occurring (see Figure 3). This is also true of lockstrip gasket glazing. The glazing system manufacturer or designer is ultimately responsible for the design of the weep system and its proper performance.

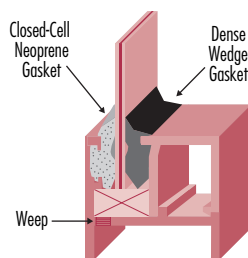


Figure 3

Glass Handling and Storage

Care needs to be taken during handling and glazing to ensure that glass damage does not occur. Do not allow glass edges to contact the frame or any hard surfaces during installation. Use rolling blocks if the laminated

units are rotated or "cartwheeled" on their corners. Damaged glass edges can ultimately result in delayed glass breakage as the units encounter in-service thermal and mechanical stresses. *Viracon assumes no responsibility for glass breakage.*

Improper glass storage techniques may result in glass breakage or damage to glass components, glass surfaces, or coatings. Store glass crates properly to prevent them from tipping. In addition, store glass indoors whenever possible. Do not subject the glass to rain, water or direct sunlight. In order to prevent condensation and subsequent glass staining while in storage, the temperature of the stored glass must remain above the dew point temperature of the air. If outdoor storage is unavoidable, construct a protective canopy using a waterproof, light blocking material that allows air circulation around the tops and sides of the cases. Ensure that stored glass and interleaving material are kept dry.

Maintenance and Cleaning

Once the glass is installed, the glazing contractor should make provisions to ensure that the glass surfaces are protected from possible damage caused by the construction practices of other trades. For routine cleaning, use a mild soap detergent and lukewarm water. Uniformly spray the cleaning solution or apply it with a clean, soft, grit-free applicator and rinse thoroughly. Dry the glass surface with a clean, grit-free cloth or a squeegee. Do not allow any metal or hard parts of the cleaning equipment to contact the glass surfaces.

Glass-Clad Polycarbonates and HRG-2

Careful consideration must be made with regard to incompatible materials that may come in contact with the laminate and polycarbonate core. Contact of such materials results in cracking of the polycarbonate. The cracking may appear as a fine crazing at the edge of the laminate or, in some cases, significant cracks develop that give the appearance of the glass itself being cracked. In all occurrences evaluated, incompatible substances have come in contact with the polycarbonate and caused the cracking.

In most cases, the potential for exposure to incompatible materials occurs after installation. A common situation is chemical run-off from the building exterior or cleaning solutions used on the interior of the building. For this reason, ***Viracon recommends that a silicone cap bead be applied around the entire perimeter between the laminate face and the retention frame on both the interior and exterior glass surfaces.*** Viracon does not recommend that silicone come in contact with the edge of the polycarbonate.

Known Incompatible Materials

Do not expose the edges of glass-clad polycarbonates to acids or solvents which include one or more of the following: Ammonia, Acetone, MEK, Methylene Chloride, Phenol, Mineral Spirits or Zylene. This is a partial list of incompatible chemicals for polycarbonates. For questions on other material, please contact the material supplier or Viracon's Technical Services group at 800-533-2080.

Spandrel Applications

Typically non-vision building areas are clad with monolithic spandrel glass. With the enactment of hurricane impact building codes, laminated glass became a requirement for spandrel glass areas, as well as vision areas. Because spandrel areas are not typically temperature controlled, elevated temperatures in these areas require the following guidelines:

1. The laminated make-up incorporate a high performance, solar controlling coating whose solar reflection is 10% or greater.
2. The make-ups incorporate a white ceramic frit.
3. Or, the space behind the glass be vented to prevent excessive heat build-up. This requirement applies to all applications of SentryGlas Plus laminates in spandrel areas.

Coating Offering by Product

The table below summarizes the Viracon Solarscreen coatings available with each type of laminated glazing. All of Viracon's coatings and substrate tint offerings are available when the laminate is the inboard ply of an insulating glass unit

Inspection Guidelines

Coated Glass Inspection Guidelines. (Viracon's coated glass products comply with ASTM Standard C 1376.)

- Pinholes – Inspect glass from a distance of 10 ft. (3m) in transmission, at a viewing angle of 90° to the specimen, against a bright uniform background. If a pinhole is readily apparent, the following criteria apply: Pinholes larger than 1/16" (1.6mm) in diameter are not allowed in 80 percent of the central glass area. Pinholes larger than 3/32" (2.4mm) are not allowed in the outer 20 percent of the glass area. No more than two readily apparent blemishes are allowed in a 3" (75mm) diameter circle and no more than five readily apparent blemishes are allowed in a 12" (300mm) diameter circle.
- Uniformity – When viewing coated glass from a minimum distance of 10 ft. (3m), color variation may occur from one unit to another. This can be caused by variations within the float glass substrate and normal

production variations and this is not considered a defect. All Viracon commercial glass products conform to industry color standards.

- Distortion – Various factors involved in heat processing, insulating air spaces and frame binding may distort reflected objects viewed on the glass surface. These are not considered defects of the coated glass or the final fabricated product.
- Scratches – Inspect glass from a distance of 10 ft. (3m). Scratches up to 2" (50mm) are allowed in 80 percent of the central glass area, and scratches up to 3" (75mm) are allowed in the outer area. Concentrated scratches or abraded areas are not allowed.

Note: The maximum size for annealed glass under any condition is 50 sq. ft. (4.65 sq. m.) Maximum size for heat-treated glass under any condition is 65 sq. ft. (6.04 sq. m.), vertical application, and 40 sq. ft. (3.70 sq. m.) for sloped glazing. Maximum piece weight is 500 pounds (226 kg).

For more information on protective glass or additional literature, call 800-533-2080.

Continuing Education

We also work with professional organizations and firms worldwide to provide AIA accredited educational seminars. As a registered provider with the AIA/Continuing Education System (AIA/CES), architects can receive 1.5 continuing learning units (LU's) with AIA/CES, including health, safety and welfare credits. You can schedule a presentation by visiting our web site at www.viracon.com or by calling 800-533-2080.



SentryGlas Plus	Solarscreen Low-e 55 (VE-55), 52 (VE-52), 42 (VE-42), 40 (VE-40), Antique (VA), Stainless Steel (VS), and Titanium (VT); all glass substrates. Versalux Blue 2000R, Versalux Blue 2000T.
StormGuard	Solarscreen Low-e 85 (VE-85), 55 (VE-55), 52 (VE-52), 42 (VE-42), 40 (VE-40), Antique (VA), Stainless Steel (VS), and Titanium (VT), Crystal Chrome (VY); all glass substrates. Versalux Blue 2000R, Versalux Blue 2000T.
Vanceva Storm	Solarscreen Low-e 85 (VE-85), 55 (VE-55), 52 (VE-52), 42 (VE-42), 40 (VE-40), Antique (VA), Stainless Steel (VS), and Titanium (VT), Crystal Chrome (VY); all glass substrates. Versalux Blue 2000R, Versalux Blue 2000T.
HRG-2	Solarscreen Low-e 85 (VE-85), 55 (VE-55), Antique (VA), Stainless Steel (VS), Titanium (VT); only on tinted glass substrates (no clear glass).
PVB Laminated glass	Solarscreen Low-e 85 (VE-85), 55 (VE-55), 52 (VE-52), 42 (VE-42), 40 (VE-40), Antique (VA), Stainless Steel (VS), and Titanium (VT), Crystal Chrome (VY); all glass substrates. Versalux Blue 2000R, Versalux Blue 2000T.

Contact Viracon for the availability of coatings not listed above.



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This publication describes Viracon's protective glass products to help you analyze possible design options and applications. To obtain warranty information, contact Viracon's Architectural Inside Sales or Technical Services Department.

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