

Case Study:

Lighter, Safer Glazing Aboard the Azura from P&O Cruises

SentryGlas® ionoplast interlayer chosen for another flagship from Fincantieri Cantieri Navali Italiani S.p.A

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To meet wind loads and weathering requirements, the glass construction consists of two layers of 15 mm (19/32 in.) low-iron laminated tempered glass with a 2.28 mm (90 mil) SentryGlas® interlayer.

Following the successful, initial adoption of tempered laminated glass with SentryGlas® ionoplast interlayer in the cruise ship the Ruby Princess, Fincantieri, global leader in the building of cruise ships, has specified the same lightweight glazing system from Somec Marine & Architectural Envelopes SRL (Italy) for several elements of the latest flagship to join P&O Cruises' fleet, the Azura.

The reasons behind the adoption of the Somec system include the use of a lighter, and therefore more cost-effective, laminate made with SentryGlas® as well as compliance with marine safety standards and high durability in the harsh sea environment.

The Azura, built by Fincantieri at the Monfalcone yards near Trieste, Italy, was christened on the 10 April 2010 in Southampton (England) before setting off on its maiden voyage to the central Mediterranean. With its 116,000 gross tons, an overall length of 290 m (951,44 ft), a width of 36 m (118,11 ft) and a maximum speed of 22 knots, Azura is equipped with 1,557 berths spread over its 15 passenger decks, accommodating up to 3096 passengers assisted by 1,226 crew.

Glass balustrades help form balconies for the 900 balconied cabins on decks 8 to 15, and line deck 16 and the sun deck as

an effective barrier to passengers. They are used to create a wind shield on deck 19, whilst the same laminate construction is used for the glazing of public corridors of deck 15.

Beyond their visual appeal, the glass balustrades and other elements featuring tempered laminated glass with SentryGlas® interlayer can withstand both human and wave impacts and harsh climates, thereby ensuring passenger safety. For example, all glazing for marine applications is required to withstand constant wind forces of 250 kg/m², whilst the strength of toughened safety glass intended for use in marine applications must be in compliance with ISO Standard 614:1989.

More recently, Lloyd's Register's safety rules for exterior glass balustrades on ferries and passenger ships now require tempered monolithic glass to be replaced by tempered laminated glass for enhanced safety. In a balustrade system first developed and installed on the Princess Ruby, the lighter, high performance laminate made with SentryGlas® interlayer ensures compliance with the change in Lloyd's Register's safety rules without adding to the overall weight or cost of the system.

"Due to the much enhanced strength behaviour and reduced laminate deflection of the SentryGlas® interlayer versus a

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conventional PVB laminate, our balustrade system is able to use a thinner laminate construction ((6 mm (15/64 in) tempered tinted glass + 1.52 mm (60 mil) SentryGlas® + 4 mm (5/32 in) tempered tinted glass)) of equivalent thickness and weight to the original monolithic tempered glass," confirms Christian Sossai, engineer at Somec.

In contrast, the use of standard laminated glass with a PVB interlayer would bring with it a significant increase in weight of approximately 10 kilograms per square meter. The high stiffness of the interlayer, up to 100 times that of PVB, means the glass laminate remains intact in the event of accidental breakage, while the dangerous glass fragments remain adhered to the interlayer. Accordingly, the potential danger to passengers is reduced and the structural capacity of the balustrade is retained.

Additionally, laminates made with SentryGlas® show excellent durability in marine conditions, where the glass surface of modern cruise ships needs to be protected against the harsh sea environment and humidity to ensure transparency and visibility. Extensive product testing, including salt spray fog testing, during which glass panels with SentryGlas® are exposed to 500 consecutive hours of salt spray, has shown the laminated glass panels to remain unchanged in terms of their structural performance and their transparency. For example measurements of bending stiffness for laminates exposed to varying weathering, up to 12 years natural exposure in Florida (temperature excursions between 0 to 45 °C, and relative humidity up to 90%) show the bending stiffness of SentryGlas® to be essentially unchanged over time and is direct evidence of the interlayer durability. The interlayer also passes the Florida (USA) Miami-Dade County requirements of 5 years accelerated weathering with less than 10 percent change in physical properties.

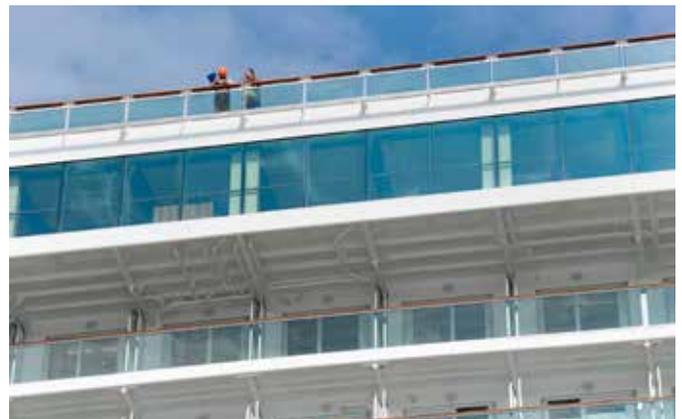
Lighter façade panels enable more subtle supporting structures

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.



P&O Cruises' Latest, Largest Liner

The Azura uses a lightweight glazing system from Somec Marine & Architectural Envelopes SRL (Italy) in balustrades for 900 balconied cabins, in glazing for public areas, and in windscreens for upper decks.



Laminated Tempered Glass Rails

Beyond their visual appeal, glass balustrades and other elements laminated with SentryGlas® are required to withstand both human and wave impacts, and harsh climates.



Durable Laminate Transparency

Laminates based on SentryGlas® in the Azura's glazed corridors show excellent durability and transparency in marine conditions, improving visibility for passengers and crew.

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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

Shipbuilder: Fincantieri Cantieri Navali Italiani S.p.A
System: Somec Marine & Archtiectural Envelopes SRL
Shipowner: P&O Cruises

REGIONAL CONTACT CENTERS

Kuraray Co., LTD
Ote Center Bldg.
1-1-3, Otemachi
Chiyoda-ku, Tokyo, 100-8115, Japan
Phone: +81 3 6701 1508

Kuraray Europe GmbH
Glass Laminating Solutions
Philipp-Reis-Str. 4
65795 Hattersheim, Germany
Phone: +49 (0) 69 30585300

Kuraray Americas, Inc.
2625 Bay Area Blvd. #600
Houston TX 77058, USA
Phone: +1.800.423.9762

Kuraray Mexico S.de R.L. de C.V.
Homero 206, Polanco V seccion,
cp 11570,
Mexico City, Mexico
Phone: +52 55 5722 1043

For further information
about SentryGlas®, please visit
www.sentryglas.com

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