

Case Study:

Berlin's renovated Tropenhaus botanical garden uses special UV-transmissible glass

Germany's first use of a specially approved UV-transmissible grade of SentryGlas® ionoplast interlayer helps sustain growth and preservation of one of the world's most significant collections of rare and endangered tropical plants.

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One of the largest self-supporting display greenhouses in the world

Following the renovation of the Grand Pavilion (das Große Tropenhaus, first built in 1906) at Berlin's Botanical Garden, daylight enters through hundreds of small, heat-insulating yet highly light-permeable glass panes onto one of the world's most significant collections of rare and endangered tropical plants.

The inner panels used in the double-glazing for the overhead sections of the pavilion are made of laminated safety glass using stiff and strong SentryGlas® ionoplast interlayers. For the first time in Germany - following its "special approval" - a special "UV-transmissible" grade of SentryGlas® is used for this application, thereby sustaining the active growth of the plants and safeguarding their preservation.

Measuring 60 m long, 29 m wide and 26.5 m high (197 by 95 by 87 ft), the Grand Pavilion is one of the largest self-supporting display greenhouses in the world, built without obstructive interior pillars. Its transparent shell, attached to a supporting structure, has a total area of 4,500 m² (48.000 sq ft), approximately 60 percent of which is overhead. Over the years, the shell had become both dull and leaky, making its extensive reconstruction essential. Acting as the client, the Freie Universität Berlin assigned the general planning of the project to the Berlin office of HAAS Architekten BDA. The work was completed in the autumn of 2009.

Adoption of UV-transparent glass follows earlier use of similarly-made laminated glass in Barcelona at an Amazonian rainforest exhibit

During the renovation work, the complete façade was replaced. During this process, high expectations were made in terms of safety and protection, heat insulation and the preferably unobstructed transmission of natural sunlight, including its UV portions. Meeting these requirements meant a venture into new territory, as such a versatile glass façade design had never been attempted anywhere else. The solution was developed by the architects and client in partnership with Radeburger Fensterbau GmbH (Radeburg-Bärwalde, Germany), the glass refiner and manufacturer Glas Trösch (Switzerland and Germany) and Kuraray Glass Laminating Solutions as the producer of laminated glass interlayers, which are used in architectural projects around the world. For the overhead sections, the multifunctional double-glazing consists of an external panel made of heatstrengthened single pane safety glass and an inner panel made of laminated safety glass. For each panel, the team selected EUROWHITE® from Glas Trösch, a highly transparent, extrawhite float glass with a low iron-oxide content, supplied with a LUXAR® anti-reflex coating on the second surface. Its good heat insulation performance - the Ug-value measures 1.1 W/m² K - is the result of using a noble gas filling between the panels and a SILVERSTAR® EN plus Low-E coating on the third surface.

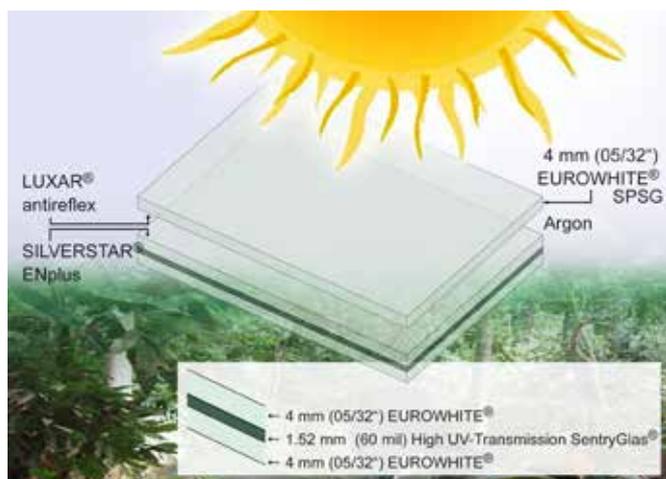
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"Initially we had difficulties sourcing a laminated safety glass which was UV-transparent," explains the architect Friedhelm Haas. "Most of the traditional laminated safety glass interlayers are made of polyvinyl butyral (PVB). This contains a UV blocking filter, which prevents the yellowing of the interlayer and the fading of furnishings and works-of-art. The botanists, however, required the ingress of light with as close to natural levels of UV as possible in order to prevent unnatural plant growth, control the spread of pests and encourage blossom induction. When looking for alternatives, we read about the adoption of crystal-clear SentryGlas® interlayers from Kuraray for the flat roof of an Amazonian rainforest exhibit in Barcelona in 2004, where - for the first time in Europe - an interlayer without a UV stabilizer was used."

Stiff, clear SentryGlas® is inherently UV stable

Much like the standard grades, high UV-transmission SentryGlas® (the name of this special greenhouse grade) consists of a polymer which is inherently UV stable and therefore does not require a UV stabilizer for its own protection. All SentryGlas® interlayers, originally developed for glazing in hurricane-prone regions, are renowned for their very good mechanical properties. Their strength is considerably higher than that of PVB, and their stiffness is up to 100 times higher than PVB. Laminated safety glass produced with SentryGlas® interlayers provides particularly high postglass breakage performance and thus offers high levels of safety and protection.

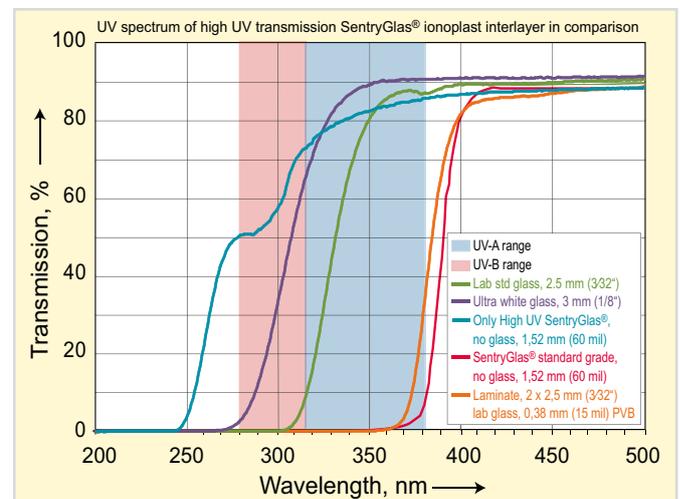
Laminated safety glass with SentryGlas® interlayers are already used in many architectural installations around the world, yet until now there had been no planning approval in Germany for the specific combination of EUROWHITE® and High UV-Transmission SentryGlas®. Following an initiative by the technical department at the Freie Universität Berlin, comprehensive testing was commissioned to confirm its conformity with safety standards.



Lighter façade panels enable more subtle supporting structures

For decades, interlayers made of polyvinyl butyral (PVB) have been the industry standard when producing laminated safety glass. Architects are well aware of the possibilities and limitations of such glass when used extensively in façade engineering, for roofing and window panels. In contrast, SentryGlas® enables an entirely new approach because the interlayer is over 100 times stiffer and five times stronger than PVB. As a consequence, there is an almost perfect transmission of load between two laminated sheets of glass, even at high temperatures, leading to the excellent flexural behavior of the glass when under load - also under direct sunlight in high summer. Accordingly, laminates with SentryGlas® show less than half the rate of deflection when compared to laminates with PVB, when under the same load, and thus almost the same behavior as monolithic glass of the same thickness.

Working in close cooperation with the curtain wall producer Radeburger Fensterbau, the department for steel and light metal construction at the University of Applied Sciences in Munich tested for properties such as tensile strength, impact protection, post-glass breakage performance, fire performance and long-term behavior when exposed to simulated weathering. The results met all expectations and ultimately their efforts were rewarded: the building authorities in the state of Berlin granted "special approval" for the use of this innovative and highly functional glazing solution in the ambitious construction project.



The Tropenhaus renovation uses insulated, double-glazed panels with the inner glass laminated for safety performance. The inner laminates are made with a special grade of SentryGlas® for high UV transmission, supporting plant health by letting through more natural light.

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Double-glazed, insulated glass panels address safety requirements and plant health needs.

- Comprehensive safety testing performed
- Special approval received for unique, high-UV transmissive interlayer used in glass laminates
- Panels feature low-iron glass with anti-reflective coatings for maximum transparency
- Botanists wanted light with as close to natural levels of UV as possible, to help prevent
- unnatural plant growth, control the spread of pests and encourage blossom induction.

As well as improved strength and stiffness, other benefits of SentryGlas® include:

- **Safety:** In the event of breakage, glass fragments remain firmly bonded to the interlayer, reducing the chance for injury
- **Security:** SentryGlas® can be used in glazing that withstands bullets, hurricane-force winds and even bomb blasts
- **Durability:** SentryGlas® is extremely durable and resistant to clouding, even after years of exposure
- **Design Versatility:** SentryGlas® can be used in glass manufactured flat or curved, including annealed, toughened, heat-strengthened, spandrel, wired, patterned and color tinted glass
- **UV control:** SentryGlas® is available with or without UV transmittance

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