

PLEOTINT

Durability Testing Suntuitive Dynamic Glass



Introduction

Pleotint is the developer and manufacturer of the safety glass interlayer known as Suntuitive® Interlayer. Suntuitive interlayer is thermochromic in nature and is used to prepare variable tinting laminates for windows. These windows adapt to changing sunlight intensity to reduce heat load and modulate illuminance in buildings.

Suntuitive windows are sunlight responsive, dynamic windows which use the sun's energy to tint and effectively block up to 90% of the sun's energy when sunlight is directly shining on the window. The dynamic nature of these windows maximizes the available daylighting and minimizes solar heat gain to provide comfort, energy savings and enable increased productivity. In addition, Suntuitive windows preserve the view to the outdoors, while reducing glare, fading and noise.

Laminate Integrity

Laminates produced with Suntuitive interlayer have passed the Impact Test, Boil Test and Pummel Test for Laminated Glass outlined in the **Code of Federal Regulations (CFR), Consumer Product Safety Commission (CPSC), "Safety Standard for Architectural Glazing Materials" CPSC 16 CFR 1201**. In addition, laminates incorporating Suntuitive Interlayer have passed **UL 972 "Standard for Burglary Resisting Glazing Material"**. These tests were performed at Architectural Testing Inc. of York, Pennsylvania, USA, an independent testing firm.

Accelerated Weathering Testing Summary

Pleotint's Suntuitive interlayer for glass lamination has surpassed the 20-year mark of solar radiation durability based upon accelerated testing in Atlas Electric xenon arc lamp Weather-ometers® (WOM). WOM testing at Pleotint employs a lamp intensity of 0.55 W/m² at 340 nm and a black panel temperature of 85 °C.

These settings reflect the long-standing method for the determination of product stability with respect to outdoor exposure and is the benchmark used in **ASTM E2141-06** for testing dynamic window materials. Internal testing at Pleotint has established a correlation between WOM testing and outdoor exposure in the Arizona desert for Suntuitive laminates, which is consistent with 8000 WOM hours equating to a minimum of 20 years of exposure in the Arizona desert.

Figure 1 (below) presents data for eight Suntuitive laminates that were exposed to the above WOM conditions for 8000 or more hours. On average, these samples maintained 95% of the initial visible light transmission at room temperature and also maintained 93% of the initial variable transmission range (i.e., the difference between the visible light transmission at room temperature and the visible light transmission when heated and darkened by direct sunlight). An average haze value of 1.4 ± 0.5 % were recorded post-WOM exposure for a subset (N=4) of these samples after 8000 WOM hours.

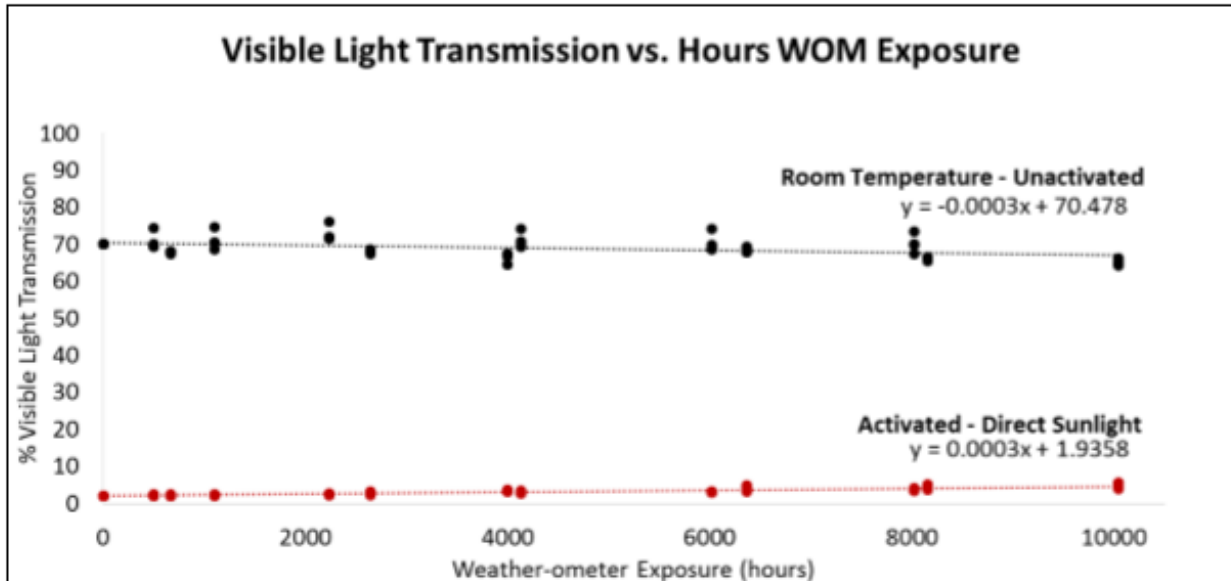


Figure 1: Suntuitive Laminate xenon arc lamp Weather-ometer results.

In addition to maintaining transmission level and tinting range, windows containing Suntuitive interlayer maintain a consistent appearance over time. As shown in Table 1, even after extended WOM exposure, the color of the samples has changed by a virtually imperceptible amount.

Table1. Room temperature L*a*b* color coordinates for Suntuitive Laminates.

WOM hours	a*	b*	L*
Initial	-3.6 ± 0.2	2.2 ± 0.4	82.4 ± 1
8000 h	-5 ± 0.1	4.0 ± 0.2	82.4 ± 0.9

N=4

Insulating glass units containing Suntuitive interlayer have been subjected to outdoor exposure tests in Arizona in a south-facing 34° sloped glazing configuration. Over the course of two years in these extreme conditions, the Suntuitive interlayer showed virtually no degradation.

In addition to internal testing at Pleotint, the **National Renewable Energy Laboratory** (Golden, CO) (NREL) has tested three large Suntuitive laminates under **ASTM E2141-06** conditions in an Atlas Electric XR260 Weatherometer® for a test duration of 2500 hours. After this test period, Suntuitive laminates showed no cosmetic defects. The samples were characterized after exposure and showed post-exposure photopic transmission ratios of ~11, with clear-state room temperature photopic transmission values of ~70% and elevated temperature transmission values of ~5-6%. These values compared favorably with a control (unexposed) sample, indicating little or no degradation in the coloration properties of the laminates. Also, the measured photopic transmission ratios were well above the ratio of 4 required to pass the **ASTM E2141-06** test for dynamic windows.

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Pleotint has also had the durability of Suntuitive laminates tested by **Q-Lab Corporation**, an independent testing laboratory, according to **ASTM G155-05a** using conditions specified in **ASTM E2141-06**. After exposure for 2500 hours, the laminates showed no cosmetic defects and they had virtually unchanged photopic transmission values. The room temperature visible light transmission had changed from 66% to 64% and the visible light transmission at elevated temperature remained unchanged at 6% post-WOM exposure.

Real World Experience

Pleotint personnel have well over 30 years of experience in the development of durable chromogenic devices and have leveraged this experience in developing the Suntuitive interlayer. Pleotint confidently offers Suntuitive interlayer as a durable, high performance product for the dynamic window market.

Additionally, Suntuitive IGUs have been installed in the field since 2010. Since this date, Suntuitive IGUs have been installed in over 400 buildings in 22 different countries. Importantly, during real world exposure to a broad range of environmental conditions, there have been no observations of decreased performance in any of the installed Suntuitive IGUs.

Conclusion

Pleotint defines the lifetime of the Suntuitive Interlayer to be the period of time where the dynamic range of the interlayer is greater than or equal to 80% of its original dynamic range. Based on extrapolation of the data above the projected lifetime of Suntuitive Interlayer would be well over 30 years in the field.