PILKINGTON

NSG GROUP

Pilkington **Planar**™
The world's leading structural glass system

Pilkington Structural Glass Systems.
Unrivalled performance for over 40 years.

Pilkington **Planar**™, the world's leading structural glass system has evolved from the original patch plate system pioneered by Pilkington over 40 years ago.

With a proven track record in the most demanding applications, the Pilkington **Planar**™ system lets architects create a complete glass envelope for buildings, with façades on any plane. Which means you can build highly attractive working environments with more light and a greater feeling of space.

Support structures, located internally or externally, can be as subtle or as dominant as you require. Support can be derived from glass mullions, a conventional steel construction, or the highly versatile Pilkington **Planar**™ Tension Structure design or even a combination of all such schemes.

Yorkshire Bank, Leeds, UK.

Quality is assured by the use of Pilkington glass, with fabrication and design carried out in an ISO 9001 certified manufacturing facility in St Helens, UK. Operating under the ISO 14001 environmental management system, this factory is the only one in the world that is dedicated solely to structural glass systems.

Further reassurance comes from our heritage. The world leader in glass manufacture since 1826, Pilkington supports constant innovation with sophisticated research and the most rigorous product testing programmes.

St. Helens Central Station, UK.

Turku Library, Finland.

Front cover image – Yorkshire Bank, Leeds, UK.

Federal Court Building, Washington, USA.

Zaułek Piękna, Warsaw, Poland.

Latest developments

Pilkington Architectural continues to lead the way with new developments. In keeping with our policy of constant innovation and improvement, the following developments are now part of the Pilkington **Planar**™ range:

Pilkington **Planar**™ Triple

The world's first triple glazed frameless bolted system, offering improved thermal insulation, design flexibility and multiple glass combinations for better solar performance or noise control.

- U values of 0.8 W/m^{2}K achievable
- Acoustic performance of $R_w > 42$ dB achievable
- Maximised load capacity for larger design modules
- Building transparency increased by larger vision areas

Pilkington **Planar**™ Integral

By using a bolt fixing incorporated into the glass rather than an exterior fastener, this revolutionary method of securing laminated panels allows the use of a greater variety of glass types.

- No holes in external glass surface
- Flush exterior for easier maintenance
- Wider choice of glass improves design flexibility

Pilkington **Planar**™ Heavy Duty

Constant improvement in Pilkington **Planar**™ bolt fittings has increased capacity to such an extent that larger and heavier Insulating Glass Units (IGUs)can now be easily accommodated.

- Larger modules available for units, even up to 600 kg
- Increased load capacity allows high wind load applications

Pier 79, New York City, USA.

Pilkington Laminated Glass Fins (Mullions)

The latest development in mullions, or fins, is composite glass mullions made from laminated glass, offering the designer greater design versatility.

- Vertical and horizontal applications possible
- Enhanced structural durability – offering design solutions for ever more demanding markets and applications
- Offers the opportunity to reduce mullion depth and need for lateral bracing

Salford Central Railway Station, Manchester, UK.

Planar™ | SentryGlas® System

The **Planar**™ | SentryGlas® System was born from a unique collaboration between Pilkington Architectural engineers and the scientists at DuPont. This high performance laminated system offers:

- Increased strength and durability
- Reduced weight of glass and structure
- Longer spans with reduced fixings
- Spectacular post glass breakage security
- Visibly improved clarity, particularly when combined with Pilkington **Optiwhite**™ low-iron glass
- Structural glass fin and beam applications
- The opportunity to specify glass for horizontal installations when access may be required for maintenance

Pilkington **Planar**™ Intrafix System

Fixing securely to the inner structural glass component of an insulated unit, the Intrafix System offers a thermally efficient facade in which the external glass surface is not penetrated with fittings.

- No holes in the external glass surface
- An increased range of coated and coloured glass

Pilkington **Planar**™. Most tested. Most trusted.

Pilkington **Planar**™ gives you the reassurance of over 40 years of testing and development.

Our testing is a continuous process, as new projects demand higher performance. All custom applications are researched, developed and tested before they are launched into the marketplace.

Pilkington **Planar**™ is subject to on-going testing by our in-house team of dedicated product development engineers in a laboratory environment at Pilkington European Research and Development Centre. The system has also been subject to extensive performance testing at a wide range of independently accredited test laboratories. This includes the prestigious British Board of Agrement (assessment of products for construction), designated by Government to issue European Technical Approval. Agreement Certificate No 97/3360 covers the "Planar Mechanically Fastened Structural Glazing System".

Specific results for everything from bomb blast loading, seismic performance, to large missile hurricane induced impact tests are used by Pilkington Architectural engineers in project design. In addition, we are prepared to carry out full size tests and scaled model analysis to prove Pilkington **Planar**™ can meet a required specification.

The knowledge we have acquired over 40 years of testing has allowed us to develop a Code of Practice for structural glass façades. All aspects of the Pilkington **Planar**™ system are designed in accordance with this criteria. Such control means we can give Pilkington **Planar**™ a 12-year design and materials warranty via a network of independent accredited installers. This provides the architect with total confidence that the Pilkington **Planar**™ system will meet and exceed the requirements of the project. Pilkington **Planar**™ is never sold as glass or hardware alone, but always as a complete engineered system.

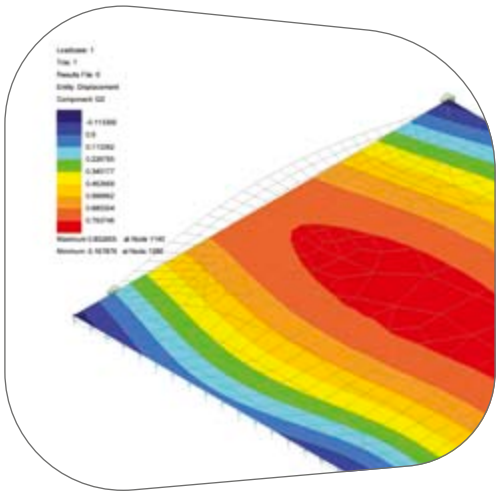
The highest quality and the widest range of glass

Structural glass façades depend on the quality of the glass for their performance and aesthetic effect. With Pilkington Architectural this is assured. All toughened glass will be supplied heat soaked to, or in excess of international specifications, e.g. EN 14179-1.

This ensures a high quality product designed to meet the demands of the built environment. Indeed, our manufacturing expertise and design knowledge is dedicated to providing safe and attractive glass structures.

Our expertise in glass manufacture means we can also place a vast array of glass types at your disposal. This gives you total flexibility of performance, appearance and transparency; allowing you to meet all requirements, functional or aesthetical.

The in-house Finite Element Analysis (FEA) modelling capability enables the accurate structural analysis of a wide range of complex glass shapes and construction for both load capacity and deflection in service.



FEA computer modelling (finite element analysis).

Glass Types

Pilkington **Planar**™ Laminated Safety Glass

For greater confidence in vertical, horizontal or inclined applications, Pilkington Architectural have developed a range of toughened (or heat strengthened) laminated glass for incorporation into the Pilkington **Planar**™ system. The design process can use a combination of materials to maintain panel integrity in post breakage situations. Furthermore the Pilkington **Planar**™ system, comprising laminated safety glass, has been used in many applications including high wind load, snow load, seismic movements, blast resistance hurricane and impact resistance.

Pilkington **Planar**™ – Insulating Glass Units

Pilkington **Planar**™ Insulating Glass Units are technically advanced, dual sealed units offering excellent in-service reliability, consistently high quality manufacture and optimum thermal performance. They incorporate a patented custom spacer bar designed to accomodate high levels of flexibility and building movement. They can also incorporate Pilkington Laminated Safety Glass and a range of other Pilkington glass types, including Pilkington **Activ**™ self-cleaning glass.

Pilkington **Optifloat**™ Clear

High quality clear float glass, from the world leaders and inventors of the float glass process.

Pilkington **Optiwhite**™

Pilkington **Planar**™ incorporating Pilkington **Optiwhite**™ increases the amount of visible light that can pass through the glass by reducing the iron content during the float glass manufacturing process.

Pilkington **Optifloat**™ Tint and Pilkington **Arctic Blue**™ body-tinted glass

Pilkington **Optifloat**™ Green, Grey, Bronze and Pilkington **Arctic Blue**™ offer excellent solar control, enhancing the interior environment.

Afognak Anchorage, Alaska, USA.

Pilkington **K Glass**™ and Pilkington **Optitherm**™

A unique low-emissivity coating on the surface of Pilkington **Optifloat**™ gives it superb energy management properties. Insulating units incorporating Pilkington **K Glass**™ offer up to 30 percent better insulation than conventional units. Pilkington **Optitherm**™ is a super neutral, off-line coated, low-emissivity glass for use in Insulating Glass Units offering excellent thermal insulation.

Glass Fin testing, Pilkington R&D Centre, UK.

Pilkington **Planar**™ Suncoated

This range offers an exciting selection of energy management glass, for insulation and combatting solar gain, in a variety of subtle colours which can be used in Pilkington **Planar**™ Insulating Glass Units. This allows the specifier maximum flexibility in choosing the level of performance that suits the project's needs.

Pilkington Decorative Glass

Choose from a selection of screen printed glass, to achieve a range of stunning visual effects. For the Afognak building (left), a custom screen print design was used to give the building a unique appearance.

Pilkington **Planar Activ**™

This product combines Pilkington **Planar**™ with Pilkington **Activ**,™ allowing designers to create the first ever self-cleaning frameless structural glazing systems. Collaboration between Pilkington Architectural engineers and scientists at the sealant companies allowed the creation of a revolutionary sealant product compatible with Pilkington **Activ**™. For compatible sealants please visit www.pilkington.co.uk/planar

Pilkington **Planar**™ fittings

We offer the most aesthetically pleasing fittings without compromising performance.

The fittings in the Pilkington **Planar**™ system offer the ideal balance between durability and appearance. All are manufactured from 316 grade stainless steel and some of the most durable engineering plastics currently available. Highly engineered and tested components allow Pilkington Architectural to offer the smallest, most aesthetically pleasing fittings available, without compromising performance. Specially customised fittings are available subject to design assessment and approval.

The 902 fitting

Connects indirectly to the secondary structure by means of Pilkington **Planar**™ spring plate brackets or castings. The 902 can accommodate any angle of slope, making it ideal for roofs and canopies.

The 905J fitting

The most popular Pilkington **Planar**™ fitting. Eliminates the need for spring plates and allows absorption of live loads and thermal expansion by rotation around a stainless steel rod connected to the back up structure.

The cast springplate

Providing the opportunity to customise and innovate, Pilkington Architectural engineers are able to develop new stainless steel connectors by use of 3D CAD and finite element models. Designs can accommodate large lateral movements and high loads from the glass panels. These connectors allow the designer to tailor the aesthetic of the façade to their individual requirement, whether that be a subtle detail or a bold design statement.

Four and two point castings (e.g. Nexus)

Detailed below are some of the many types of stainless steel connectors designed to connect the glass fitting to the back-up structure whether structural steel or glass mullion.

Planar Intrafix insulated double glazed unit with standard angle spring plates.

The Planar 905J fitting to a tubular steel support structure.

Vertical stainless steel splice plate connecting sections of a glass fin (mullion) together, incorporating Planar 905J fittings.

A custom casting connected to a glass fin (mullion) and Planar 902 bolts to façade glass.

Planar 905J fitting to a glass fin (mullion).

The Planar Nexus casting connected to steelwork and Planar 902 bolts to a façade glass.

Swansea Leisure Centre,
Swansea, UK.

The effectiveness of Pilkington **Planar**™ has been demonstrated in Swansea, South Wales, where it has been used extensively in the major refurbishment of an existing leisure complex. It is a perfect example of how glazing can transform a building stylistically and functionally. New vertical glazing totalling nearly 2000 square metres was specified for the indoor water park, including its reception area, sports hall and state-of-the-art gym.

The original shape of the building, defined by a series of concrete pillars, meant that the new glazing had to be installed inside the structure rather than outside it. As a result, the flush glass surface was built facing into the building, with structured support on the outside.

The system is by definition more durable and practical for the aggressive conditions which can often exist within chlorinated leisure pools.

Glass Fin (Mullion) Systems

Vertical glass façades whose performance is assured by testing.

The use of Pilkington **Planar**™ in combination with a glass fin system creates the ultimate in transparency. Glass fins are used to transfer wind loading to the structure. Pilkington Architectural have led the way in the development and testing of this design technology.

Cruise Liner Ferry Terminal, Liverpool, UK.

Beverly Centre, Los Angeles, USA.

American Stores, Salt Lake City, USA.

Structures of this type can be either supported at the base (ground based) or suspended (hung) from above depending upon the height of the façade. The façade glass panels are fastened to the fins by Pilkington **Planar**™ fittings. This means the weight of both the panels and the fins is carried by the connection at the head or base of each fin. This allows the design of very high façades that don't exert large in-plane loads on the Pilkington **Planar**™ panels. In places of high seismic activity, glass fin projects must be suspended. Pilkington **Planar**™ has an enviable pedigree in seismic activity areas, as its excellent performance in the San Francisco Bay, Kobe and Taiwan earthquakes testifies.

River East Centre, Chicago, USA.

Steel structures

Various forms of steel structures can be used to support a Pilkington **Planar**™ façade. The design of these structures can be varied and either simple, in the form of mullions, or intricate in the form of trusses. The versatility of the Pilkington **Planar**™ connections enables almost any type of structure to be used.

St Helens Central Railway Station, UK.

American Bible Society, New York, USA.

Pier 79, New York City, USA.

Pier 79, New York City, USA.

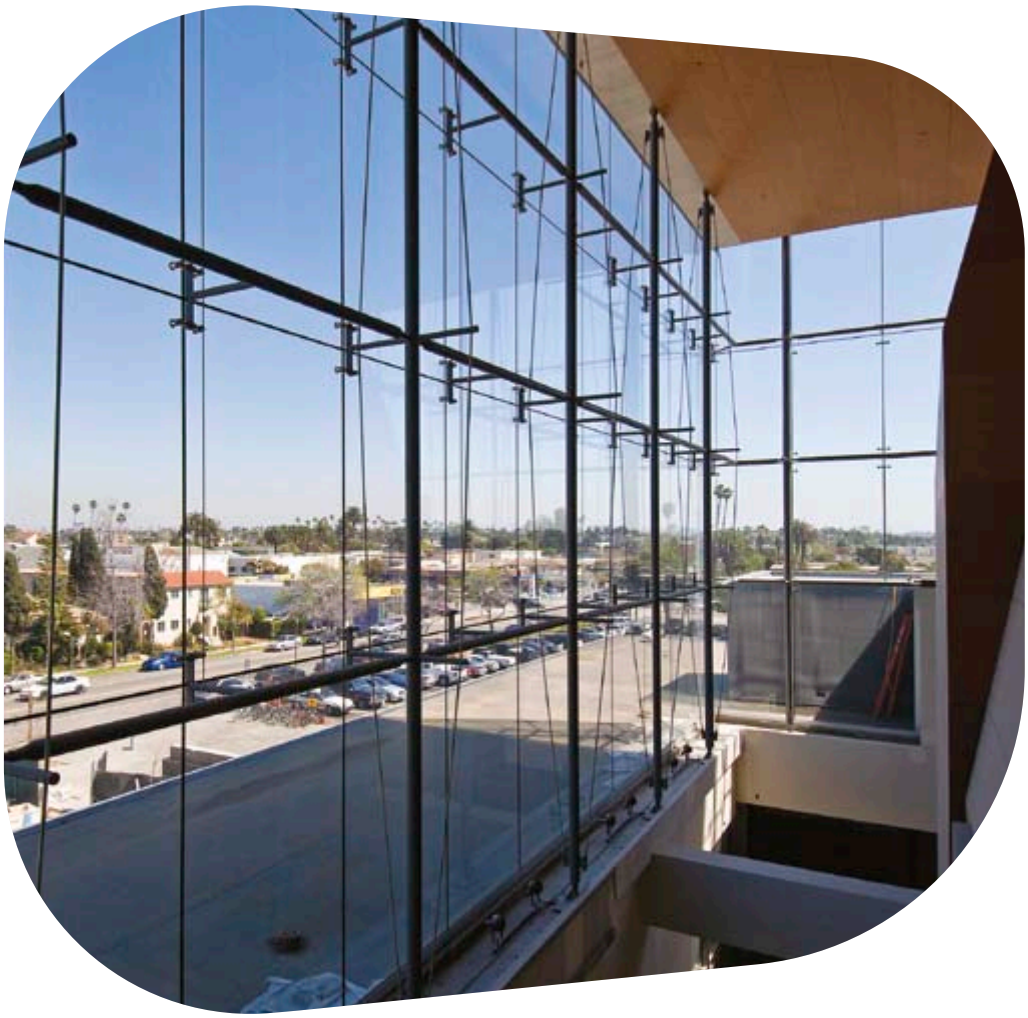
Alice Tully Hall, New York, USA.

Pilkington **Planar**™ T.S. (Tension Structures)

Creates a feeling of space and openness for an aesthetically pleasing environment.

A proven performance

Pilkington **Planar**™ T.S. has already met performance requirements for seismic loads, live and dead loads and wind loading up to tropical storm level. We also offer a full technical design service, starting with the basic design concept and leading through to 2D and 3D analysis, full performance specifications, design drawings and, via a network of specialist subcontractors, budgets leading to the bid process. In addition, there are many examples of Pilkington **Planar**™ T.S. in acclaimed projects around the world.



Santa Monica College Theatre, USA.

Alice Tully Hall, New York, USA.

Yorkshire bank, Leeds, UK.

The perfect system for skylights and canopies

The design flexibility of Pilkington **Planar**™ and its elimination of metal framing makes it the perfect choice for horizontal and overhead glazing. Pilkington Architectural has extensive experience in the supply of glazing for canopies and skylights and the Pilkington **Planar**™ system can be specified with confidence for such applications.

55 Water Street, New York, USA.

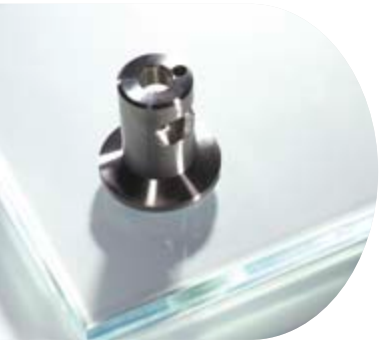
1250 Eye Street, Washington DC, USA.

National Indoor Climbing Centre, Edinburgh, UK.

Muni Metro, San Fransisco, USA.

National Indoor Climbing Centre, Edinburgh, UK.

The **Planar**™ | SentryGlas® System

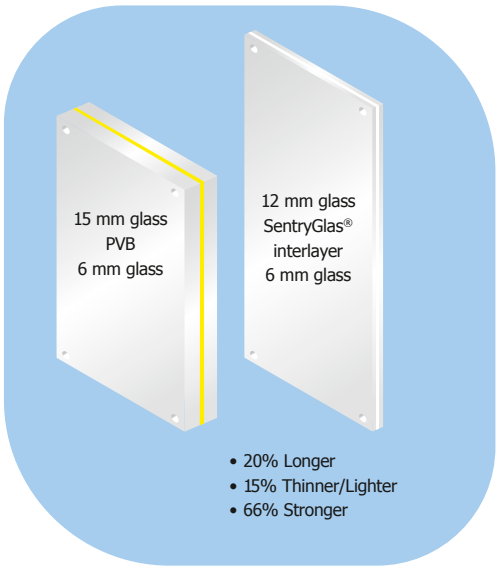


Exceptional clarity.

Pilkington Architectural and DuPont, world leaders in structural glass systems and laminate interlayers, have joined forces to create the ultimate in strength, safety, durability and appearance in laminated structural glass – the **Planar**™ | SentryGlas® System: a revolution in terms of frameless laminated glazing.

Applications of the **Planar**™ | SentryGlas® System are not just confined to complex projects. Significant benefits can be realised on any project in which increased strength or enhanced appearance are considered to be of importance. The versatility of the **Planar**™ | SentryGlas® System can now match the demands of projects on all levels.

Performance comparison of Pilkington **Planar**™ using SentryGlas® versus PVB interlayers*



* Based on Test Data.

Benefits

Stronger

The laminated glass in the **Planar**™ | SentryGlas® System is substantially stronger than traditional PVB laminated systems. Therefore, while the system still offers the same high levels of performance synonymous with Pilkington **Planar**™, it can be made with a thinner glass.

Lighter

The use of custom-designed Pilkington **Planar**™ fittings in combination with stronger laminated glass panels results in a **Planar**™ | SentryGlas® System typically being much lighter than its more conventional PVB counterpart. This can result in longer panels, a reduced number of support fixings and lighter weight support structures – reducing their visual impact, as well as providing cost savings.

More durable

SentryGlas® is manufactured by DuPont; the leader in glass interlayers, and has been subjected to intensive testing to ensure its long-term stability.

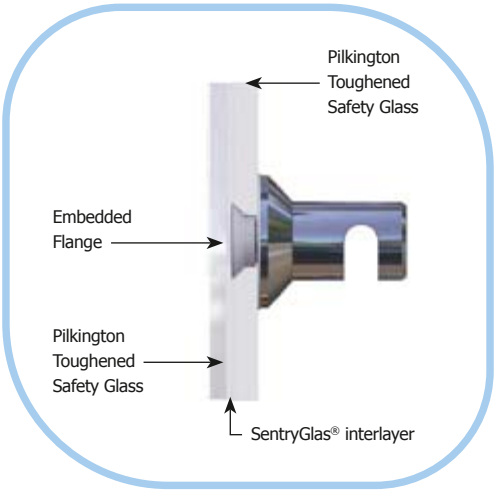
Safer

Tests have proven that the **Planar**™ | SentryGlas® System has residual strength, even with both glass components broken. This brings greater peace of mind in locations subject to typhoons or hurricanes, and makes it possible to specify laminated glass for canopies and skylights with limited access for maintenance.*

* Subject to local regulations and safe working practices.

More applications

The **Planar**™ | SentryGlas® System can be supplied using the revolutionary Pilkington **Planar**™ Integral System, allowing a much wider choice of glass than traditional structural laminates.



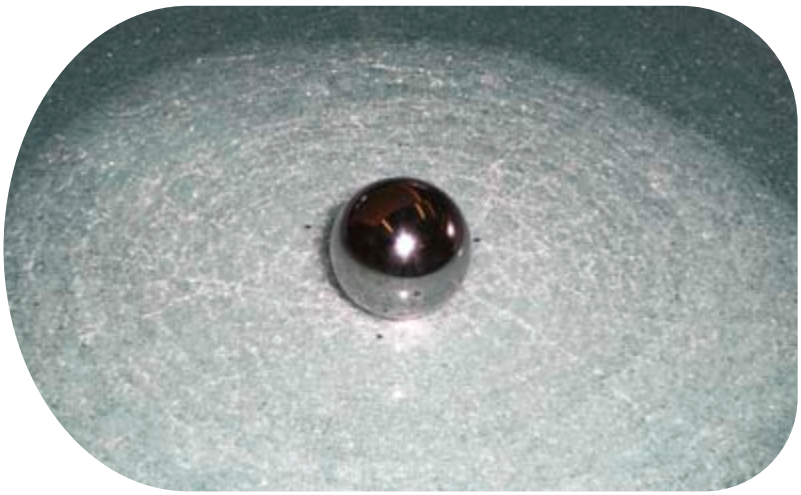
Maximum clarity

The SentryGlas® structural interlayer is significantly clearer than traditional interlayers. When used with Pilkington **Optiwhite**™ exceptional clarity is achieved, even in a laminated glass.

What makes the **Planar**™ | SentryGlas® System so efficient?

Load sharing

Specially developed Pilkington **Planar**™ fittings combined with the much higher modulus of the structural interlayer (compared with traditional interlayers) allows the **Planar**™ | SentryGlas® System to share applied loads between both glass components of the laminate. The fittings are designed to interlock with the interlayer to develop maximum strength and structural efficiency, giving a significant increase in load bearing capacity while at the same time reducing the thickness required.



Impact testing, EN356.

Low deflection

The **Planar**™ | SentryGlas® System fully utilises the increased stiffness of the SentryGlas® interlayer (in some cases 100 times that of PVB) to reduce deflections under wind, snow and dead loads – often a limiting factor when designing structural glazing installations.

High & low temperatures

SentryGlas® has a higher Glass Transition temperature (Tg) than other interlayers which means enhanced mechanical properties can be utilised over a much greater range of temperatures. Pilkington Architectural engineers allow for temperature variations and all load combinations when designing **Planar**™ | SentryGlas® System installations, using techniques developed by DuPont and Pilkington Architectural and more recently being reflected in international design standards.

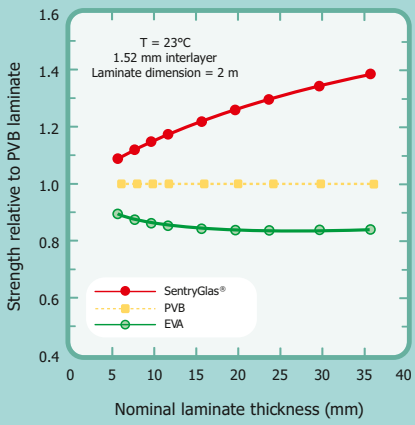
Durability

SentryGlas® is a DuPont engineered polymer containing no plasticisers, resulting in unrivalled edge stability. Edge Stability Numbers (ESN) with SentryGlas® interlayers remain zero at all known installations, including seven year test panels exposed to severe Florida heat and humidity. Pilkington Architectural and DuPont together with the sealant suppliers have also tested for compatibility and approved a wide range of weather seals for use in the **Planar**™ | SentryGlas® System.

Load shared between both panels of the laminate

Relative Strength (Bending)

- SentryGlas® laminates show superior strength properties.
- Up to 65% stronger than EVA laminates.
- Good opportunities to reduce glass thickness, particularly for thicker glass.



Yorkdale Shopping Centre, Toronto, Canada.

CE

CE marking confirms that a product complies with its relevant harmonised European Norm.
The CE marking label for each product, including declared values, can be found at www.pilkington.com/CE

NSG GROUP

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