



## Composite Product UV Protection White Paper

### The Facts

An unprotected polyester-fiberglass composite product, offered by any manufacturer, will deteriorate over time in the sun's strong ultraviolet light. However, when effective weathering and UV protection are incorporated into the production and finishing processes, the product lifespan can be greatly extended.

### The Shakespeare Solution

For long-life performance, Shakespeare provides triple protection from ambient ultraviolet exposure. First, during the pole and crossarm production processes, 100% of the glass-fiber strands and fiberglass mat components are saturated with UV-inhibitor-laden resins. This means that even if the resin subsurface is exposed, it will stand up to UV rays for some time. Second, for an additional layer of protection, these core materials are covered with a UV-polyester-veil barrier. Third, during the finishing process, the composite product exterior is coated with a high-performance finish. The result is a systematic approach to protection from weathering with scientifically tested, proven results.

This exceptional integration and combination of UV-barrier elements contributes to the long-life durability of Shakespeare fiberglass composite poles and crossarms. With a remarkable performance longevity of 60 years, Shakespeare composite products will not splinter and rot like wood, nor rust like metal. The specified strength factors remain intact over the product lifespan.

Frequently, our expert team is asked about product weathering. Questions often relate to the ability of fiberglass composites to withstand extremes of heat, cold, humidity, UV exposure, and other environmental factors. Since Shakespeare's founding, we have employed testing methods and a variety of technologies to quantify and greatly extend the outdoor longevity of our composite products. We scientifically test these factors in a variety of ways, in accordance with applicable ASTM standards.

### Sunlight/UV Exposure Test Results Summary

Shakespeare tests its triple-UV protection system in accordance with the American Society for Testing and Materials (ASTM) G154: Standard Practice for Operating Light and Water Exposure Apparatus for Exposure of Non-Metallic Materials using a fluorescent UV-Condensation apparatus. (See Performance Testing and Verification content for details of the test setup).

The testing equipment mimics a severe Florida-level environment. Among scientists, Florida is an internationally recognized benchmark location for outdoor exposure testing of materials, because the state's sunny, subtropical environment produces faster deterioration than northern climates.

Under these conditions, Shakespeare poles and crossarms exhibited no fiber exposure, crazing, chalking, or color change within a 2,500-hour test period. Further accelerated tests have substantiated Shakespeare products' UV weathering abilities beyond 15,000 hours.

Shakespeare has also conducted other extensive accelerated testing, including a 996-day test utilizing the EMMAQUA® sunlight concentrating machine in the Arizona desert (ASTM G90-91, Procedure B). In addition, our engineers have observed real-time, real-world weather effects on Shakespeare products that have been in service for more than 40 years.

### **Moisture/UV Exposure Test Results Summary**

Using the accelerated testing guidelines for ASTM G154, Shakespeare poles were exposed to saturated air and water vapor on one side of the specimens and cooling ambient room air on the other, further mimicking Florida's climate.

Under these conditions, the poles exhibited no fiber exposure, crazing, chalking, or color change within an accelerated 2,500-hour test period.

Experience has shown the materials initially resistant to UV alone or to moisture alone can fail when exposed to UV and moisture in combination. For this reason, the accelerated testing per ASTM G154 also includes exposure to saturated air and water vapor on one side of the specimens being tested, and exposure to cooling ambient room air on the other side.

### **The Shakespeare Composite Product Testing Process**

Shakespeare conducts extensive testing to establish and verify the performance of its products for mechanical strengths, weather qualities, and conformance to in-house standards for finish and sheen. We test the raw materials delivered by suppliers and closely monitor the manufacturing processes. Before we make claims about our products' ability to withstand weathering, we test them thoroughly and scientifically. Extensive testing is performed in house. In addition, we employ outside independent labs for additional tests.

### **Specify Product Testing Standards to Get the Product You Need**

When you compose a specification for composite poles or crossarms, we recommend you specify the performance testing you need. To make your investment pay off, composite poles and crossarms should have been tested in accordance with ASTM G154 with UVA for a minimum of 15,000 hours of accelerated UV exposure tests.

### **UV Exposure Testing**

Shakespeare maintains an in-house accelerated UV exposure testing facility that has been in continuous operation for decades. We perform accelerated weathering tests using UV lamps, concentrated sunlight, and normal sunlight in accordance with scientific standards.

## **The QUV Test**

Our engineers perform UV testing in accordance with the American Society for Testing and Materials (ASTM) G154: Standard Practice for Operating Light and Water Exposure Apparatus for Exposure of Non-Metallic Materials using a fluorescent UV-Condensation apparatus.

The primary testing equipment used by Shakespeare is the QUV Accelerated Weathering Tester made by Q-Lab. This equipment exposes samples to intense UV lamps for a four-hour on, four-hour off cycle, with sprays of water at intervals. The device is equipped with UVA lamps which have peak emission at 340nm. These lamps create one of the most severe exposures used for accelerated UV testing and mimics very highly concentrated Florida-level sunlight. Among scientists, Florida is an internationally recognized benchmark location for outdoor exposure testing of materials because the state's sunny, subtropical environment produces faster deterioration than northern climates.

QUV exposure for 1,000 hours (about 41 days), approximates one year of Florida sunshine. Our accelerated testing has been applied to coated and uncoated fiberglass specimens for more than 15,000 hours.

Unlike real sunlight, the lamp's spectrum begins to fall off after 340nm. Therefore, although the emitted spectrum comprises most of the damaging wavelengths, we also conduct tests with both concentrated and natural sunlight.

## **Concentrated Sunlight Testing**

Concentrated sunlight is another way to simulate long-term effects of weathering, and Shakespeare has contracted with independent test facilities for extensive accelerated testing using the EMMAQUA® sunlight concentrating machine in the Arizona desert (ASTM G90-91, Procedure B). This includes a 996-day test of coated and uncoated sidewall samples from Shakespeare crossarms.

The EMMAQUA system comprises a mirror system on a motorized platform that tracks the sun, just as telescopes track the stars. The result is about five times the normal exposure to sunlight. The systems also impose heating/cooling cycles and intervals of water spray to mimic weather, dew, and rain.

## **Natural Sunlight Tests**

For decades, Shakespeare has continuously tested its fiberglass products and coatings with natural sunlight at our South Carolina production facility. This test entails a rack on which samples are mounted at an angle which optimizes exposure. Such testing has been ongoing for more than 40 years. In addition, our engineers have also been observing and documenting real-time, real-world weathering on Shakespeare products that have been in service for more than 40 years.