QUV Test Results of Polyester Resin, E-glass Reinforced Utility Structure Profiles

Accelerated UV Testing for StormStrong® Utility Products

WHITE PAPER

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Contents

Prepared by:

Jeremy Mostoller
Product Design Engineer

Dustin Troutman
Corporate Director of Marketing and Product Development

Introduction

Pultruded fiberglass Reinforced Polymer (FRP) utility structures are becoming the product of choice for many electrical utilities around the globe. FRP poles and crossarms have been used to replace wood structures for well over 20 years. However, history has shown that UV light does influence the cosmetic and structural properties of FRP over time. The extent depends on climate, temperature, moisture and UV protection. Creative Composites Group, (CCG) performed an extensive study on painted and unpainted profiles. This paper describes the test methods, assumptions and results.

Investigation

CCG manufactured samples of 3.625”x4.625” heavy tangent/heavy deadend crossarms (TR410.1B2) in standard polyester resin with E-glass reinforcement. Two separate data sets were developed for the UV testing. The first data set consisted of CCG’s standard polyester crossarm without paint. The second sample consisted of the standard polyester crossarm painted with Sherwin Williams Polane S-Plus Polyurethane paint. The paint was applied per CCG’s standard paint application work instructions.

The crossarm samples were then sectioned into plates and conditioned in a QUV test chamber for a total of 8,000 hours. The QUV conditioning was conducted in accordance ASTM G154. Conditioning was programed for continuous four hour cycles of 100% humidity and four hours of UVA light. A UVA-340 lamp was used throughout the duration of the experimentation.

The control and conditioned samples were tested per ASTM D6641 (compression) and ASTM D2344 (short beam shear) methods. Samples were extracted every 2,000 hours and evaluated in terms of strength and appearance.

Hypothesis

It was hypothesized that the unpainted samples would color fade faster than the painted samples. However, it is believed that the paint would have little effect on the long term mechanical properties.

Experiment

The 3.625” wide sections of the coated and uncoated crossarm samples were extracted from the profile and placed into the QUV chamber for time periods of 2,000, 4,217, 6,000, and 8,426 hours. One set of plates was tested unconditioned to develop a baseline control for the experimentation. Upon removal from the chamber, the specimens were conditioned at room temperature and standard humidity prior to testing.

Compression and shear testing was performed with a 250 kN Instron-test machine calibrated and maintained per CCG ISO requirements.

Five specimens were tested for each conditioning period and test method. All observations were based on the average values from the five samples per the ASTM requirements.

Observations and Results

Table 1 shows the average test results that were collected from the experimentation. The following graphs show the normalized data plotted against the QUV conditioning time period.

The data indicates an increase in compression strength of the non-painted specimen of 4% and a decrease in compression strength of the painted specimen of 15.9% as compared to the control. The short beam shear strength of the non-painted specimen increased by 6%, while the painted specimen short beam shear strength increased by 2.75%.

Table 1: *Average values recorded from experimentation*

		Test Results: No Paint					
Mechanical Property	**ASTM Test Spec**	**0 Hours**	**2000 Hours**	**4000 Hours**	**6000 Hours**	**8426 Hours**	**Units**
Compressive Strength Lengthwise	D6641	112,706	1.03E+05	9.01E+04	9.76E+04	117,411	psi
SBS Strength Lengthwise	D2344	7,253	7,762	7,733	7,661	7,697	psi

		Test Results: Painted w/ Sherwin Williams Polane S+ RAL7013					
Mechanical Property	**ASTM Test Spec**	**0 Hours**	**2000 Hours**	**4000 Hours**	**6000 Hours**	**8426 Hours**	**Units**
Compressive Strength Lengthwise	D6641	112,706	112,996	95,774	90,401	94,808	psi
SBS Strength Lengthwise	D2344	7,253	7,793	7,794	7,680	7,453	psi

The data is expressed graphically in charts one and two.

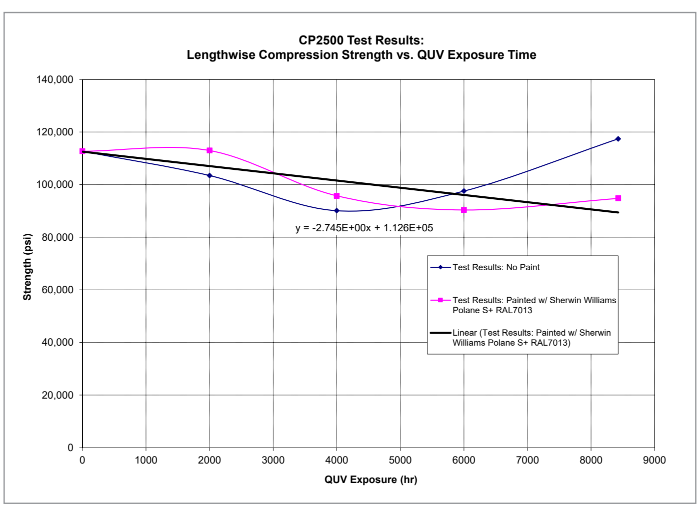

Chart 1

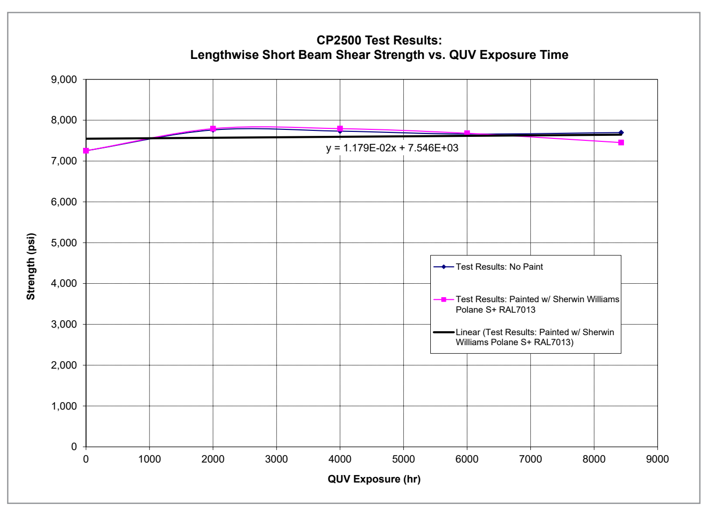

Chart 2

Table 2.0 demonstrates the Delta E values registered when each specimen was tested utilizing a spectrometer. The readings measure a change in visual perception between two colors. Any value equal to or less than 1 is not perceptible by the human eye, however, a change can be seen for any reading greater than 1. In the subsequent pictures, the color change for each specimen can be observed as it relates to the total delta E, at the various test intervals.

Table 2: *Delta values based on the spectrometer results*

Condition	Spectrometer Reading	2000 Hours	4217 Hours	6000 Hours	8422 Hours
Painted	Delta L*	0.51	1.02	2.59	5.43
	Delta A*	-0.03	0.08	-0.47	-0.57
	Delta B*	-0.71	-1.02	-1.52	-1.76
	Total Delta	0.87	1.45	3.03	5.73
Not Painted	Delta L*	2.04	5.37	4.97	6.27
	Delta A*	-0.91	-1.19	-0.88	-0.69
	Delta B*	5.18	3.19	3.67	3.96
	Total Delta	5.64	6.35	6.25	7.44

Painted Test Specimens


Control


2,000 Hours


4,217 Hours


6,000 Hours


8,422 Hours

Unpainted Test Specimens


Control


2,000 Hours


4,217 Hours


6,000 Hours


8,422 Hours

Discussions

The results suggest the coupons go through a cycle in which water absorption takes place in the near term and causes a decrease in the initial compression strength. The decrease in the initial values are eventually overcome by post curing which takes place as a result of the heat generated from the QUV cycles.

The paint appears to delay the initial water ingression timeline. Thus, the initial decrease, due to moisture uptake is shifted, as is the post cure which overcomes the initial compression strength reduction.

The trend of the compression strength is positive after 4,000 and 6,000 hours for the unpainted and painted specimens.

ABOUT THE COMPANY

Creative Composites Group is a custom design, engineering and Fiber Reinforced Polymer (FRP) fabrication provider. We offer comprehensive engineering, design and consultation for unique fabrication projects. Our manufacturing capabilities include the broadest range of engineered FRP solutions to build your ideal projects. That's possible only with our proven engineering processes, end-to-end collaboration, service and support resources. Since FRP composites last longer than conventional materials they often have a lower lifetime cost when you consider longer service life and low to no maintenance costs.

CREATIVE COMPOSITES GROUP

Creative Composites Group

214 Industrial Lane
Alum Bank, PA 15521

CreativeCompositesGroup.com

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