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Warranty for Polycarbonate – Yellowing

The main reasons to use polycarbonate sheets:

1. **High Impact Resistance** (in a wide range of temperatures: -40⁰F to +250⁰F)
2. **Clarity** – allows a high percentage of light to pass through
3. **High Fire Resistance**

All polycarbonate manufacturers offer a warranty for their sheets. How to read and understand these warranties and compare the differences from one to the other is what is important.

When used as a glazing material polycarbonate sheets are commonly exposed to the sun and they are constantly attacked by the sun's UV wavelength. While the UV rays do not "penetrate" the polycarbonate sheet to the naked eye, these intense rays will constantly attack the outer layer of the sheet and thereby destroy the sheet and its inherent properties. This attack manifests itself in turning the outer layer of the sheet yellow which indicates a general degradation of the sheet. How the sheet's surface is protected from these UV rays and therefore how they are warranted is what differentiates the various sheets in the market.

The most common procedure used to protect the sheet is a microscopic layer of UV/polycarbonate inhibitor. This "co-extruded protection layer" blocks the UV wavelength before it gets to the outer most layer of the polycarbonate sheets. During the life of the panels, some of the UV does get through the protection layer but most of it is stopped on the outside. Over time however, the UV breaks down this protective layer thereby rendering the polycarbonate sheet defenseless against its attack. The different warranties for polycarbonate product on the market reflect the effectiveness of the different methods used to protect the outer layer from UV attack. The Lexan Thermoclear Plus warranty clearly shows the relative effectiveness of their protective layer is much better than any other one on the market.

When the polycarbonate is attacked by the UV it changes color; it starts to become yellow. This phenomenon happens because the connections between the polycarbonate molecules lose their strength. The color turning "yellow" is just the "visual symptom" of the loss of the sheets mechanical properties; namely LT (Light Transmission) and impact resistance.

The industry standard is to measure "yellowing" in terms of "Delta YI". The essence of this test is to measure the difference in the color of the sheet at any point in time when comparing it to its original color. The difference as measured by "Delta YI" (i.e.: change in the Yellowness Index between "new product" and "old product") denotes that change. These results also correlate with a proportionate amount of loss of the sheet's ability to transmit light (light transmission).

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Most companies will replace “out of warranty” sheets according to a prorated schedule (i.e.: as time passes the warranty reduces the percentage of reimbursement)

The table below shows the comparison of warranties between the main producers in the USA market.

| | SABIC | | | | | | |
|-----------------------|-------------|-----------|------------|------------|----------------|----------|----------|
| | Palram | Polygal | Co-Ex | Gallina | Danpalon (CPI) | "Plus" | "Sun XP" |
| total years | 10 | 10 | 10 | 10 | 10 | 10 | 15 |
| Loss of LT / Delta Yl | 8.5% / Δ 10 | 6% / Δ 10 | 10% / Δ 10 | 6% / Δ 10 | 6% / Δ 10 | 2% / Δ 2 | 4% / Δ 4 |
| \$\$ after 5 years | 80% | 100% | 100% | 100% | 100% | 100% | 100% |
| \$\$ after 6 years | 70% | 100% | 90% | 75% | 60% | 75% | 100% |
| 7 | 60% | 100% | 80% | 60% | 60% | 60% | 100% |
| 8 | 50% | 100% | 70% | 45% | 30% | 45% | 100% |
| 9 | 40% | 100% | 60% | 30% | 30% | 30% | 75% |
| 10 | 30% | 100% | 50% | 15% | 30% | 15% | 60% |
| 11 | | | | | | | 45% |
| 12 | | | | | | | 40% |
| 13 | | | | | | | 30% |
| 14 | | | | | | | 20% |
| \$\$ after 15 years | | | | | | | 15% |
| ISO* | YES | YES | YES | Italy only | YES | YES | YES |
| Impact | #months/120 | 10 years | 10 years | 10 years | 5 years only | 10 years | 15 years |

Sabic Warranty:

- 1) [“Plus” Warranty \(click here\)](#)
- 2) [“SunXP” warranty \(click here\)](#)



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Definitions:

***ISO:** (International Organization for Standardization) is the world's **largest developer** and publisher of **International Standards**. ISO is a **network** of the national standards institutes of **159 countries**, one member per country, with a Central Secretariat in Geneva, Switzerland, that coordinates the system. ISO is a **non-governmental organization** that forms a bridge between the public and private sectors. ISO enables a **consensus** to be reached on solutions that meet both the requirements of business and **the broader needs of society**.

Transmission of Light

Spectral Transmission of Polycarbonate Sheeting

Polycarbonate sheet is transparent to wavelengths of light between 385nm at the lower limit and approximately 5000nm at the upper limit. Importantly polycarbonate is opaque to infra-red radiation: light in the visible spectrum entering a building is absorbed by the interior and contents and re-radiated as long wave infrared radiation, which cannot be re-transmitted back through the polycarbonate sheeting.

Yellowness Index is a number calculated from spectrophotometric data that describes the change in color of a test sample from clear or white toward yellow. This test is most commonly used to evaluate color changes in a material caused by real or simulated outdoor exposure.

Yellowness index

Yellowness is a property important in many industries, for several reasons. First, processing of various materials may cause yellowing. Next, the purity of some products may be determined based on the amount of yellowness present. Also, some products degrade and yellow with exposure to sunlight, temperature, or other environmental factors during use. Thus, yellowness has become an important variable to measure in industries such as textiles, paints, and plastics. There are different types of yellowness indices available, depending on the type of product being measured. Two of the most common are

- ASTM Designation E313-73 (Reapproved 1993), "Standard Test Method for Indexes of Whiteness and Yellowness of Near-White, Opaque Materials"
- ASTM Designation D1925-70, "Standard Test Method for Yellowness Index of Plastics."

ASTM D1925 has recently been withdrawn, but its yellowness index is still used in many industries. Samples measured by method E313 must be nearly white and opaque. When items are being compared using YI E313, they must be similar in gloss, texture, translucency, and other physical attributes. If these criteria are not met, the yellowness values will not be meaningful. Products such as paints, textiles, and plastics are often measured by this method.

The D1925 method requires samples that are nearly colorless transparent plastics or nearly white translucent or opaque plastics. When items are being compared using YI D1925, they must be similar in transparency, translucency, opacity, thickness, shape, and other physical attributes. As with method E313, if these criteria are not met, the yellowness index values are not meaningful.

Lexan* Thermoclear*Plus 2UV Sheet

Warranty Conditions

Ten Year Limited Written Warranty

Lexan Thermoclear Plus 2UV sheet will not break due to loss of impact strength through weathering and will not display excessive yellowing and loss of light transmission as defined herein, within ten (10) years of date of sale by SABIC Innovative Plastics.

This limited written warranty is subject to the following conditions:

- 1) This limited written warranty applies solely to standard sheets produced by SABIC Innovative Plastics in Europe with a minimum gauge of 6 mm in the colors standard clear (112), opal white (WH7A092X) and standard bronze (515055), used correctly as sloped, vertical or cold curved glazing, handled, stored, processed, installed and maintained according to SABIC Innovative Plastics' recommendations contained in the Technical Manual. In all cases, the surface bearing the proprietary UV protection must be the only side exposed to direct sunlight and the effects of weather.
 - Loss of light transmission will be determined by subjecting a cleaned sheet sample to the Light Transmission Test ASTM D1003 (1977). Any claims for sheets displaying a loss of light transmission of 2 % or less, compared to the original value, will not be accepted.
- 2) This limited written warranty does not apply to sheet that has been thermoformed, scratched, abraded or exposed to corrosive materials or chemicals.
- 3) This limited written warranty is given only to the original purchaser of SABIC Innovative Plastics sheet and does not extend to any subsequent purchaser or transferee. Any warranty claim hereunder must be made immediately within the warranty period by specifying the claim in writing and submitting to SABIC Innovative Plastics the original sales receipt which must contain the name and address of the purchaser, the date of purchase, the complete product name, the lot number and the volume purchased. On request of SABIC Innovative Plastics claimant must allow the material to be inspected on site and/or return the sheet to SABIC Innovative Plastics for testing.
- 4) For the purpose of this limited written warranty:
 - Loss of impact strength through weathering leading to hail breakage will be determined by subjecting an undamaged sample of the sheet to a standard hail simulation test developed by KRI-TNO, Delft, The Netherlands.
 - Acceptance of a claim under this limited written warranty requires that this test (10 shots with artificial hailstones of 20 mm in diameter aimed at different points of the sheet surface with a speed of 21 m/s) causes at least 5 holes in the weathered surface of the sheet.
- 5) SABIC Innovative Plastics reserves the right to investigate independently the cause of any failure.
- 6) If a claim under this limited written warranty is justified, SABIC Innovative Plastics will provide the purchaser with replacement material free of charge in accordance with the following schedule:

| Time from Orig. Purchase Date | Material Replacement |
|-------------------------------|----------------------|
| Up to 5 years | 100% |
| in 6th year | 75% |
| in 7th year | 60% |
| in 8th year | 45% |
| in 9th year | 30% |
| in 10th year | 15% |

If replacement material cannot be provided within a reasonable period of time, SABIC Innovative Plastics may opt to refund the original purchase price paid to SABIC Innovative Plastics, or a portion thereof, in accordance with the above schedule.
- 7) This limited written warranty shall be SABIC Innovative Plastics' sole liability and customer's exclusive remedy for the products and all other claims for damages are excluded. The limited written warranty is in lieu of all other warranties (except of title), written or oral, statutory, express or implied, including any warranty of merchantability or fitness of purpose. This ten (10) Year limited written warranty shall be governed by the laws of the Netherlands.
- 8) This limited written warranty has been issued on July 1st 2000, is restricted to material sold by SABIC Innovative Plastics after such date and supersedes all previously issued warranties for the products mentioned above.
- Yellowing will be determined by subjecting a cleaned sheet sample to the Yellowness Index Test ASTM D1925 (1977). Any claims for sheets displaying a change in Yellowness Index of 2 Δ or less for standard clear (112) and 5 Δ or less for opal white (WH7A092X) and bronze (515055), compared with their original value, will not be accepted.

* Trademarks of SABIC Innovative Plastics IP BV

Lexan* Thermoclear*