



INDUSTRIAL TESTING LABORATORY

Report No. 090813-02J

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TEST REPORT

Report Date: 02 September 2009
Project Name: Aura 104 Engineering Grade 12 month Florida Weathered Retroreflective Sheeting (Type I)
Submitted by: Aura Optical Systems Southlake, TX 76092
Test Laboratory: Calcoast - ITL Emeryville, CA 94608
Products Tested: Aura 104 Engineer Grade, 2 exposed panels each: White (Lot # 700T07120203W, sample #s 4 & 9) Yellow (Lot # 700T07101801Y, sample #s 2 & 6) Green (Lot # 700T07120303G, sample #s 1 & 5) Red (Lot # 700T08070603R, sample #s 4 & 9) Blue (Lot # 700T07120601B, sample #s 1 & 5)

SUMMARY

Specification: ASTM D4956-07e1
Sheeting Type I, Class 1 Backing

- 6.2 Coefficient of Retroreflection ...Not Tested
6.3 Daytime Color and Luminance ...Not Tested
6.4 Outdoor Weathering (Florida Only) ...Passed
6.5 Colorfastness ...Passed
6.6 Shrinkage ...Not Tested
6.7 Flexibility ...Not Tested
6.8 Liner Removal ...Not Tested
6.9 Adhesion ...Not Tested
6.10 Impact Resistance ...Not Tested
6.11 Specular Gloss ...Not Tested
6.12 Nighttime Color ...Informational Only

Written by: Douglas G. Cummins Photometric Engineer

Approved by: Mark A. Evans Laboratory Director

TEST DATA SHEET

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Retroreflective Sheeting (Type I)

6.4 Accelerated Outdoor Weathering

Requirement: 50% of ASTM D4956 Table 5 (Type I), 0.2° observation only
Test Method: ASTM E810, G7

Exposed samples supplied by Q-Labs on 6" x 12" aluminum panels. The top and bottom of each panel was masked leaving a center 6" x 6" exposed area for testing. Coefficient of Retroreflection (R_A) measured at two orientation angles ($\varepsilon=0^\circ$ and $\varepsilon=90^\circ$) and averaged. $\varepsilon=0^\circ$ indicated on samples and is with long axis of panel inline with projector/detector half-plane.

Florida, 12 month exposure (Homestead, Florida); July 31, 2008 to July 31, 2009
Q-Lab Weathering Research Service Test Program Number: ARA-1-TP-1

Entrance Angle:		-4°				+30°			
Prod.	Sample	0°	90°	Avg.	Min R_A	0°	90°	Avg.	Min R_A
White	4	97.0	96.8	96.9	35	52.1	55.2	53.7	15
	9	92.6	92.0	92.3		47.8	51.6	49.7	
	Average	94.8	94.4	94.6		50.0	53.4	51.7	
Yellow	2	45.3	45.1	45.2	25	19.9	22.5	21.2	11
	6	57.3	57.4	57.4		30.2	30.3	30.3	
	Average	51.3	51.3	51.3		25.1	26.4	25.7	
Green	1	10.2	10.1	10.2	4.5	5.3	5.9	5.6	1.8
	5	11.5	11.5	11.5		6.6	7.3	7.0	
	Average	10.9	10.8	10.8		6.0	6.6	6.3	
Red	4	16.2	16.2	16.2	7.0	9.8	10.3	10.1	3.0
	9	17.8	17.7	17.8		10.9	11.6	11.3	
	Average	17.0	17.0	17.0		10.4	11.0	10.7	
Blue	1	7.5	7.5	7.5	2.0	3.9	4.4	4.2	0.9
	5	7.0	7.0	7.0		3.8	4.1	4.0	
	Average	7.3	7.3	7.3		3.9	4.3	4.1	

Samples show no appreciable cracking, scaling, pitting, blistering, edge lifting, or curling, or more than $1/32$ " shrinkage or expansion.

Samples meet Accelerated Outdoor Weathering requirements.

TEST DATA SHEET

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6.5 Colorfastness

Requirement: ASTM D4956 Tables 6 and 17 (Type I Sheeting)

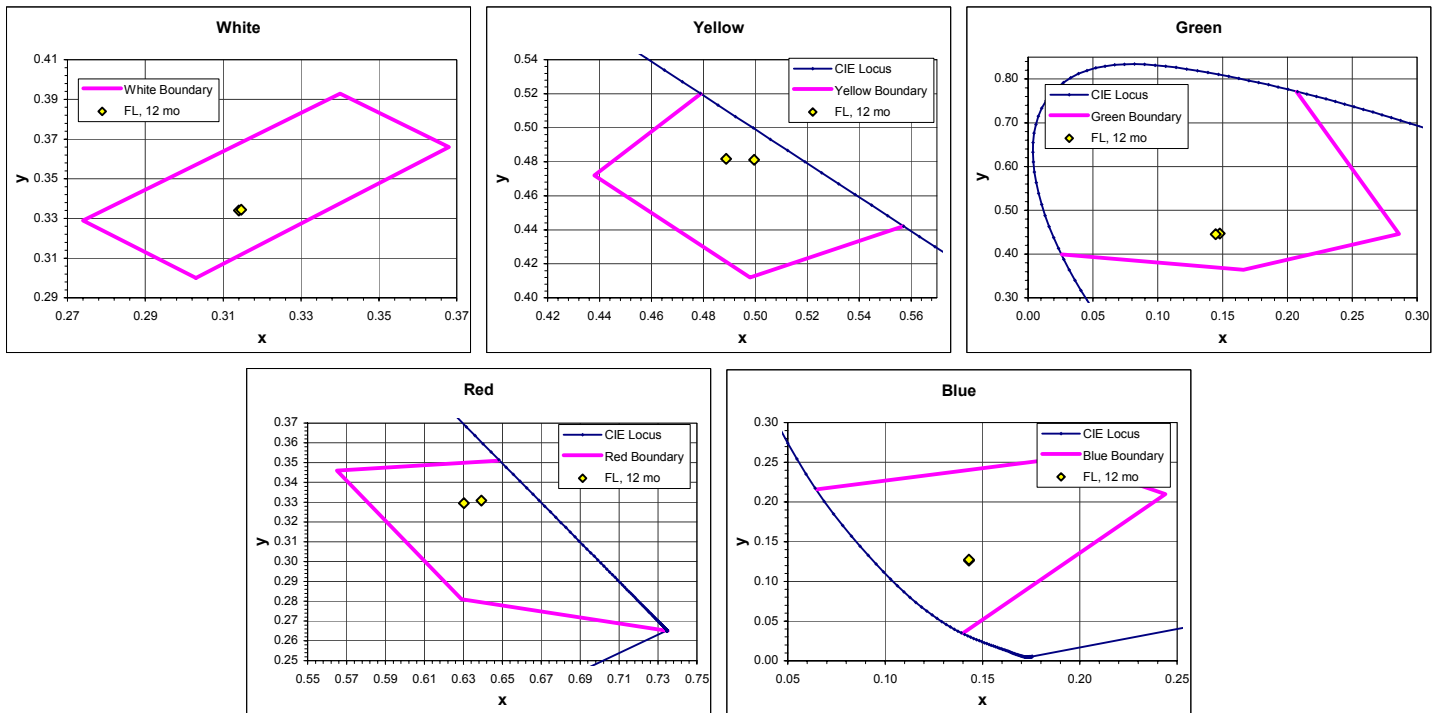
Test Method: ASTM E308, E1347, E1349, E991, E1164
 (Illuminant D65, 2° Observer, Annular 45/0 Geometry)
 Average of 8 reads, each read oriented 45° apart

Instrument: Hunterlab Colorflex A60 Spectrocolorimeter (No SCF available)

Florida, 12 month exposure

Sample		x	y	Y		
				Measured	Minimum	Maximum
White	4	0.3140	0.3340	45.04	27	-
	9	0.3146	0.3344	43.24		
Yellow	2	0.4996	0.4811	33.21	15	45
	6	0.4888	0.4817	34.20		
Green	1	0.1478	0.4472	8.98	3.0	9.0
	5	0.1446	0.4453	8.87		
Red	4	0.6393	0.3309	9.25	2.5	12
	9	0.6303	0.3295	9.67		
Blue	1	0.1430	0.1261	4.32	1.0	10
	5	0.1430	0.1274	4.45		

Samples meet Colorfastness requirements.



TEST DATA SHEET

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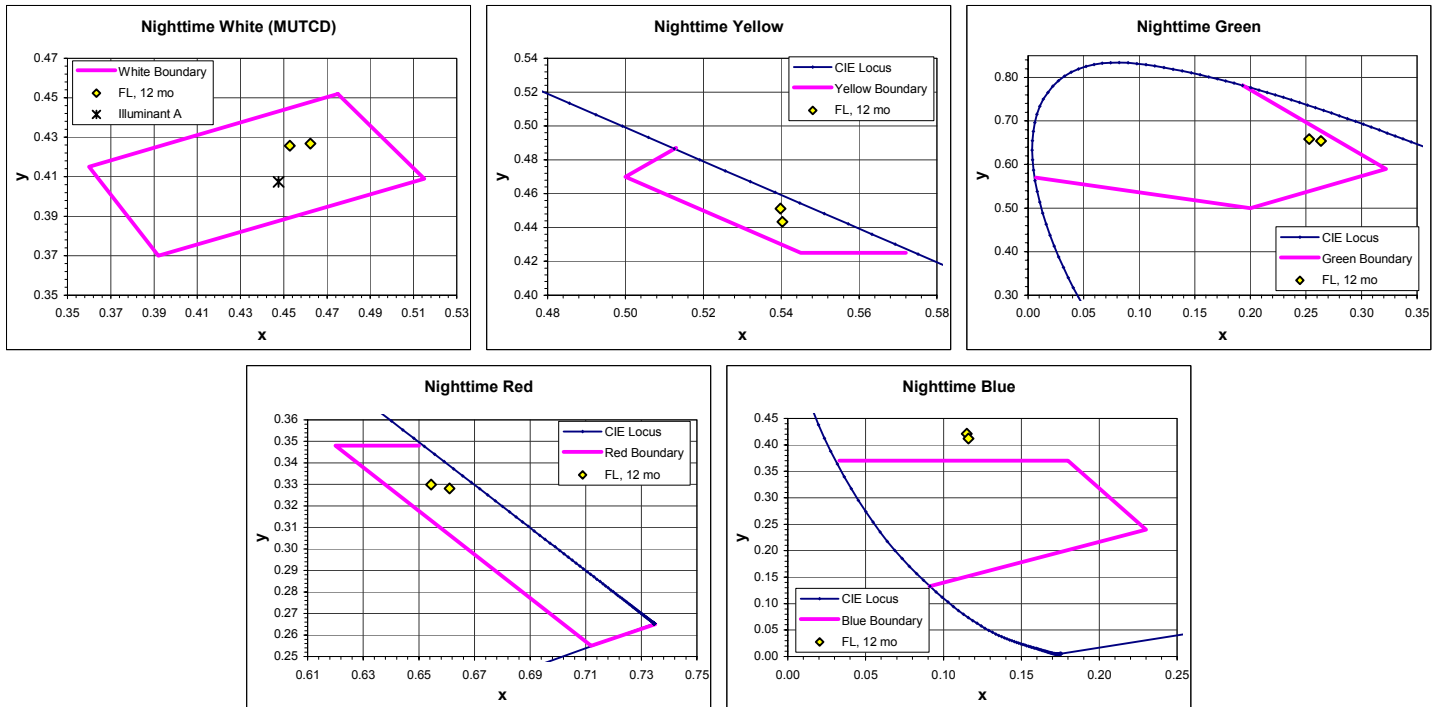
6.12 Nighttime Color

Requirement: ASTM D4956 Table 18
 Test Method: ASTM E811, E308
 (Illuminant A, 2° Observer, +5°/0.33° Geometry at 10 feet)
 Average of 3 reads
 Instrument: Photo Research PR-650 Spectroradiometer

Product	Florida, 12 month	
	x	y
White	0.4623	0.4268
	0.4528	0.4257
Yellow	0.5398	0.4512
	0.5403	0.4433
Green	0.2635	0.6541
	0.2529	0.6585
Red	0.6610	0.3281
	0.6544	0.3299
Blue	0.1149*	0.4210*
	0.1160*	0.4120*

* - color outside chromaticity boundary limits

Note: D4956 has no White requirements; using MUTCD White requirements.
 All other color requirements identical to MUTCD requirements.

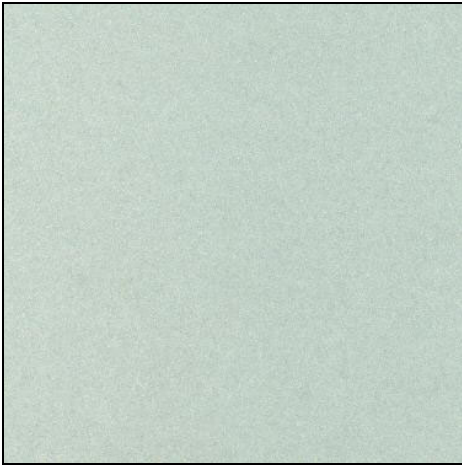


Note: ASTM D4956 does not specify a nighttime colorfastness nor nighttime color measurements for weathered samples. Calcoast - ITL does perform the measurement for sake of completeness, but typically will not fail a product when its weathered sample does not meet nighttime color requirements.

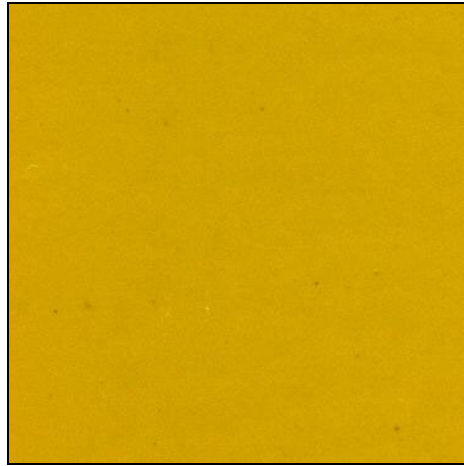
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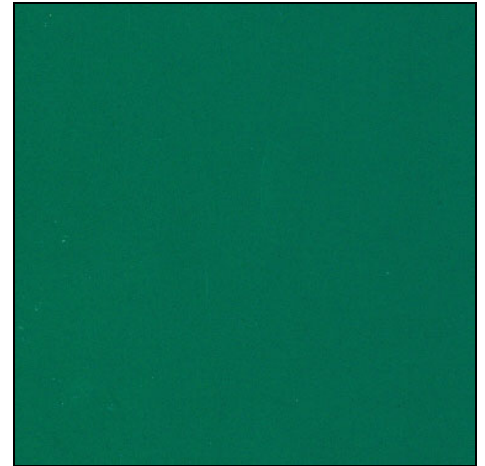
Photographs



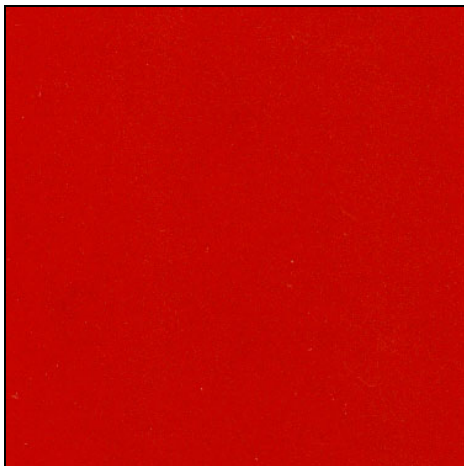
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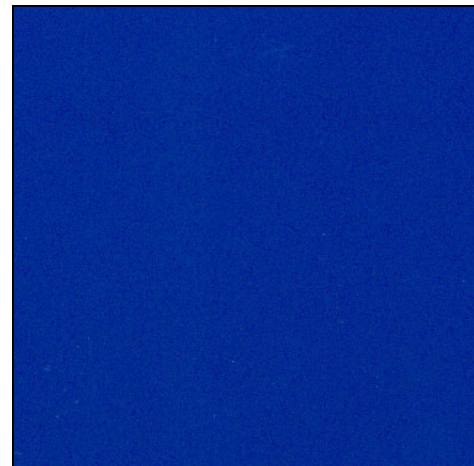
Yellow



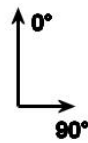
Green



Red



Blue



Sheeting Orientation