



## LM-79-08 Test and ISTMT Report

for

**A.L.P. Lighting Components, Inc.**

6333 Gross Point Road, Niles, IL 60714

**2x2 LED Recessed Interior Luminaires**

**Model: ELNV22-3750-1**

**Laboratory: Leading Testing Laboratories**

**NVLAP CODE: 200960-0**

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Report No.: HZ15070025g/R1

This report is replaced the old report No. HZ15070025g dated Sep. 08, 2015

The laboratory that conducted the testing detailed in this report has been accredited for SSL by NVLAP.

Review by:

Engineer: April Zou  
Nov. 12, 2015

Approved by:



Manager: Jim Zhang  
Nov. 12, 2015

Note: This report does not imply product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

## Test Summary

Sample Tested: **ELNV22-3750-1**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
91.5	2625.9	28.69	0.9944
CCT (K)	CRI	Stabilization Time (Light & Power)	
5274	84.4	60	

Table 1: Executive Data Summary

### Test specifications:

<b>Date of Receipt</b>	: Jul. 15, 2015
<b>Date of Test</b>	: Jul. 29, 2015 to Sep. 02, 2015
<b>Test item</b>	: Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters
<b>Reference Standard</b>	: IESNA LM-79-2008 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products ANSI/UL 8750-2011 Light Emitting Diode (LED) Equipment for Use in Lighting Products ANSI/UL 1598-2010 Standard for Safety of Luminaire

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## Sample Photo



Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: 2x2 LED Recessed Interior Luminaires
<b>Model</b>	: ELNV22-3750-1
<b>Brand Name</b>	: A.L.P Lighting
<b>Electrical Ratings</b>	: AC120~277V, 50/60Hz, 37W
<b>Product Description</b>	: 2x2 Panel Light, 5000K, Dimmable Driver: PIFC-C201R (Consist of PIFC-C201B with Resistor 511 Ohm) Manufacturer of light source: LG Model of light source: LGITLED1-28-50K Quantity of light source: 56pcs
<b>Manufacturer</b>	: A.L.P. Lighting Components, Inc.
<b>Address</b>	: 6333 Gross Point Road, Niles, IL 60714

## TEST RESULTS

Test ambient temperature was 25.2°C.

Sample orientation was light down. Test was conducted without a dimmer in the circuit.

The stabilization time of the sample was 60 minutes, and the total operating time including stabilization was 95 minutes.

The photometric distance of Goniophotometer is 30m.

Luminous data was taken at 0.5°vertical intervals and 10°horizontal intervals.

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.240	0.114
Power Factor	0.9944	0.9262
Test Power (W)	28.69	29.11
Off-State Power (W)	0	0
THD A%	6.23	17.95
Luminous Efficacy (lm/W)	91.5	90.2
Total Luminous Flux (lm)	2625.9	2626.4
Color Rendering Index (CRI)	84.4	
R9	12	
Correlated Color Temperature (CCT) (K)	5274	
Chromaticity (Chroma x, Chroma y)	(0.3379, 0.3469)	
Chromaticity (Chroma u, Chroma v)	(0.2084, 0.3209)	
Chromaticity (Chroma u', Chroma v')	(0.2084, 0.4813)	
Duv	0.0006	
Average Beam Angle (°)	106.7	
Center Beam Candle Power (cd)	984	
Spacing Criteria	1.21 (0°-180°)/ 1.21 (90°-270°)	
Zonal Lumens in the 0°-60°Zone	80.11%	
Zonal Lumens in the 60°-90°Zone	19.64%	
Zonal Lumens in the 90°-120°Zone	0.14%	
Zonal Lumens in the 120°-180°Zone	0.11%	

Special Rendering Indices	Color
R1	83
R2	89
R3	93
R4	85
R5	84
R6	85
R7	87
R8	69
R9	12
R10	74
R11	85
R12	69
R13	84
R14	96

Table 2 Test data per Goniophotometer Method

Note: According to CIE 1976 (u', v') diagram,  $u' = u = 4x/(-2x+12y+3)$ ,  $v' = 3v/2 = 9y/(-2x+12y+3)$ .

### Spectral Power Distribution

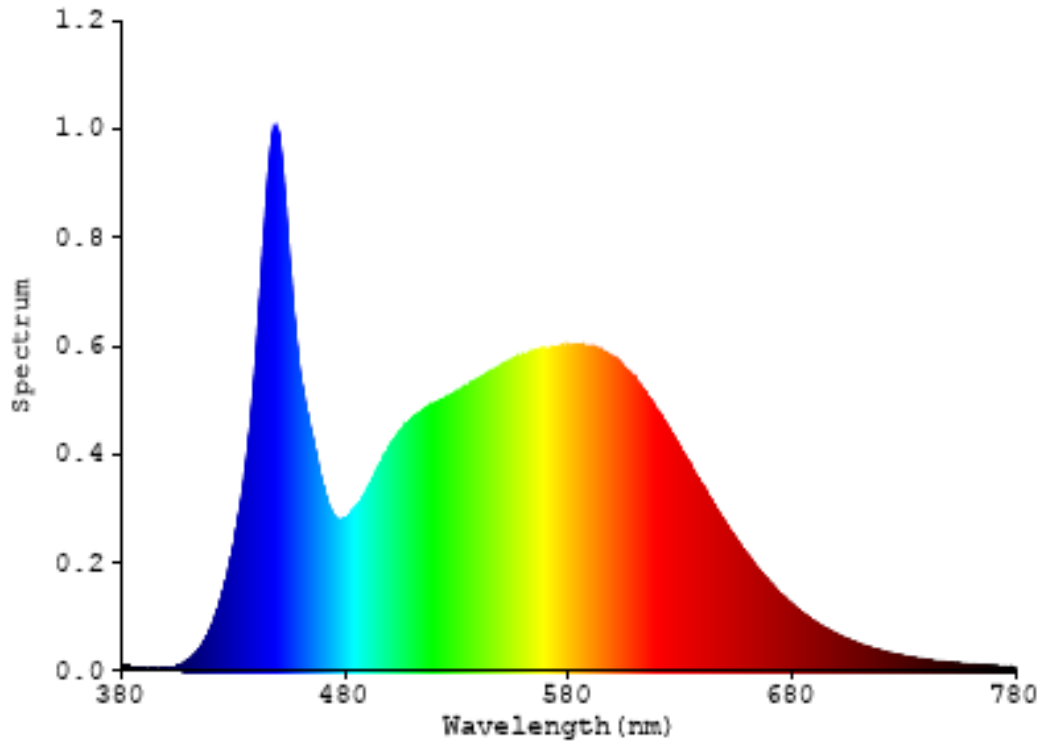


Chart 1: Spectral Power Distribution

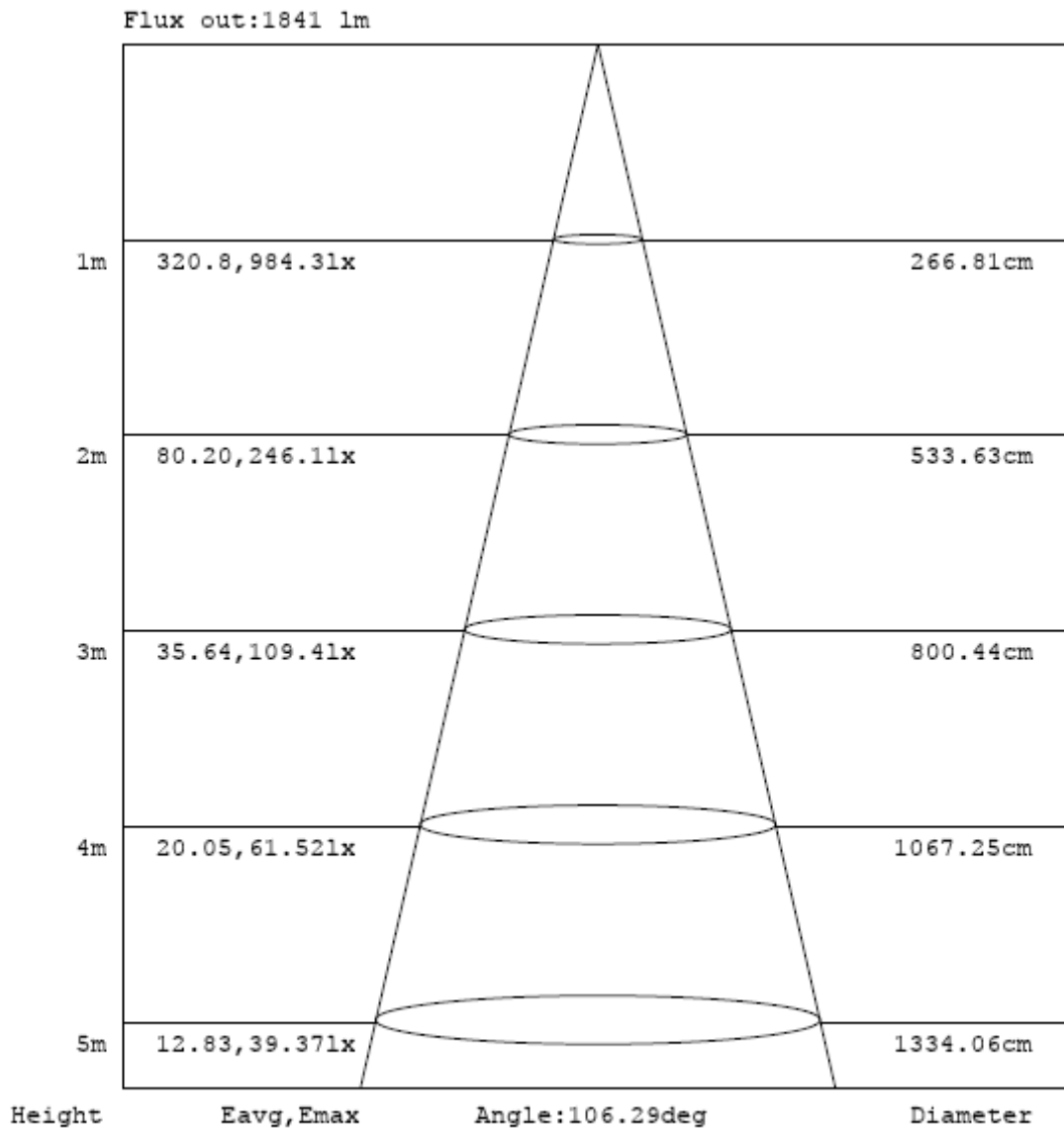
### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	92.892	3.54%
10- 20	263.578	10.04%
20- 30	392.813	14.96%
30- 40	464.127	17.68%
40- 50	471.805	17.97%
50- 60	418.301	15.93%
60- 70	312.587	11.90%
70- 80	170.012	6.47%
80- 90	33.291	1.27%
90-100	1.247	0.05%
100-110	1.374	0.05%
110-120	1.072	0.04%
120-130	0.821	0.03%
130-140	0.679	0.03%
140-150	0.546	0.02%
150-160	0.386	0.01%
160-170	0.247	0.01%
170-180	0.083	0.00%
Total	2625.9	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	2103.516	80.11%
60- 90	515.89	19.64%
0-90	2619.406	99.75%
90- 180	6.455	0.25%
0- 180	2625.9	100%

Table 3: Zonal Lumen Data

### Illuminance Plots



Note: The Curves indicate the illuminated area and the average illumination when the luminaire is at different distance.

Chart 2: Beam angle



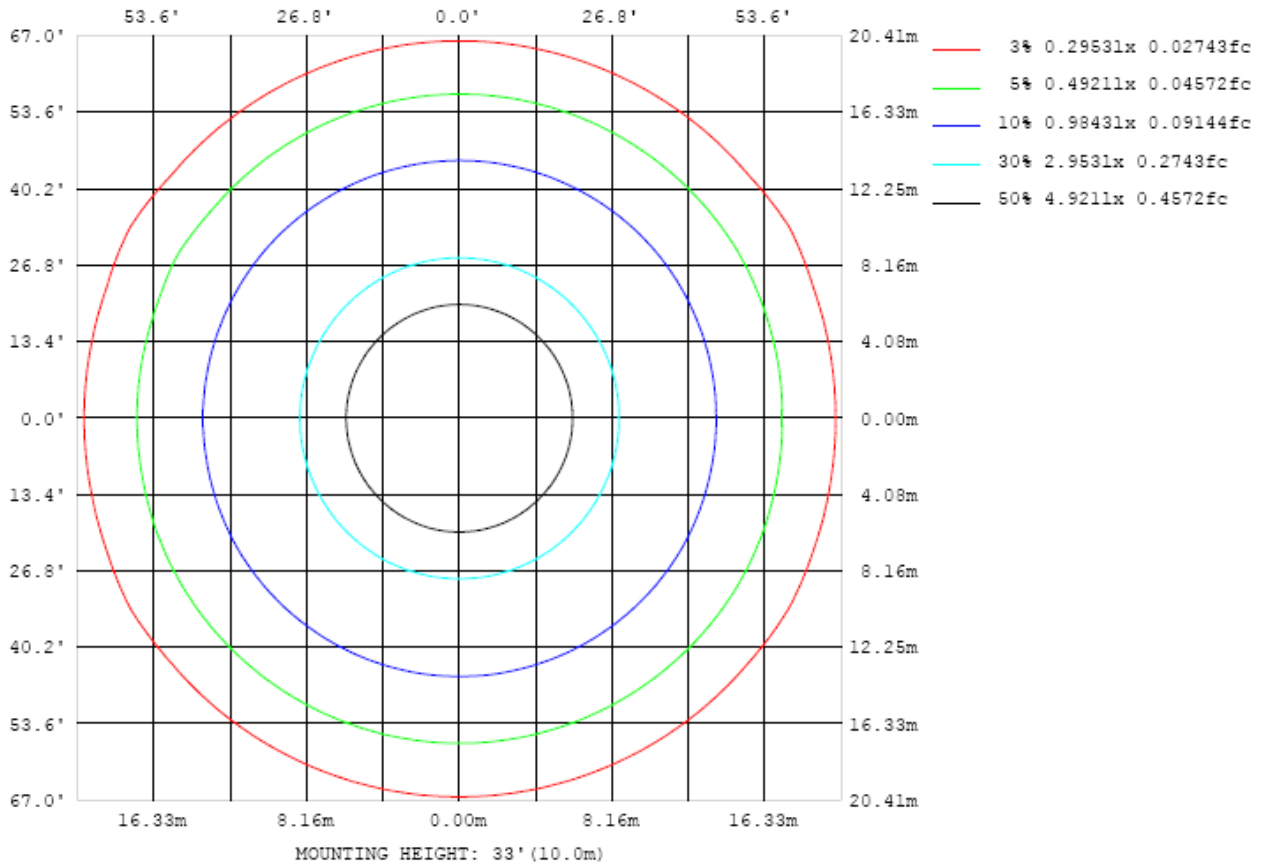


Chart 3: Illuminance Plot (Footcandles)

### Luminous Intensity Distribution Plots

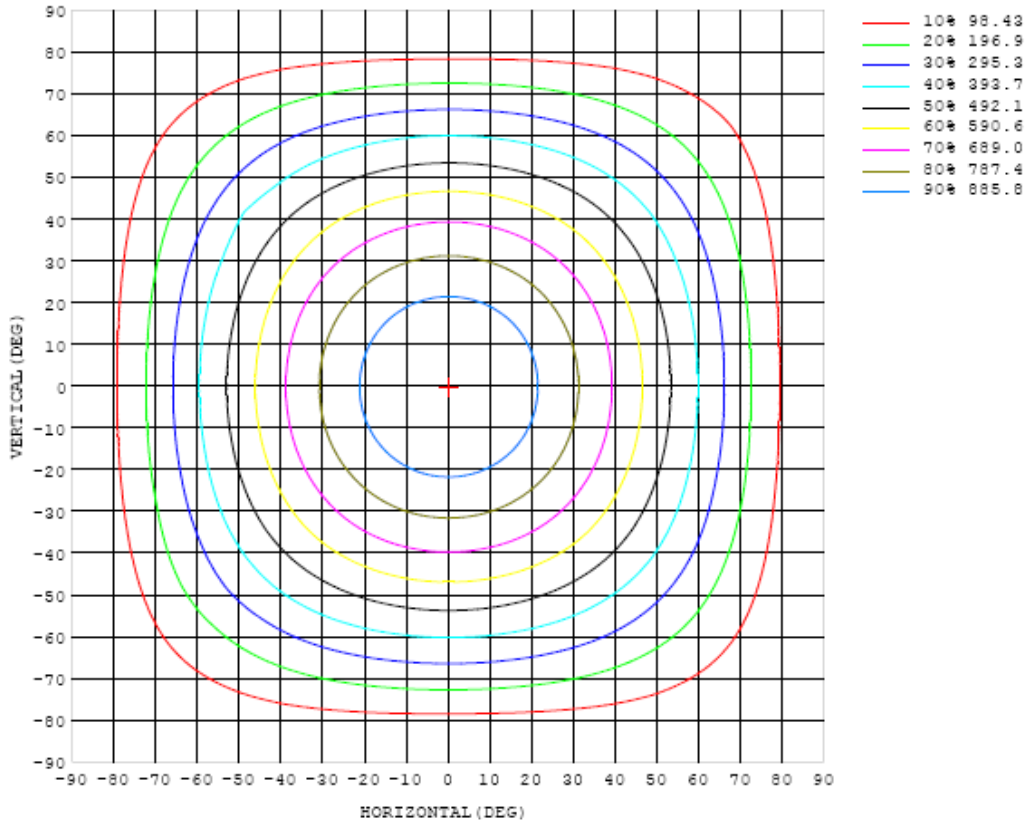


Chart 4: Isocandla Plot

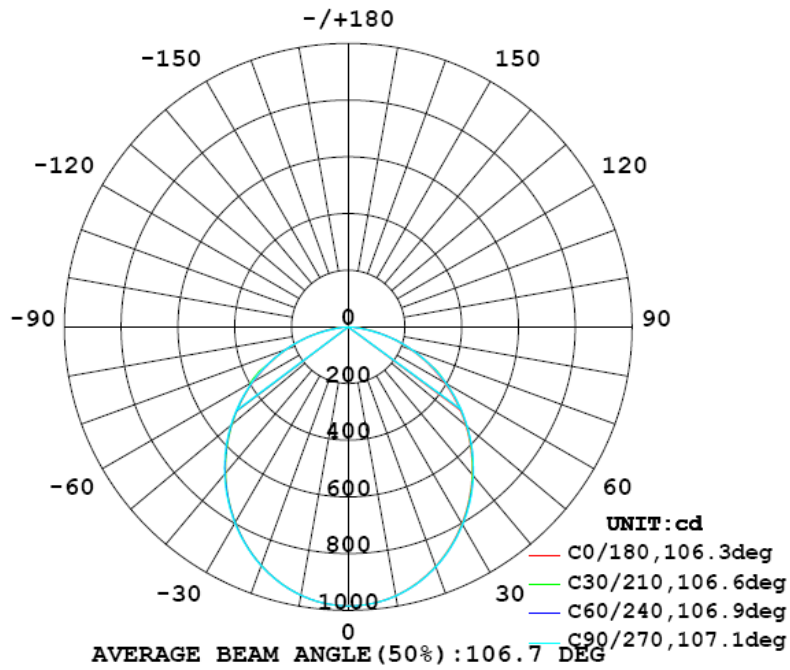


Chart 5: Polar Candela Distribution

### Luminous Intensity Data

Table--1 UNIT: cd

C (DEG) \ y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984
5	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	978
10	962	963	963	963	963	963	963	964	963	963	963	963	963	963	962	962	962	962	961
15	935	935	936	936	937	937	937	937	937	937	937	937	936	936	935	935	934	934	933
20	899	899	899	900	900	901	901	901	901	901	901	901	900	899	898	898	897	896	896
25	854	854	854	855	855	856	856	857	857	857	857	856	855	854	853	852	851	850	850
30	801	802	802	803	803	804	804	805	806	806	805	804	803	801	800	799	798	797	797
35	743	743	744	744	745	746	747	748	749	749	748	747	745	743	741	740	739	738	738
40	679	679	680	681	682	684	685	686	686	686	686	685	683	681	678	676	675	674	674
45	612	612	613	614	616	617	618	618	619	619	618	617	616	614	612	609	607	606	606
50	541	541	542	544	546	547	547	548	548	548	548	546	545	543	542	540	537	536	536
55	467	468	469	473	473	473	474	474	474	474	474	473	472	470	469	468	464	462	462
60	390	391	395	397	397	398	398	398	398	398	398	397	396	395	394	392	390	386	387
65	313	314	318	321	320	320	320	320	319	319	319	319	319	318	317	325	313	309	309
70	235	237	249	241	247	242	242	241	241	241	241	241	241	240	244	237	244	231	232
75	160	162	166	165	165	165	165	164	162	162	162	164	164	163	162	162	159	157	158
80	90.1	91.9	93.4	92.9	92.6	88.8	82.5	77.4	74.1	73.1	74.4	78.5	83.5	88.4	90.1	89.5	91.7	88.1	88.6
85	28.2	29.3	30.1	27.0	24.3	22.3	21.3	21.3	21.1	20.8	20.8	20.6	20.4	21.6	23.4	27.2	28.2	27.3	27.9
90	1.12	1.57	1.25	1.04	0.89	0.68	0.48	0.30	0.17	0.24	0.22	1.27	0.42	0.65	0.79	0.85	0.94	2.37	1.05
95	1.47	1.94	1.72	1.43	1.23	0.93	0.66	0.39	0.19	0.16	0.22	0.44	0.79	1.06	1.33	1.46	1.76	1.96	1.60
100	1.89	2.93	2.17	1.54	1.29	1.20	0.71	0.42	0.26	0.21	0.27	0.43	0.75	1.06	1.48	1.48	1.88	1.84	1.61
105	1.52	2.65	1.63	1.36	1.33	1.03	0.71	0.44	0.32	0.26	0.34	0.43	0.70	1.05	1.31	1.40	1.68	2.52	1.77
110	1.50	2.10	1.66	1.87	1.19	0.91	0.84	0.46	0.35	0.35	0.39	0.50	0.62	0.93	1.29	1.61	1.59	2.36	1.61
115	1.38	1.59	1.92	1.14	1.66	0.93	0.66	0.56	0.44	0.46	0.48	0.57	0.63	1.24	1.24	1.19	1.83	1.63	1.45
120	1.30	1.45	1.34	1.09	1.06	0.86	0.66	0.60	0.50	0.53	0.55	0.56	0.71	0.81	0.97	1.44	1.42	1.49	1.33
125	1.16	1.28	1.23	1.04	0.89	0.85	0.75	0.57	0.54	0.54	0.56	0.56	0.73	0.84	0.90	0.90	1.18	1.39	1.08
130	1.04	1.14	1.21	1.08	0.88	0.79	0.78	0.58	0.59	0.60	0.60	0.56	0.73	0.80	0.87	1.08	1.31	1.17	1.17
135	1.17	1.13	1.11	0.99	0.96	0.86	0.71	0.56	0.59	0.62	0.62	0.60	0.64	0.84	1.00	1.31	1.09	1.01	1.17
140	1.09	1.09	1.04	1.03	0.97	0.88	0.69	0.75	0.64	0.67	0.66	0.69	0.68	0.70	0.91	1.05	1.17	0.96	1.07
145	1.06	1.02	1.08	1.01	0.89	0.74	0.69	0.76	0.69	0.71	0.73	0.78	0.68	0.74	0.76	0.91	1.06	1.00	1.07
150	1.04	0.99	1.05	0.97	0.80	0.77	0.80	0.79	0.75	0.73	0.76	0.80	0.85	0.76	0.78	0.79	0.78	0.73	0.82
155	0.88	0.91	0.83	0.81	0.78	0.73	0.84	0.81	0.78	0.78	0.80	0.83	0.89	0.80	0.83	0.86	0.87	0.75	0.75
160	0.83	0.79	0.80	0.82	0.92	0.92	0.83	0.79	0.83	0.79	0.81	0.88	0.91	0.93	0.95	0.83	0.72	0.75	0.86
165	0.96	0.91	0.88	0.94	0.95	0.84	0.83	0.83	0.82	0.80	0.83	0.84	0.85	0.91	0.91	0.90	0.85	0.86	0.91
170	0.90	0.89	0.85	0.85	0.86	0.84	0.84	0.87	0.85	0.80	0.78	0.80	0.83	0.89	0.85	0.81	0.85	0.87	0.88
175	0.97	0.94	0.92	0.91	0.89	0.85	0.83	0.80	0.75	0.74	0.80	0.84	0.85	0.84	0.84	0.85	0.90	0.97	0.97
180	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89

Table 4: Luminous Intensity Data

Table--2 UNIT: cd

C (DEG) \ y (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984		
5	978	978	978	978	978	978	978	978	978	978	978	978	978	979	979	979	979		
10	961	961	961	961	961	961	961	961	961	961	961	961	962	962	962	962	962		
15	933	933	933	933	933	933	934	934	934	934	934	934	934	935	935	935	935		
20	896	895	895	895	896	896	897	897	897	897	897	897	898	898	898	898	898		
25	850	849	849	849	850	850	851	851	852	852	852	852	852	852	852	853	853		
30	797	796	796	796	797	797	798	799	800	800	799	799	799	800	800	800	801		
35	737	737	737	737	738	739	740	741	742	742	741	741	741	741	741	742	742		
40	673	673	673	673	674	675	677	678	679	679	678	678	678	678	678	678	679		
45	606	605	605	606	607	609	610	611	612	612	612	611	611	611	610	611	611		
50	535	535	535	536	537	538	539	540	541	541	541	541	541	541	540	540	541		
55	462	462	463	464	465	465	466	467	467	468	467	468	468	469	468	467	467		
60	386	387	399	389	389	389	390	391	391	391	391	392	393	394	395	391	391		
65	308	310	314	313	313	313	312	313	313	313	314	315	316	316	322	315	313		
70	232	243	234	240	236	235	234	234	235	235	236	237	238	244	238	248	237		
75	158	162	159	159	159	159	157	156	155	156	159	161	162	162	165	165	163		
80	88.9	90.7	88.4	87.8	83.6	77.3	73.3	70.9	70.5	71.4	74.5	79.6	87.1	90.8	91.8	96.4	92.7		
85	28.2	28.9	26.8	23.9	21.6	21.2	21.1	21.0	20.7	20.9	20.8	20.8	22.7	24.4	28.5	29.7	30.0		
90	1.45	1.32	1.06	1.08	0.90	0.70	0.45	0.26	0.25	0.27	0.44	0.70	0.90	1.00	1.29	1.34	1.78		
95	2.16	2.08	1.79	1.58	1.22	0.87	0.56	0.36	0.32	0.36	0.57	0.86	1.19	1.40	1.94	1.96	2.16		
100	3.15	3.44	1.66	1.51	1.45	0.90	0.60	0.45	0.40	0.46	0.62	0.94	1.26	1.40	1.85	3.50	2.94		
105	2.50	1.90	2.11	1.52	1.18	0.89	0.63	0.52	0.46	0.53	0.64	0.96	1.34	1.45	2.33	1.92	3.10		
110	2.28	2.07	1.44	1.51	1.10	0.78	0.64	0.53	0.49	0.54	0.67	0.85	1.11	1.61	1.59	2.12	2.30		
115	1.75	1.74	1.26	1.24	0.93	0.74	0.65	0.55	0.53	0.59	0.69	0.76	1.13	1.24	1.38	1.95	1.85		
120	1.62	1.45	1.19	1.06	0.90	0.71	0.58	0.54	0.55	0.62	0.62	0.77	0.89	1.06	1.34	1.44	1.59		
125	1.29	1.24	1.01	0.95	0.82	0.73	0.55	0.53	0.54	0.58	0.57	0.77	0.86	0.92	0.93	1.31	1.34		
130	1.17	1.12	1.07	0.87	0.81	0.75	0.54	0.58	0.60	0.62	0.57	0.74	0.83	0.91	1.08	1.14	1.19		
135	1.18	1.02	1.00	0.99	0.85	0.68	0.60	0.61	0.63	0.64	0.63	0.70	0.92	1.01	1.08	1.11	1.01		
140	1.07	1.04	1.02	0.94	0.80	0.71	0.71	0.70	0.69	0.69	0.78	0.69	0.90	0.94	1.03	1.12	0.95		
145	1.09	1.10	0.96	0.83	0.80	0.69	0.79	0.76	0.75	0.74	0.81	0.68	0.76	0.93	1.05	1.13	0.99		
150	0.82	0.85	0.86	0.82	0.74	0.82	0.81	0.79	0.74	0.76	0.83	0.85	0.73	0.80	0.97	1.01	0.92		
155	0.73	0.83	0.90	0.84	0.84	0.93	0.83	0.82	0.77	0.80	0.82	0.91	0.91	0.80	0.83	0.78	0.74		
160	0.98	0.83	0.77	0.93	0.96	0.91	0.89	0.88	0.82	0.85	0.84	0.86	0.94	0.97	0.82	0.76	0.84		
165	0.91	0.86	0.86	0.88	0.94	0.93	0.90	0.85	0.82	0.85	0.87	0.90	0.89	0.93	0.93	0.91	0.93		
170	0.88	0.93	0.94	0.85	0.84	0.87	0.84	0.82	0.82	0.85	0.86	0.88	0.85	0.86	0.88	0.96	0.96		
175	0.98	0.99	1.01	1.05	1.11	0.94	0.92	0.89	0.83	0.82	0.86	0.93	0.94	0.98	0.97	0.95	0.93		
180	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89		

Table 5: Luminous Intensity Data

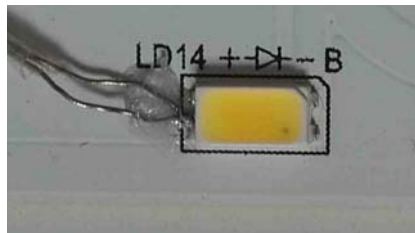
**ISTMT TEST DATA:**

Sample Tested: **ELNV22-3750-1**

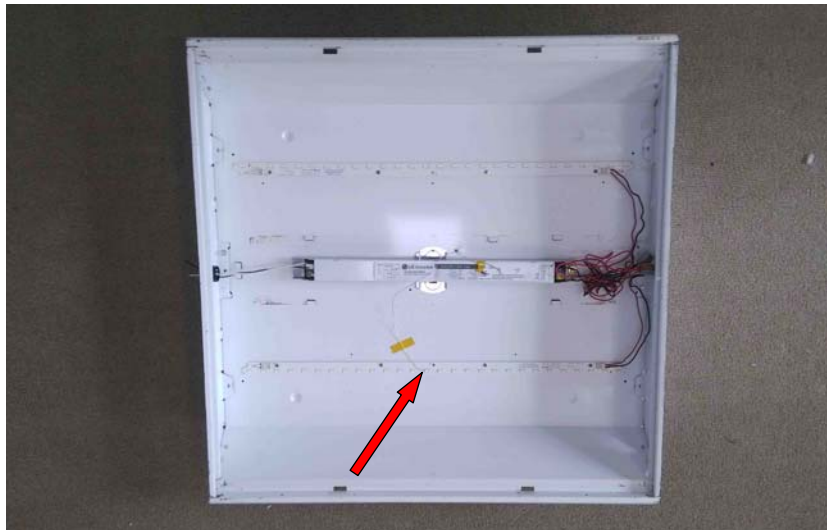
Test ambient temperature was 29.2°C.

Test orientation was Light Down.

The stabilization time of the sample was 7.5 hours.



View of In-Situ Point- Ts



Location of In-Situ Point from overall view

To get the maximum temperature, Ts point is middle of the LED board.

Input Voltage (V)	Input Power (W)	Tested LED source current (mA)	Measured Driver Temp Maximum Temperature (Corrected to Ta=25°C)	Measured In-Situ Maximum Temperature (Corrected to Ta=25°C)
120.0	28.69	132.4	41.3	47.4
277.0	29.11	132.5	41.5	47.5

Table 6: ISTMT test data

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Sep. 18, 2014	Sep. 17, 2015
Digital Power Meter	PF2010A	HZTE028-01	Sep. 18, 2014	Sep. 17, 2015
AC Power Supply	PCR 500L	HZTE001-08	Sep. 18, 2014	Sep. 17, 2015
DC Power Supply	WY12010	HZTE004-03	Sep. 18, 2014	Sep. 17, 2015
Temperature Meter	TES1310	HZTE017-01	Sep. 18, 2014	Sep. 17, 2015
Standard source	D908	HZTE012-01	Sep. 18, 2014	Sep. 17, 2015
Digital Power Meter	WT210	HZTE008-01	Sep. 18, 2014	Sep. 17, 2015
AC Power Supply	PCR 500L	HZTE001-07	Sep. 18, 2014	Sep. 17, 2015
DC Power Supply	6154	HZTE004-04	Sep. 18, 2014	Sep. 17, 2015
Temperature and humidity recorder	JR900	HZTE018-01	Sep. 18, 2014	Sep. 17, 2015
Multi-Meter	FLUKE 289	HZTE020-03	Nov. 09, 2014	Nov. 08, 2015

Table 7: Test Equipment List

## TEST METHODS

### Seasoning of SSL Product

For the purpose of rating new SSL products, SSL products shall be tested with no seasoning. Therefore, no seasoning was performed.

### Goniophotometer Method

#### Photometric and Electrical Measurements

An EVERFINE Type C Model GO-R5000 Goniophotometer was used to measure the intensity at each angle of distribution for each sample. The photometric distance is 2.475m for near-field measurement or 30m for far-field measurement. Bandwidth of spectroradiometer is 380nm-780nm.

Ambient temperature was measured at the same height of the sample mounted on the Goniophotometer equipment. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation.

The stabilization time typically ranges from 30 min (small integrated LED lamps) to 2 or more hours for large SSL luminaires). It can be judged that stability is reached when the variation (maximum – minimum) of at least 3 readings of the light output and electrical power over a period of 30 min, taken 15 minutes apart, is less than 0.5 %.

Electrical measurements including voltage, current, and power were measured using the Everfine Digital Power Meter.

Some graphics were created with Photometric Plus software.

The standard reference of the Goniophotometer system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Metrology P.R. China.

The uncertainty of goniophotometer system reported in this document is expanded uncertainty is 1.94% with a coverage factor  $k=2$ .

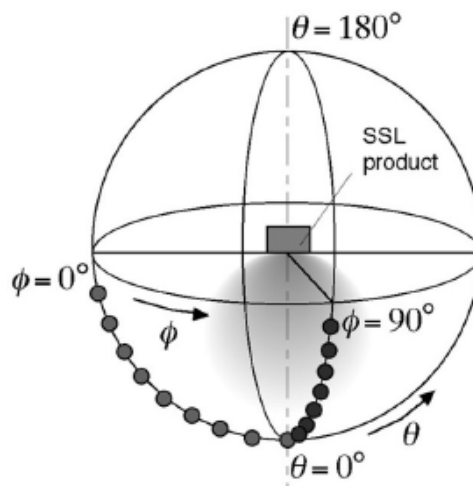
### Color Characteristics Measurements

The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as values that are spatially average, weighted to intensity, over the angular range where light is intentionally emitted from the SSL product. The color characteristics measurements are using gonio-spectroradiometer.

### Color Spatial Uniformity

The characteristics of SSL products may be spatially non-uniform, the chromaticity coordinate shall be measured at two vertical planes ( $C=0^\circ/180^\circ$  and  $C=90^\circ/270^\circ$ ) and at  $10^\circ$  or less intervals for vertical angle until the light output dropped to below 10% of the peak intensity. The averaged weighted chromaticity coordinate was calculated from these points. The data was then analyzed to check for delta color differences of the  $u'$ ,  $v'$  chromaticity coordinates. The spatial non-uniformity of chromaticity,  $\Delta u'v'$ , is determined as the maximum deviation (distance on the CIE ( $u'$ ,  $v'$ ) diagram) among all measured points from the spatially averaged chromaticity coordinate.

The geometry for the chromaticity measurement using gonio-spectroradiometer is shown as following.



### ISTMT

The luminaire was installed to simulate intended usage, in accordance with the manufacturer's instructions.

Temperatures were measured after they stabilized, when the test was run for a minimum of 7.5 h.

The tests were conducted in an ambient temperature of  $25 \pm 5$  °C. Ambient temperature variations above or below 25°C were respectively subtracted from or added to temperatures recorded at points on the luminaire. Temperatures recorded at points on a luminaire were measured by means of thermocouples.

The thermocouples had conductors no larger than No. 24 AWG ( $0.21\text{mm}^2$ ) and no smaller than No. 30 AWG ( $0.05\text{mm}^2$ ). Thermocouples complied with the requirements specified in ASTM MNL 12 and thermocouples as listed in the table of the limits of error specified in NIST ITS 90, or ISA MC96.1.

The luminaire was installed in the test box in the configuration that resulted in the highest operating temperatures, considering different trim and maximum lamp wattage combinations, lampholder adjustment heights, and the like.

The test box was constructed of 12mm thick plywood as described below:

The test box was rectangular and had four sides and a bottom.

The four sides of the test box for a ceiling-mounted luminaire were a minimum distance of 8.5 in (215mm) from the nearest part of the lamp housing or heat-producing parts. The top edge of the sides of the test box were a minimum of 8.5 in (215mm) above the highest point of any permanently attached part of the lamp housing.

Thermal insulation of the loose-fill type was poured into the test box through the open top, until level with the top, without applying any compacting procedure.

The thermal insulation was conditioned to the density specified by the insulation manufacturer to obtain a required rated thermal resistance of Rsi 0.56 to 0.678 (R3.2 to R3.85).

All spaces around the luminaire and between it and the sides of the box were filled with the thermal insulation.

\*\*\* End of Report \*\*\*

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