



AERO

## Summary of UV Xenon Test

Wichita State University – NIAR (National Institute of for Aviation Research)

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ToughGuard ASTM D7869-17 Xenon 2000 hrs. Testing Report

Summary and Analysis:

Testing Data Results indicate that all 3 ToughGuard Paint Sealant resin test panels and the SpeedGuard SGX test panel performed extremely well. **Readings below 1.0 are considered excellent results.**

### ASTM D2244 Color Difference Calculations

ToughGuard Paint Sealant

<u>ΔE*ab @</u>	<u>500</u>	<u>1000</u>	<u>1500</u>	<u>2000 hours</u>	<u>Difference</u>
1-Coat	0.45	0.41	0.41	0.52	-0.07
2-Coats	0.75	0.78	0.77	0.84	-0.09
3-Coats	0.95	0.92	0.89	0.92	+0.03
SpeedGuard SGX	0.29	0.32	0.36	0.39	-0.10

ASTM D2244 calculates the color tolerances and small colors differences between opaque surfaces. Perceived and measurable color is affected by gloss. Multiple identical objects with the same true color will be perceived as having a vivid or dull color depending on the gloss level. The ASTM D523 Specular Gloss measures and calculates the capacity of a surface to reflect light.

High gloss surfaces (i.e.: 70 GU or more) with a high specular component measurement will appear as more saturated in color (vivid) increasing the Color Difference Calculations. (GU = Gloss Units)

As the human eye can only perceive a Delta “E” greater than or equal to 2.3, the testing results indicate that no perceivable color change took place after the equivalent of 3 years of Miami, Florida sun and weather environmental conditions including rain, heat, and salt. As can be observed with the 1-Coat application data, a minimal color difference calculation is measured that is not even recognizable to the human eye.

The larger Delta “E” of the 2-coats and 3-coats of ToughGuard Paint Sealant is the result of increased resin coating thickness on top of the painted surface and higher gloss measurements due to additional light capture and refraction magnifying the substrate color like a prism making it more vivid and increasing the Color Difference Calculations. As you can see from the “Difference” numbers, the level of degradation of ToughGuard paint sealant is negligible regardless of the number of coats.

## ASTM D523-14 Specular Gloss Test

### ToughGuard Paint Sealant

<u>Test Panel</u>	<u>Gloss Degree</u>	<u>500h</u>	<u>1000</u>	<u>1500</u>	<u>2000</u>	<u>Difference</u>
1-Coat	20	84.4	83.8	82.9	85.5	+1.1
	60	92.9	92.8	93.0	93.3	+0.4
	85	98.1	98.1	97.9	99.6	+1.5
2-Coats	20	84.3	84.8	84.5	85.7	+1.4
	60	93.3	93.4	93.4	93.7	+0.4
	85	97.7	97.3	97.4	99.6	+1.9
3-Coats	20	83.7	84.3	83.8	86.0	+1.1
	60	93.5	93.6	93.5	93.8	+0.3
	85	98.3	97.7	97.8	99.8	+1.5
SpeedGuard SGX	20	86.0	87.0	86.1	86.7	+0.7
	60	94.5	94.2	94.0	93.9	-0.4
	85	97.7	97.5	97.5	99.4	+1.7

### Summary and Analysis:

Gloss angles of 20 degrees and 60 degrees are used to evaluate high gloss coatings. Gloss Unit (GU) rating of 85 or higher is considered "High Gloss". ToughGuard Paint Sealant Resin panel 1, panel 2, panel 3, and SpeedGuard SGX panel all achieved GU's of 85 degrees or higher at 2000 hours. ToughGuard Paint Sealant and SpeedGuard SGX performed very well in maintaining and in fact INCREASING GU's over the course of testing at 500hrs, 1000hrs, 1500hrs, and 2000hrs.

### **ToughGuard Explanation of Performance:**

ToughGuard GU's (Gloss Units) generally will increase as the coating cures. This is due to evaporation and evacuation of the sealant's nano-silane carrier agents and the physical properties enhancement of the paint system. These enhancements solve the problem of residual porosity created by the drying and curing process of the paint system. These enhancements increase the aesthetics, resilience, and durability of the paint system. ToughGuard Paint Protection was the first of its kind over 35 years ago and still is the only of its kind Quartz-Acrylic-Nano-Silane protective coating technology.

## **ToughGuard Benefits**

Increased Durability = Extended Paint System Lifespan

Increased UV Protection = Reduced Fading & Color Loss

Increased Water Repellency = Better Anti-Corrosion

Increased Gloss = Deeper Color and Better Aesthetics

Eco-Friendly Water-Based Formula = No hazardous or noxious solvents

Ease of Application = Lower Application Costs

Ease of Cleaning = Less Maintenance Costs

\*Increases paint surface resistance to oxidation, scratches, marring, dulling, bird droppings, caustic chemicals, in addition to preventing corrosion by inhibiting the absorption of water into the paint. (A little-known fact, the average car absorbs a pint of water when rained on).

\*Increases the total hardness and strength of the paint by penetrating deep into the paint and sealing the microscopic pores left behind during the drying and curing process of the post-paint application

\*ToughGuard's proprietary quartz-crystal natural properties assist to inhibit UV from penetrating into the paint system therefore extending the paint system lifespan by bonding an additional layer of UV protection deep within the paint and protecting the UV absorbers and stabilizers built into the paint system

\*Unlike other "nano" or "ceramic" coatings that chemically and physically "bond" to the surface, ToughGuard's "nano-silane" technology penetrates deep into the film-binder of the paint permanently fusing quartz-acrylic making it stronger and more resilient. This process is analogous to "calcium makes bones strong"

\*Certified a true functional nano-particle by ONAMI (Oregon NanoScience and Microtechnologies Institute).

\*ToughGuard contains NO silicones, silicone-based polymer resins such as polydimethylsiloxane (PDMS), or Teflon!

Most "ceramic" coatings on the market today use siloxanes in product formulations. Siloxanes are similar to a silane; however, they are much more complex and cannot penetrate as deep as a silane.

## **ToughGuard Nano-Silane Technology**

\*Extremely small sized molecules that have the ability to penetrate deep into a porous substrate.

\*Superior Adhesion vs. siloxane

\*Water-Resistant and extremely hydrophobic

\*High-Crosslinking and covalent bonding

\*Anti-Corrosion Properties

\*Extremely Durable compared to siloxane