Laminated Architectural Glass

Safety Glazing

National Sunroom Association
Las Vegas, Nevada – March 6, 2009

Prepared & presented by J. Schimmelpenningh
About Solutia Inc.

- World Headquarters located in St. Louis, MO
- $2.0 Billion Chemical Company
- Saflex division is the world’s largest producer of polyvinyl butyral (PVB) interlayer for laminated glass
Discussion Outline

• Define Safety Glazing
• Safety Glazing Products
• Hazardous Locations
• Overhead Glazing
• Safety Glazing Applications
• Design Considerations & Other Benefits
• Questions
Safety

- Protection from cutting and piercing injuries, and fall out of glass from unintentional damages to glazing
  - Human Impact Protection
  - Hazardous Locations
  - Overhead Glazing
  - Structural
  - Railing and Balusters
  - Hurricane
  - Seismic

Requirements covered in Building Codes
Regulations and Standards Overview

• CFR 16 CPSC Part 1201
  – Cat I or Cat II

• ANSI Z97.1
  – Class A, B or C

• Building Codes prescribe areas of use by defining “Hazardous Locations” and required applications
CPSC 16 CFR 1201

- Federal Safety Standard
  - Shot bag test
  - Enacted in 1977
  - Has not changed since enactment
  - Doors and Door leaves only
  - Tempered Glass, Laminated Glass
  - Wired Glass included with exemption
CPSC 16 CFR 1201 Test Method

• 100 lb lead shot filled punching bag
  – Pendulum test

• Two drop heights:
  • Category I = 150 ft-lb.
    – Drop height 18
    – Glass < 9 sqft
  • Category II = 400 ft-lb.
    – Drop height 48”
    – Glass > 9 sqft

• Test size: up to 34” x 76”
• Boil test required for Laminated Glass
Human Impact Protection

16 CFR PART 1201/ANSI Z97.1
ANSI Z97.1

- Voluntary Safety Standard
  - Shot bag test (same impactor as CPSC 16 CFR 1201)
  - Enacted in 1964
  - Modified to meet industry changes
  - Latest Revision 2004
  - Applies to all safety glazing
    - Tempered glass
    - Laminated glass
    - Plastic glazing
    - Organic Coated Glass
ANSI Z97.1 Test Method

- 100 lb lead filled punching bag
  - Pendulum test
- Three drop heights:
  - Class C = 100 ft-lb.
    - Drop height 12”
    - Fire rated wired glass only
  - Class B = 150 ft-lb.
    - Drop height 18”
    - Glass < 9 sqft
  - Class A = 400 ft-lb.
    - Drop height 48”
    - Glass > 9 sqft
- Test size: 16 x 30 minimum up to 34” x 76”
- Boil test required for Laminated Glass
- Weathering tests required for Laminated Glass
Shot Bag Pass Fail Criteria

- 10 largest pieces (FT)
- 3” solid sphere passage for Laminated, Plastic, Organic Coated and Filmed Glass
- Modulus of Rupture for Plastics
- Pass Boil
- Pass Weathering (ANSI only)
Safety Glazing
Typical Laminated Configurations

- CPSC Cat I or ANSI Z97.1 Class B
  - “lami” glass |≥0.015” (0.38mm) Saflex| “lami” glass

- CPSC Cat II or ANSI Z97.1 Class A
  - “lami” glass |≥0.030” (0.76mm) Saflex| “lami” glass
GANA Ball Drop Test Method and Specification

- QC test methodology
- Correlated to
  - CPSC 16 CFR 1201 Cat II and
  - ANSI Z97.1 Class A

- Test Method
- Specification for type and pass/fail criteria
GANA Ball Drop Test
Safety Standards in Development

- **ANSI Z97.1 – 2009**
  - Center Punch Fragmentation
  - New weathering evaluations
  - Mode of Breakage Interpretation
- **Furniture Glass Standard ASTM F15.42**
  - Safety Glazing requirement for furniture
- **Skylight Fall-Through standard**
  - Simulates person falling on a skylight
Product Descriptions

Safety Glazing
Product Descriptions

• Annealed Glass
  – Glass from float line
  – Breaks Easily
  – Dangerous Long Shards
  – Not Safety Glazing
Product Definitions

• Fabricated Glass
  – Chemically Strengthened
    • Difficult to break
    • Long dangerous shards
    • **Not Safety Glazing**
  – Thermally Strengthened
    • Heat Strengthened
      – **Not Safety Glazing**
    • Fully Tempered
      – Safety Glazing due to break pattern
Product Descriptions

Surface Applied Materials

– Varied thicknesses
– Application Types
  • Daylight
  • Edge to Edge
  • Anchored
– Typically Retrofit
– Consult Glass Manufacturer regarding warranty
Product Descriptions

• **Laminated Glass**
  – Two or more lites of glass
  – Bonded to form single lite
  – Interlayer
    • “Adheres to Glass”
      – Liquid
      – Flexible Roll Form
      – Rigid Sheet
  – Various Thicknesses
  – Various Colors
  – Retention Characteristics
  – Safety Glazing
Product Descriptions

Plastic Products
  – Polycarbonates
  – Acrylics
  – Impact Resistant
  – Surface Damage Prevention
  – Single layers
  – Multi-ply Laminated
Product Descriptions

- Glass Clad Plastics
  - Plastics
  - Glass
  - Interlayers
- High Impact Strength
- Bullet Resistant
- Detention & Institutional
- Shelters
Product Descriptions

Insulating Glass Units
- Two or more lites of glass
- Insulating Space
- Thermal & Energy
- Triple IG with two Air Spaces
- Safety Glazing as one or more lites depending upon application
Safety Glazing Products

- Tempered Glass
- Plastic Glazings
- Filmed Glass
- PVB Laminates
- Polyurethane Laminates
- Ionomer Laminates
- Resin Laminates
- EVA Laminates
- Glass Clad Polycarbonate
Glazing in Hazardous Locations

Interpretation from:
International Building Code 2006
(Section 2406.3)
International Residential Code 2006
(Section R308.4)
Swinging Doors except Jalousies
Storm and Unframed Doors

Legend
- Safety
- Non-Safety
Fixed and Sliding Door Assemblies
Panels in Sliding Door Assemblies

Legend
- Safety
- Non-Safety
Panels in Bi-Fold Door Assemblies
Fixed or Operable Panels

Area >9 ft² (0.84 m²)  
<18 in (46 cm) Above floor

> 36 in (91 cm)

Legend
Safety  
Non-Safety
Panel Adjacent to a Door

≤ 24 in (61 cm)

< 60 in (152 cm)

Legend
- Safety
- Non-Safety
Walking Surface Adjacent

≤ 36 in (91 cm) ≤ 36 in (91 cm)

< 18 in (46 cm)

Above Floor

Legend
Safety
Non-Safety
Glazing in Guards and Railings
Bathtubs, Showers etc…
Glazing Near Pools, Tubs and Spas

< 60 in (152 cm) Above Walking Surface

≤ 60 in (152 cm)

Legend

Safety
Non-Safety
Glazing Adjacent to Stairways

Legend

Safety

Non-Safety

≤ 36 in (91 cm)

≤ 60 in (152 cm)

< 60 in (152 cm) Above nose of tread

≤ 60 in (152 cm) From Bottom Tread
Stair Diagrams

≤ 60 in (152 cm) Horizontally of Bottom Tread

≤ 18 in (46 cm)

> 18 in (46 cm)

Legend

Safety

Non-Safety

Non structural rail

≤ 60 in (152 cm)
Stairways Exception & Diagram

< 18 in (46 cm) From Railing

< 60 in (152 cm)

Rail Complying with IBC Section 1013 and 1607.7

≤ 60 in (152 cm) Horizontally of Bottom Tread

Legend

Safety
Non-Safety

< 60 in (152 cm)
Panel Adjacent to a Door Exceptions

- Safety Glazing not required due to intervening wall
- Safety Glazing not required (Except to meet Item 7)
- Closet Depth ≤ 36 in (91 cm)

Legend
- Safety
- Non-Safety
Protective Bar Exception

Bar capable of withstanding Horizontal Load of 50 plf (730 N/m) without contacting glass

Minimum 1.5 in (3.8 cm)

34 – 38 in (86 - 97 cm)

Legend
Saiflex
Safety
Non-Safety
Outboard Lite of Insulating Glass Exception

Floor to Ceiling Glass
Outboard can be non-safety
Inboard must be Safety

Outboard Lite ≥ 25 ft (7.6 m)
Above Grade

Legend

Safety
Non-Safety

Grade, roof, walking surface, horizontal or sloped surface adjacent to the glass exterior
Small Opening Exception

3 in (7.6 cm) sphere cannot pass – Safety Glazing is not required

Legend
- Safety
- Non-Safety
Decorative Glazing Exception

- < 60 in (152 cm)
- ≤ 24 in (61 cm)
- < 36 in (91 cm)
- < 18 in (46 cm) Above floor
- > 9 ft² (0.84 m²)

Legend:
- Safety
- Non-Safety
Revolving Door Exception

Legend
- Safety
- Non-Safety

Outside
Commercial Refrigerated Cabinet Glazed Door Exception

Legend
- Safety
- Non-Safety
Glass Block

Legend
- Safety
- Non-Safety
Louvered Windows & Jalousies Exception
Continuous Backing Support Exception

Legend

<table>
<thead>
<tr>
<th>Safety</th>
<th>Non-Safety</th>
</tr>
</thead>
</table>

![Diagram of Continuous Backing Support Exception](image)
Summary of Hazardous Locations

- Doors
- Adjacent Panels to Doors
- Windows 18” or below sill height
- Guardrails
- Tub and Shower Enclosures
- Swimming Pool Enclosures
Code Mandated Applications

Safety Glazing
Structural

- Building Stability
- Wind and Snow Loads
- ASCE 7 Wind Speed
- ASTM E 1300 Compliance
- First Design Consideration
Sloped Glazing & Skylights
IBC 2405/IRC 308.6

Rock and Roll Hall of Fame and Museum
Architectural Firm: Pei Cobb Freed and Partners

Sloped Glazing:
Any glazing >15 degrees from vertical
Applications

- Skylights
- Unit skylights
- Solariums
- Sunrooms
- Roofs
- Slope walls
Allowable Glazing Materials

• Monolithic glazing systems
  – Laminated (0.030 in PVB – IBC)
  – Laminated (0.015 in PVB – IRC)
  – Wired glass
  – Heat Strengthened
  – Fully Tempered
  – Plastic materials (Section 2607; 2610)
  – Annealed Glass (IBC only)
  – Glass Block (IBC only - Section 2101.2.5)

• Multiple Layer systems
  – All Lites or layers made from above materials
Dimension & Height Requirements

- ≤ 12 ft (366 cm) ≤ 16 sqft (1.5 m²)
  
  Laminated Glass
  0.015 (0.38 mm) PVB
  IRC R308.6.2 (1)

- > 12 ft (366 cm) > 16 sqft (1.5 m²)
  
  Laminated Glass
  0.030 (0.76 mm) PVB
  IRC R308.6.2 (1)
Screening Requirements

Monolithic Lites
- Heat Strengthened Glass
- Tempered Glass
- Wired Glass

Multiple Glazing
- Screen
- Heat Strengthened Glass
- Tempered Glass
- Wired Glass

Glazing #2
As listed
Screen Requirements

- Capable of supporting 2x the weight of the glazing
- Firmly fastened to framing members
- Mesh opening not greater than 1 in x 1 in (2.5 cm x 2.5 cm)
- Installed within 4 inches (10 cm) of the glazing (IBC only)
- Non combustible material (IBC only)
- Non Corrosive material (IBC only)
Screening Exceptions
Individual Dwelling Units

- Laminated glass with 0.015 in (0.38 mm) PVB
- Fully tempered Glass
- Single or Both Panes of IG
- ≤ 3/16 in (5 mm)

≤ 16 sqft (1.5 m²)
≤ 12 ft (366 cm)
Screening Exceptions
Individual Dwelling Units

- Fully tempered Glass
- Single or Both Panes of IG
- ≤ 3/16 in (5 mm)
Screening Exceptions
Intervening Floor

- Fully tempered Glass
- Single or Both Panes of IG
Protected or Prohibited

No Screen
Any Glazing Material

Protection from Falling Glass

No Screen
Any Glazing Material
Greenhouses

Height to Ridge

IRC
≤20 ft
(610 cm)

IBC
≤30 ft
(914 cm)

Exclusively for Growing Plants
Not Open to the Public
Glazing Subject to Impact Loads

- Racquetball and Squash Courts
- Gymnasium and Basketball Courts
- Glass in Elevator Enclosures
Hurricane
Objective Standards & Codes

• Ensure elements of the building envelope remain Unbreached during storms (hurricanes) to protect lives and property
Unprotected Structure

- Flying debris breaks glass
- Wind and rain enters a building through breached openings
- 1% opening on windward wall
  - 200% increase in pressure on underside of roof
  - 50% increase in pressure on exterior walls
Hurricane Requirements

2009

1994

Saflex
Hurricane Test Segments

- Large missile
- Small missile
- Cyclical Loading

Note: Missile size based on Protection classification and wind zone.
# Windborne Debris Requirements

## Missile sizes

<table>
<thead>
<tr>
<th>Missile Level</th>
<th>Missile</th>
<th>Impact Speed feet/sec (mph)</th>
<th>Typical Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2 gram steel ball</td>
<td>130 (89)</td>
<td>Above 30 ft</td>
</tr>
<tr>
<td>B</td>
<td>2 lb. Lumber</td>
<td>50 (34)</td>
<td>Skylights ≤ 30 ft. Wind Zone 2</td>
</tr>
<tr>
<td>C</td>
<td>4.5 lb. Lumber</td>
<td>40 (27)</td>
<td>Less than 30 ft. Wind Zone 1 &amp; 2</td>
</tr>
<tr>
<td>D</td>
<td>9 lb. Lumber</td>
<td>50 (34)</td>
<td>Less than 30 ft. Basic Protection</td>
</tr>
<tr>
<td>E</td>
<td>9 lb. Lumber</td>
<td>80 (55)</td>
<td>Less than 30 ft. Enhanced Protection</td>
</tr>
</tbody>
</table>
Hurricane Regulations

• Mandated by code
• Method in a standard
  – Dade County, FL
  – ICC (IRC, IBC)
  – NFPA 5000
  – ASTM E1886 & E1996
Large Missile Impact
## Laminated Glass Construction

### Glass Configuration Criteria & Recommendations

Glass Designed to meet ASCE-7 & ASTM E 1300

#### Glass Constructions:

<table>
<thead>
<tr>
<th>Missile</th>
<th>Code</th>
<th>Glass Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>PA(TAS) 201/3 Dade</td>
<td>Glass / .090” Saflex*;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.100”Saflex HP; or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.075” Saflex VSO2 / Glass</td>
</tr>
<tr>
<td>Large</td>
<td>SSTD-12</td>
<td>Glass / .090” Saflex*;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.100”Saflex HP; or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.075” Saflex VSO2 / Glass</td>
</tr>
<tr>
<td>Large</td>
<td>ASTM E 1886/1996</td>
<td>Glass / .090” Saflex*;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.100”Saflex HP; or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.075” Saflex VSO2 / Glass</td>
</tr>
<tr>
<td>Small</td>
<td>SSTD-12</td>
<td>Glass / minimum .060” Saflex / Glass</td>
</tr>
<tr>
<td>Small</td>
<td>ASTM E 1886/1996</td>
<td>Glass / minimum .060” Saflex* / Glass</td>
</tr>
</tbody>
</table>

* Thinner gauge has been demonstrated to intermittently pass the large missile impact test.
Laminated Glass for Seismic Applications
Seismic Background

- 500,000 “events” detectable each year
- 100,000 are felt by humans
- 100 cause damage
- Southern California has 10,000 Seismic events yearly
- Alaska is most prone to seismic events
Architectural Glass and Earthquakes

- Building vibrates with low intensity quakes
- Inter-story drift may occur
- Building Sways
- Glazing system “racks” with movement
  - Glass contact frames
  - Glass cracks
  - Monolithic glass fall-out
    - Building breach
    - Lacerations
  - Engineered glass may crack, but typically is retained
- Glass First Crack ~ 3” of movement
- Delta Fall Out – NRG ~3 in movement
Seismic Summary

- Seismic Requirements in IBC
- AAMA 501.4 and 501.6
- FEMA Studies
- NEHRP Provisions
- NIBS BSSC
- Retention Specifications
- Laminated Glass as design choice
- Anchored Filmed Glass (Retrofit)
Design Considerations and Other Benefits

Safety Glazing
Other Safety Glazing Applications

• Golf Course Homes
  – Golf ball impact
  – Fear of Shards
• Bird Impact
• Potential Fall-Out/Fall-Through Areas
Laminated Glass Benefits

Beyond Safety...
Sound Control
Acoustic Glazing

• Noise is an overwhelming problem
• Population Density increasing
• Landscape of Built environment changing
• Sources and pressures are increasing and varied
  – Trains, Planes, Automobiles…
  – Building is Stationary
• Human need for quiet
• Windows can be a weak link for Noise Infiltration
Noise disrupts activities

- Disturbs peace and quiet
- Impedes Communication
- Disrupts Comfort
- Detrimental to Safety
- Decreases Job performance
- Adverse Effects
  - Physically
  - Psychologically
Sound Transmission Loss
Equivalent Mass Units

- 6 mm (0.25 inch) Monolithic Glass
- 6 mm (0.25 inch) Laminated -- 3.0-(0.76 Saflex®)-3.0

Damping Performance from Interlayer

Critical Frequency Dip

One-Third Octave Band Frequencies in Hz

Sound Transmission Loss in dB
Glazing Design
Sound Transmission Loss

• The three basic features
  – Glass thickness (stiffness)
  – Insulating glass air space thickness
  – Interlayer damping
### Sound Transmission Loss Data

- **Glass Panel - no frame**
- **Ambient Room Temperature**: 21 - 24°C (70 - 75°F)
- **Opening Area**: ~ 18 sqft
- **Nominal Thickness**: 6 mm (1/4 in.)
- **Measured**: ASTM E 90; Calculated ASTM E 413 & E 1332

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<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Transmission Loss (dB)</th>
<th>Type/STC</th>
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<tbody>
<tr>
<td>80</td>
<td>15</td>
<td>Monolithic: STC 32</td>
</tr>
<tr>
<td>125</td>
<td>20</td>
<td>Laminate: Saflex Q; STC 35</td>
</tr>
<tr>
<td>200</td>
<td>25</td>
<td>Laminate: Saflex R; STC 34</td>
</tr>
<tr>
<td>315</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>35</td>
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<td>800</td>
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<td>3150</td>
<td>55</td>
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<tr>
<td>5000</td>
<td>60</td>
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</tbody>
</table>

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**1/3 Octave Band Frequency (Hz)**
Glass Thickness and Interlayer Type

<table>
<thead>
<tr>
<th>Overall Thickness (mm)</th>
<th>Single Number Acoustical Rating (STC)</th>
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<tbody>
<tr>
<td>3</td>
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<td>5</td>
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<td>13</td>
<td>43</td>
</tr>
<tr>
<td>14</td>
<td>45</td>
</tr>
</tbody>
</table>

- Saflex Q series
- Saflex Standard PVB R series
- Monolithic Glass
Saflex SilentGlass Technology™
Conclusions

• Acoustical interlayer delivers high performance damping with lower weight configurations

• Typical STC ranges from 30 - 50

• Laminates offer flexibility in design variables

• Up to 10 db noise reduction can be achieved in the critical frequency range

• Laminated glazings can be used to create acoustically comfortable architectural settings
Security
Security

- Penetration resistant glazing that deters falling and flying glass generated from the intentional attack
  - Forced Entry
  - Forced Exit
  - Ballistic
  - Bomb Blast

Voluntary Requirements
Security: Blast

Chronology of a blast event

Other considerations
- Intentional Debris
- Secondary Debris
- Glass Retention
- Surrounding Buildings
Large Shock Tube

Photo Courtesy of Baker Risk – San Antonio, Tx
Explosive in tube
Specimen Chambers
Blast Detonation
Post Blast Analysis

- Blast Information
- Glass Crack / Shatter
- Glass Retention/Opening
- Location of Shards
- Damage to Witness Panel
Blast Protection/Hazard Rating

- **Blast Window**
- **Threshold**
- **0.5 m**
- **0.6 m** (ISC/GSA)

**Hazard Zones**:
- **VLH (Very Low Hazard Zone)**
- **LH (Low Hazard Zone)**
- **HH (High Hazard Zone)**

**Threshold Levels**
- **1.0 m**
- **2.0 m**

**Hazard Levels**:
- **No Break**
- **No Hazard**
- **Minimal Hazard**
- **Very Low Hazard (VLH)**
- **Low Hazard (LH)**
- **High Hazard (HH)**
High Grade Wood Window - AN Glass

4 psi; 28 psi*msec
Blast Resistant Glazing
Retrofit Installations

- Laminated Glass
- Existing Glass
- Glazing Tape
- Retrofit Frame
- Setting Block
  - 1/8 - 1/4” thick
  - (positioned at bottom of glass only - 6” from corners & midpoint)
- Existing Aluminum Frame or Window

*Note: Diagram depicts the installation process for blast-resistant glazing with retrofit installations.*
High Grade Wood Window
LAG Retrofit

4 psi; 28 psi*msec
Solar/Energy
Fade Resistance

• Reduces fading of fabrics, carpets, furniture
• No adverse affects on plant life
• Blocks out approximately 99% UV rays (up to 380 nanometers)
• Untreated glass blocks out less than 15% of UV rays
Comparative UV Screening Performance

- 1/4" Laminate 0.030" Saflex
- 1/4" Clear Glass
- 1/4" Low-e Glass
Regulatory Trends

- Energy Codes
- Windborne Debris Protection
- Acoustics
- Seismic
- Bomb Blast Protection (overall security)
- Certifications
Growing Applications

- Energy Efficient Building Demand
- Windborne Debris Protection
- Fall out prevention
- Acoustic damping
- Interior Glass Use Increase
- Customization of Space
- Multi-functional glazing
- Laminated Heat Strengthened
- Laminated Insulating Units
- Availability of Products Increase
  - Amount of Glass use in Buildings Could Decrease
    - Lack of Performance Understanding
    - Perceived Threat
    - Energy Requirements
Industry Trends

• Consolidation
• Vertical Integration
  – Independent Lamination
  – Glazing Contractors Developing Proprietary Systems
• Demand for Glass Retention
• Four Sided Structural Applications
• In House Assembly/Unitized Construction
• Green Buildings
  – Energy Performance
  – Sustainability
  – Double Wall Construction
  – RFID
  – Deconstruction Requirements
U.S. MARKET DRIVERS

- Building Codes
- Government Regulation/Mandates
- Government Mitigation Programs
- Insurance Industry
  - Lobbying efforts
  - Premiums
  - Availability of Insurance
- Architects, Specifiers and Glazing Contractors
- Standard Development
- Consolidation
- Need for Differentiation
- Need for “Security and Comfort”
- Social Responsibility
- Ease of acquisition and use
## Laminated Glass Protection

**Summary**

<table>
<thead>
<tr>
<th>Application</th>
<th>Requirement</th>
<th>Basic Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td>Glass</td>
<td>Glass</td>
</tr>
<tr>
<td>Safety Glazing</td>
<td>CPSC 16 CFR 1201 Cat I</td>
<td>Glass</td>
</tr>
<tr>
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<td>CPSC 16 CFR 1201 Cat II</td>
<td>Glass</td>
</tr>
<tr>
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<td>ANSI Z97.1 Class A</td>
<td>Glass</td>
</tr>
<tr>
<td></td>
<td>ANSI Z97.1 Class B</td>
<td>Glass</td>
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<tr>
<td>Overhead &amp; Sloped</td>
<td>IRC &amp; IBC &lt; 16 sqft</td>
<td>Glass</td>
</tr>
<tr>
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<td>IRC &amp; IBC &gt;16 sqft</td>
<td>Glass</td>
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<tr>
<td>Hurricane</td>
<td>Small Missile</td>
<td>Glass</td>
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<td>Glass</td>
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<td>Large Missile</td>
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<tr>
<td></td>
<td>Glass Saflex Storm 0.075 in</td>
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<td></td>
<td>1.91 mm)</td>
<td>Glass</td>
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<td>Seismic</td>
<td>IBC</td>
<td>Glass</td>
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<td>Forced Entry/Exit</td>
<td>UL 972; ASTM F 1233</td>
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<td>Ballistic</td>
<td>UL 752; ASTM F 1233</td>
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<td>ASTM F 1642; GSA</td>
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<td>UV Screening</td>
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<td>Sound</td>
<td>ASTM E90, 413, 1332</td>
<td>Glass</td>
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Contact Information

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