Laminated Glass Railings with DuPont Interlayers

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The DuPont Company has supplied plastic ‘interlayers’ for manufacture of laminated safety glass since the advent of safety glass for the car windshield beginning with Ford in 1924.

Interlayer chemistry progressed from cellulose nitrate to cellulose acetate and then to PVB plasticized interlayer which was honored in 1938 as a major technological achievement.

The latest major interlayer development for laminated glass by DuPont in 1998 was SentryGlas® structural interlayer.

DuPont launches Butacite® PVB interlayer for safety glass - 1938
Laminated glass

• Two or more lites of glass and one or more interlayers
  – Polyvinyl butyral (PVB)
  – Ionoplast

*A sandwich of “glass” and “plastic”*
The Laminating Process
Laminated glass offers …

- Safety
- Glass retention
- Durability
- Cleaning ease
- Missile impact performance
- Decorative options
Types of Glass

- Annealed (basic glass)
- Patterned
- Tempered* (4x the strength of annealed)
- Heat strengthened* (2x the strength of annealed)
- Curved

*Polishing of glass edges is done prior to heat-treating
Safety

- Safety after breakage
- Interlayers retain glass fragments if breakage occurs
- Laminated glass is retained in frame
- Meets safety glazing impact requirements
Glass retention

• Safety after breakage
• Interlayers retain glass fragments if breakage occurs
• Laminated glass is retained in frame
Durability

- Laminates go through natural and accelerated testing for weathering to demonstrate durability
Cleaning Ease

- Glass surfaces are easy to clean with readily available cleaning products
- Glass surfaces are durable—no yellowing, cracking, or crazing
Missile Impact Performance

- **Large Missile Test**
  - Covers the first three floors
  - 9 lb. 2x4 fired at 50 ft/sec

- **Small Missile Test**
  - Covers above 30 feet
  - 2-gram ball @ 130 fps
Missile impact
Decorative Options

- **SentryGlas® Expressions™**
  - 4-color digital printing process enhances color and image options
  - Available from designated licensees
SentryGlas® Interlayers

• Additional benefits
  – Exposed edge durability
  – Stiffness and strength
  – Post-glass breakage performance
  – Ultra-clear appearance
Exposed edge durability

- Ionoplast laminate’s ability over time to resist the formation of defects along the edge as a result of temperature and humidity
- PVB laminates are durable, but moisture sensitive
Stiffness and strength

- Unobstructed vision onto playing field
- Thinner, lighter laminates
- Safety performance, even after breakage
Post-glass breakage performance

- Material: 5mm HS / 2.29 mm Interlayer / 5 mm HS
- Size: 0.75 m x 1.2 m Plate
- Impact: 5 kg steel ball dropped from 3 m
- Time: 0, 200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800 seconds
- Center Displacement: 0, 50, 100, 150, 200, 250, 300 mm
- Load ramped to 330 kg.

Graph showing:
- PVB Laminat Failure
- SentryGlas® Plus Laminate
- Center Displacement vs Time

Image of glass panel with partial breakage.
Breakage characteristics

1/2 inch Fully Tempered Glass
Ultra-clear appearance

- SentryGlas® laminates offer:
  - High clarity
  - Low yellowness index
  - Low-iron glass options
Project Examples

- Condos
- Hotels
- Office buildings
- Shopping malls
- Schools, colleges, and universities
- Hospitals
- Courthouses
- Stadiums
- Private residences
- Airports
- Transit centers
- Museums
- Theaters
- Concert halls
- Swimming pools
- Balconies
Fiumara Cinema, Genoa

- Curved laminated glass panels
- Laminates with tight radiuses possible
- Bolted fixation system
Victoria & Albert Museum, London

- Exterior laminated glass railing
- Safety from glass fall-out
- SentryGlas® interlayer less sensitive to moisture intrusion
New England Aquarium, Boston

- Bolted fixation system
- Tempered glass for strength
- Low iron glass for clarity
- Laminated glass with SentryGlas® interlayer for post-glass breakage performance and superior edge durability
Top of the Rock, New York

- Better durability
- Strength
- Post-breakage safety
Red Rocks Casino, Las Vegas

- Better durability
- Strength
- Post-breakage safety
- Expanded visibility
Four Seasons Hotel, Mumbai

- Rooftop bar atop 34 story hotel
- Laminated glass supported on its bottom edge
- Laminate benefits: Safety, edge durability, post-glass breakage performance
- Make up: 2 plies of 10mm glass with 3mm ionoplast interlayer
Marina Bay Sands Casino, Singapore

- Balustrades/windcreens
- Exterior fins
- Strength, post-glass breakage, edge stability and appearance
Building code requirements

- Attached handrail or guard required for support
- where the glass balusters are laminated glass with two or more glass plies of equal thickness and the same glass type when approved by the building official

*(IBC 2009)*
Glass Railing Code Requirements

- In exterior railings in wind-borne debris regions
  - Laminated glass required
  - When the top rail is supported by glass, missile impact testing required
Falling glass

The downside to monolithic tempered glass is glass fall-out after breakage

W Hotel, Austin, Texas
Falling glass

- Falling glass can cause injuries to people below

Murano Condominiums, Toronto, Canada
Glass Railing Code Requirements

- Laminated glass required for interior and exterior railings
- Effective 2015 IBC
  - Monolithic tempered glass limited
    - No walkway below railing
    - Permanent protection from falling glass

Kirby Tower
Laminated glass suppliers

- Laminated glass suppliers are located throughout North America
- Capabilities may include:
  - Heat-strengthening and tempering
  - Laminating
  - Custom printing on interlayer
Conclusions

• Railing systems designed with laminated glass provide safety and glass retention after breakage
• SentryGlas® interlayers are stronger, deflect less, and provide better post-glass breakage performance in minimally supported railings
• Building code requirements for railings allow laminated glass and, in some cases, require laminated glass for missile impact and structural glass systems
• Sealant compatibility and glazing support details require special attention
• Laminated glass available from glass fabricators throughout the world
Thank you.

Questions?
See our website
www.sentryglas.com