100 East Glenside Avenue, Glenside, PA 19038 USA http://www.solarlight.com Phone (215) 517-8700, Fax: (215) 517-8747

Accelerated Fluorescent UVA Exposure Testing of Customer Supplied Material

1/11/17

CUSTOMER INFORMATION:

Ryan Smith
RF Works Corp.

OBJECTIVE:

To expose the customer supplied materials to a one year equivalent of ultraviolet radiation similar to the incident Outdoor UV measured at a Sub-Tropical location.
The sample types are colored foam materials used in boat upholstery.

EXECUTIVE SUMMARY:

The samples were exposed to approximately one year of outdoor sun ultraviolet. Blocking strips were applied to highlight the presence of fading of the materials. After 1061 hours, there was no discernable fading of the materials.

Measurements performed by:
Drew Hmiel

OBJECTIVE

To expose the customer supplied material to an equivalent of up to 1 year of ultraviolet radiation similar to the incident Outdoor UV from sunlight at a Sub-Tropical location using a fluorescent simulator at nominal temperature and humidity.
The sample types are: 10 samples of boat upholstery.

The investigation is to apply fluorescent UV for 550 and 1100 hours, with photographic records of the materials at the waypoints.

TEST AND MEASUREMENT EQUIPMENT

Custom Solar Light Co. UVA&B Outdoor Fluorescent Simulator Shelf Unit #003
Solar Light Co. model PMA2100 dual channel datalogging radiometer serial number **4339**
Solar Light Co. model PMA2101 UVA+B detector serial number **12250**
UVT-1 Temp. / Humidity Datalogger
CANON digital camera

TEST SETUP

The Custom Fluorescent Simulator was configured to produce UVA+B radiation of approximately 3.1 MED/hr. The ***UVA-340*** fluorescent lamp's light spectrum is a spread of light energy around the UVA and UVB wavelengths of 300 - 400 nm. See Appendix B. The output of the simulator was measured at 5 cm intervals and recorded with the PMA2101 UVA+B detector. The UVA+B detector has an Erythema weighted response. See Appendix C, Figure C1.

In this test UVA and B will be used in simulating the outdoor exposure, in addition the lamps also generate a small fraction of visible light. Successful simulations on several materials have shown the efficacy of this approach.

The Test Protocol that was followed is an adaptation of ASTM D4329 where exclusively UVA+B lamps were used in a linear configuration. The SUV lamps were arranged as a set of six in one plane with reflective panels on four sides of each shelf.

TEST DATA

per ASTM 4329

9.1.1	Type and model of exposure device	Custom Solar Light Co. UVAB Outdoor Fluorescent Simulator Shelf Unit #003
9.1.2	Age of lamps used at the start of the exposure, and whether any lamps were changed during the exposure	Lamps ages were approximately 500 hours
9.1.3	Irradiance in W/m^2nm or radiant exposure in J/m^2 at the sample plane and the measurement wavelength region	Total UVA&B Irradiance 3.1 MED/hr Exposure 3243 MED
9.1.4	Elapsed exposure time	1062 Hours
9.1.5	Light and dark water condensation or humidity cycle	100 % Light
9.1.6	Operating black panel temperature	**Avg. Min Max** **21.6 12.0 26.5**
9.1.7	Operating relative humidity	**Avg. Min Max** **14.3 8.5 27.0**
9.1.8	Type of spray nozzle, if used	N/A
9.1.9	Specimen repositioning procedure	At each term junction mixed randomly
9.1.10	Results of property tests	See below

A cosine corrected detector[1] was used to create a mapping of the UVA+B irradiance at the indicated height. The test articles were arranged 14 cm from the lamps.
The samples were exposed to approximately one year of outdoor sun ultraviolet.

	Event Time		Equiv. Months	
Start	**11/14/16 17:10**			
	11/18/16 15:10	96	1.1	
	11/28/16 14:30	335	3.8	
	12/05/16 18:30	507	5.7	
	12/20/16 12:50	791	9	
End	**01/04/17 16:06**	1062	12	

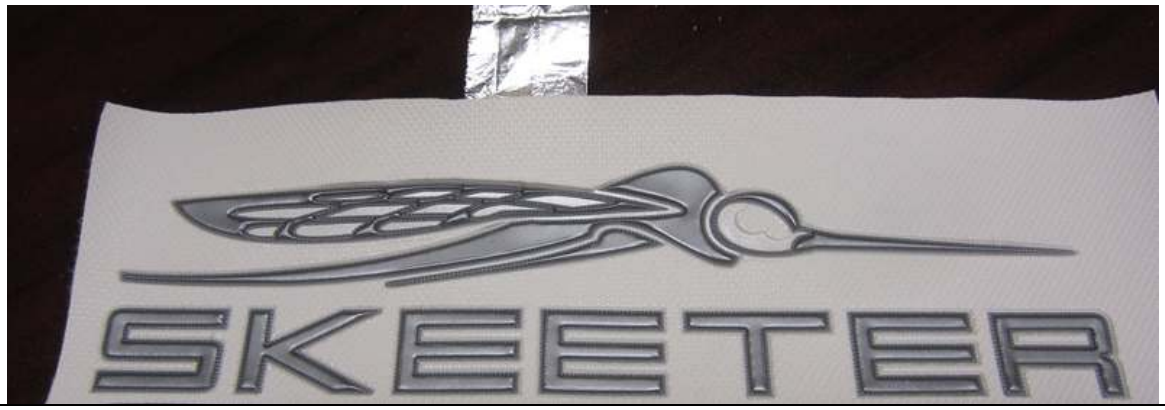
RESULTS

As the photographic evidence shows, across the surfaces of the samples, there were no apparent color changes. Al Foil strips were placed over an area on each sample, and no 'shadow' was formed by fading or color change.

[1] Solar Light PMA 2101 UVA+B detector, SN **12250**

PHOTO SURVEY

AT 5.7 YEARS



AT 5.7 YEARS

AT 5.7 YEARS

12 Months Equivalent

12 Months Equivalent

12 Months Equivalent

APPENDIX A

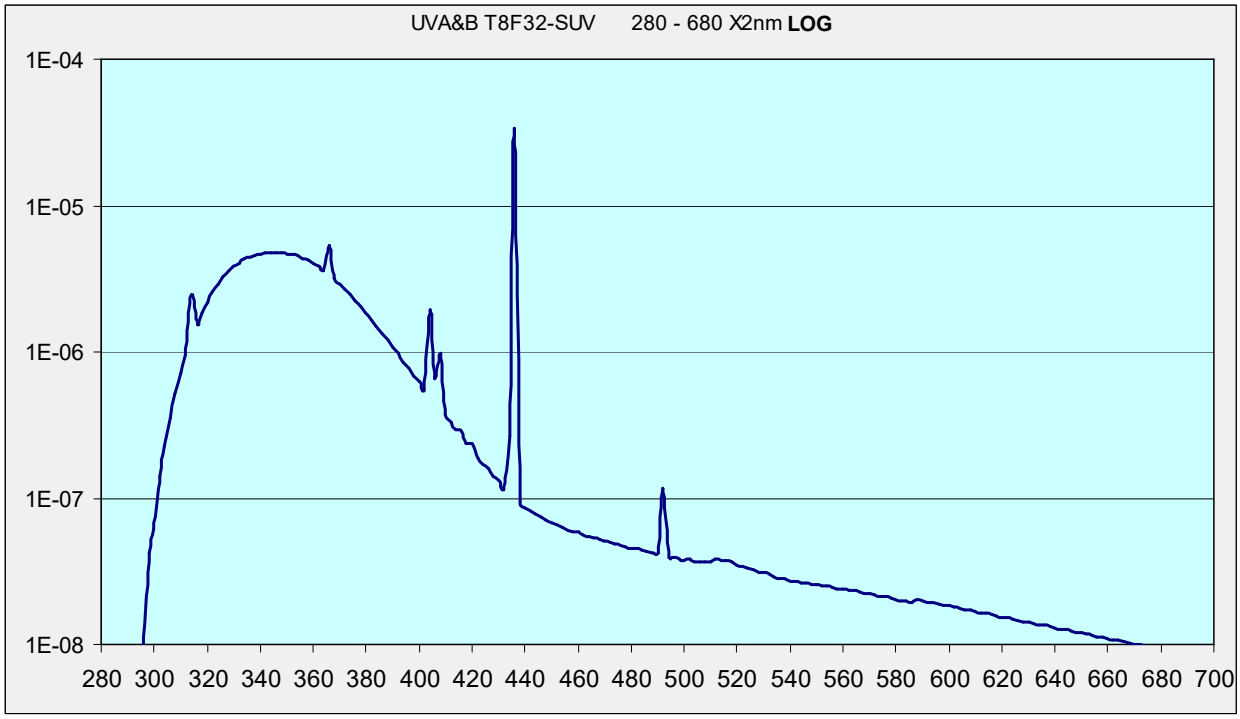


Fig. A1 - UVA + B Fluorescent Lamp power spectrum

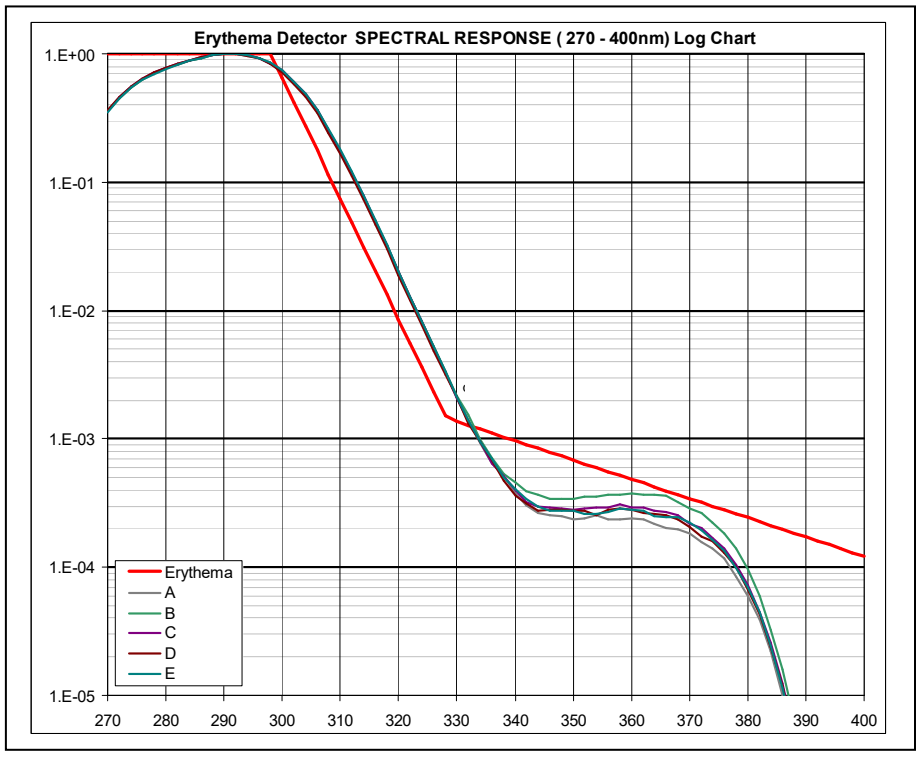


Fig. A2 - Erythema Weighted UVA+B Detector Response

REFERENCES

ASTM G154 specification: "**Standard Practice for Operating Fluorescent Light Apparatus for Exposure of Non-Metallic Materials**." ASTM, 100 Bar Harbor Dr., Wes t Conshohocken, PA 19428

ASTM G151 specification: "**Standard Practice for Exposing Non-Metallic Materials in Accelerated Test Devices that use Laboratory Light Sources**." ASTM