NVLAP LAB CODE 200960-0

LM-79-08 Test and ISTMT Report

for

A.L.P. Lighting Components, Inc.

6333 Gross Point Road, Niles, IL 60714

1x4 LED Recessed Interior Luminaire

Model: ELNV14-3750-1

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ15100009j

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

Review by: April Zou

Engineer: April Zou

Dec. 11, 2015

Approved by: Jim Zhang

Manager: Jim Zhang

Dec. 11, 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: **ELNV14-3750-1**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
89.1	2417.2	27.14	0.9938

CCT (K)	CRI	Stabilization Time (Light & Power)
5053	83.7	60

Table 1: Executive Data Summary

Test specifications:

Date of Receipt	: Oct. 09, 2015
Date of Test	: Dec. 04, 2015 to Dec. 10, 2015
Test item	: Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters
Reference Standard	: 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)	
Name	: 1x4 LED Recessed Interior Luminaire
Model	: ELNV14-3750-1
Brand Name	: A.L.P Lighting
Electrical Ratings	: AC120~277V, 50/60Hz, 37W
Product Description	: 1x4 Panel Light, 5000K, Dimmable Driver: PIFC-C201R Manufacturer of light source: LG Model of light source: LGITLED1-28-50K
Manufacturer	: A.L.P. Lighting Components, Inc.
Address	: 6333 Gross Point Road, Niles, IL 60714

TEST RESULTS

Test ambient temperature was 24.3℃.

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)	0.228	0.108
Power Factor	0.9938	0.9213
Test Power (W)	27.14	27.56
Off-State Power (W)	0	0
THD A%	6.61	18.35
Luminous Efficacy (lm/W)	89.1	87.7
Total Luminous Flux (lm)	2417.2	2416.8
Color Rendering Index (CRI)	83.7	
R9	5	
Correlated Color Temperature (CCT) (K)	5053	
Chromaticity (Chroma x, Chroma y)	(0.3441, 0.3559)	
Chromaticity (Chroma u, Chroma v)	(0.2091, 0.3244)	
Chromaticity (Chroma u', Chroma v')	(0.2091, 0.4866)	
Duv	0.0026	
Average Beam Angle (°)	111.0	
Center Beam Candle Power (cd)	865	
Spacing Criteria	1.27 (0°-180°)/ 1.21 (90°-270°)	
Zonal Lumens in the 0°-60°Zone	79.32%	
Zonal Lumens in the 60°-90°Zone	20.50%	
Zonal Lumens in the 90°-120°Zone	0.08%	
Zonal Lumens in the 120°-180°Zone	0.10%	

Special Color Rendering Indices	
R1	81
R2	89
R3	94
R4	84
R5	83
R6	86
R7	86
R8	66
R9	5
R10	75
R11	84
R12	69
R13	83
R14	97

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

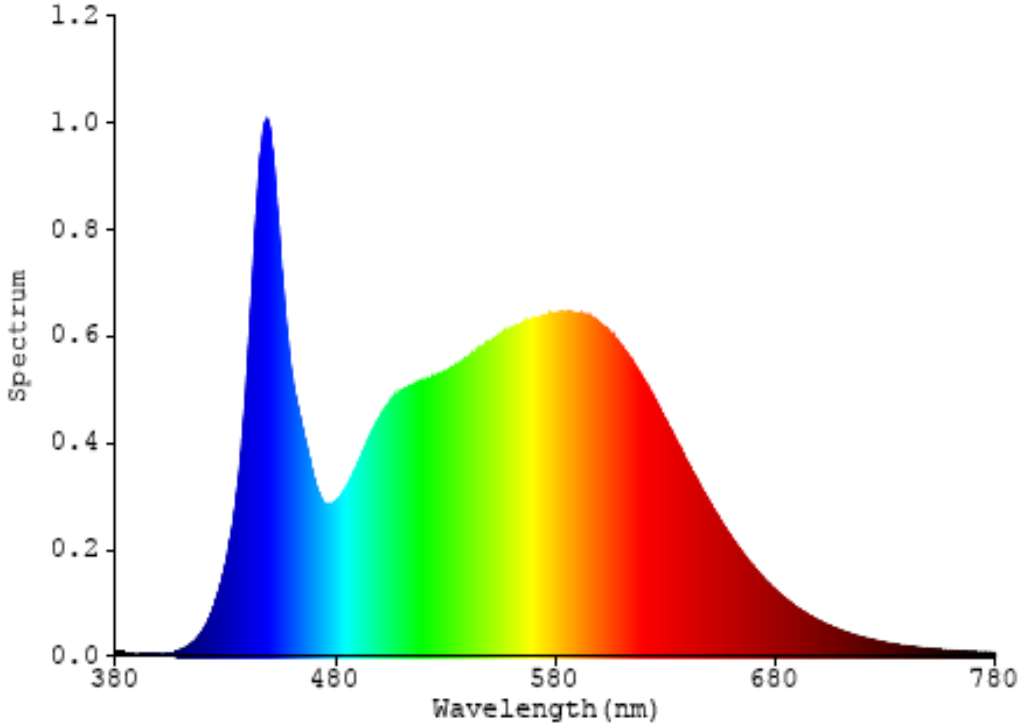


Chart 1: Spectral Power Distribution

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	81.757	3.38%
10- 20	233.193	9.65%
20- 30	351.523	14.54%
30- 40	421.904	17.45%
40- 50	436.258	18.05%
50- 60	392.773	16.25%
60- 70	294.767	12.19%
70- 80	160.885	6.66%
80- 90	39.886	1.65%
90-100	0.591	0.02%
100-110	0.661	0.03%
110-120	0.65	0.03%
120-130	0.612	0.03%
130-140	0.583	0.02%
140-150	0.49	0.02%
150-160	0.365	0.02%
160-170	0.218	0.01%
170-180	0.083	0.00%
Total	2417.2	100%

γ(°)	Lumens	% Total
0- 60	1917.408	79.32%
60- 90	495.538	20.50%
0-90	2412.946	99.82%
90- 180	4.253	0.18%
0- 180	2417.2	100%

Table 3: Zonal Lumen Data

Illuminance Plots

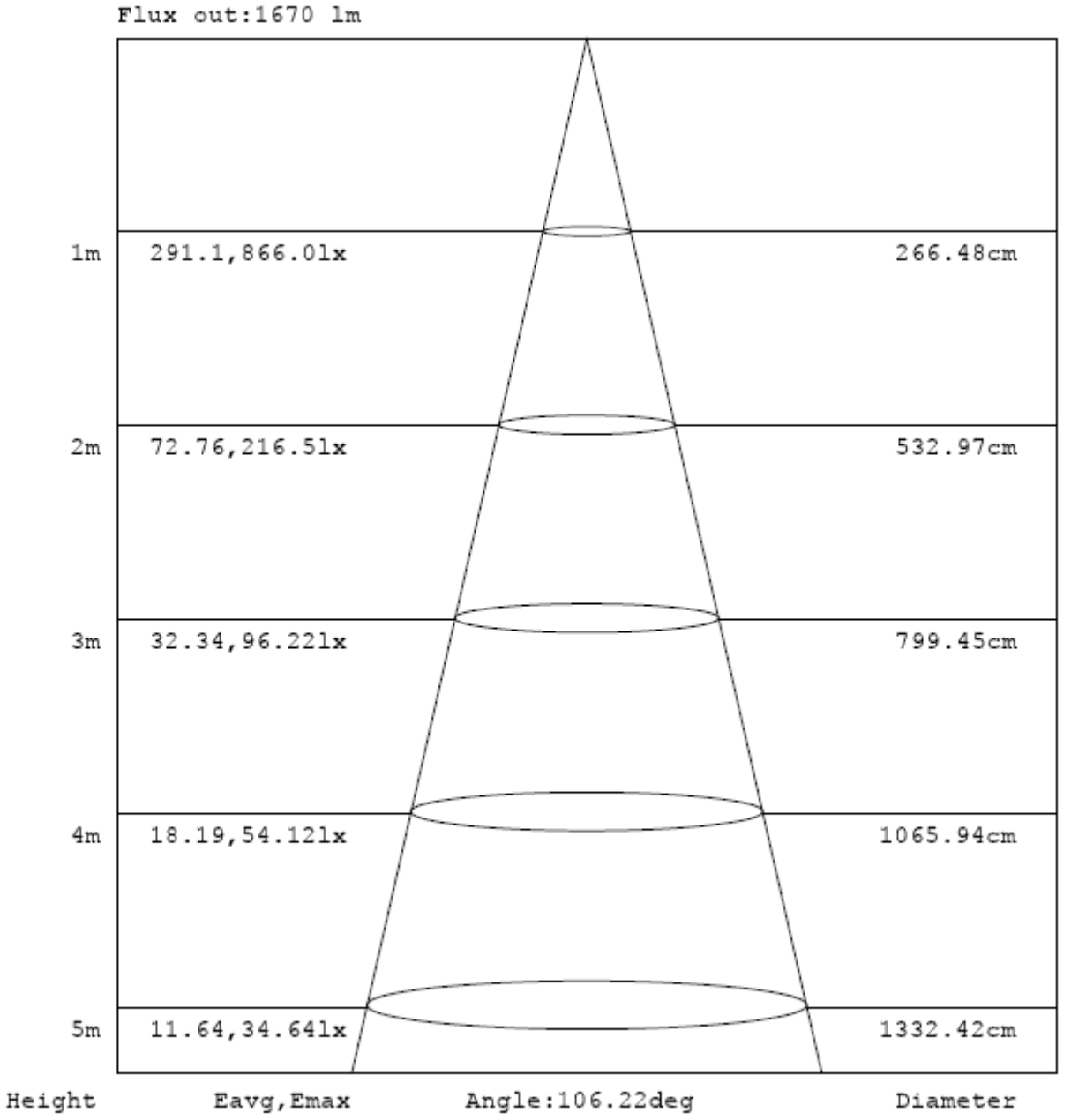


Chart 2: Beam angle

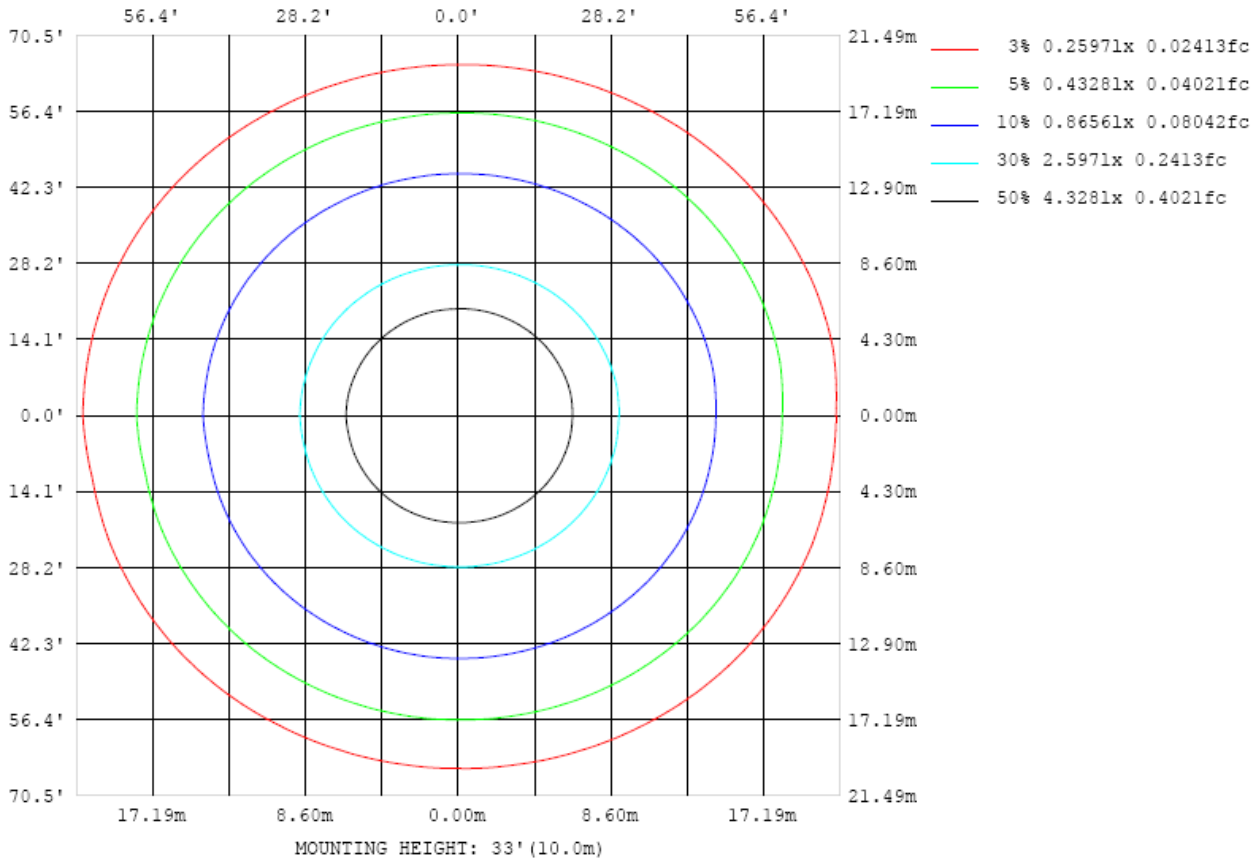


Chart 3: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots

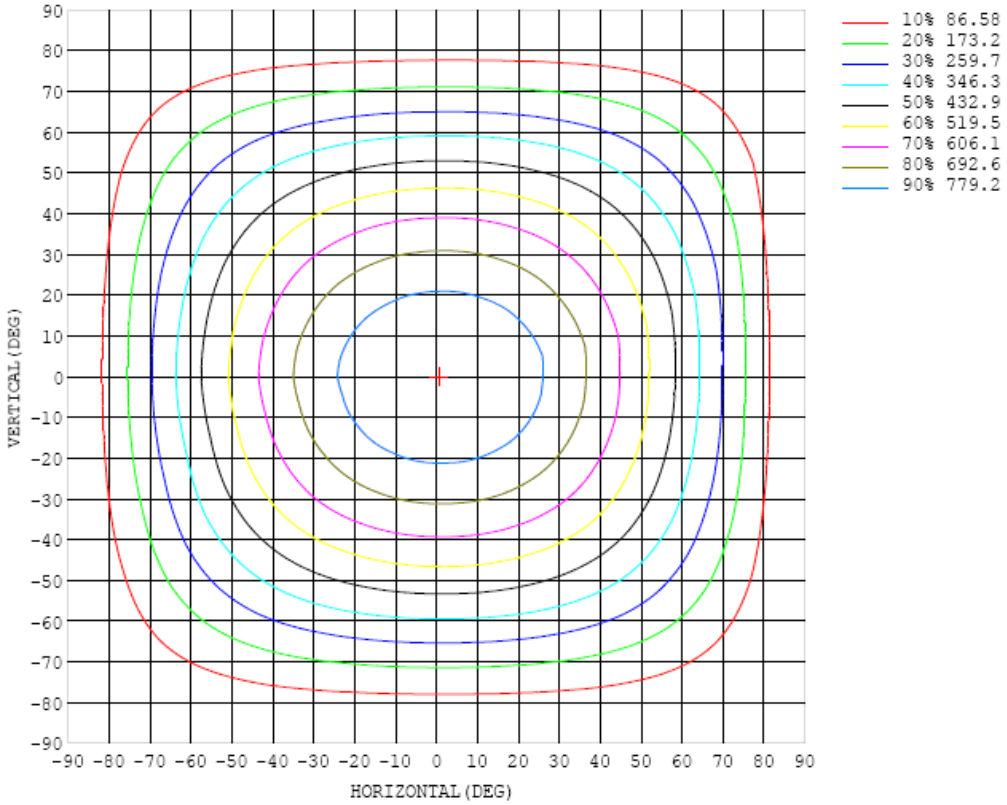


Chart 4: Isocandla Plot

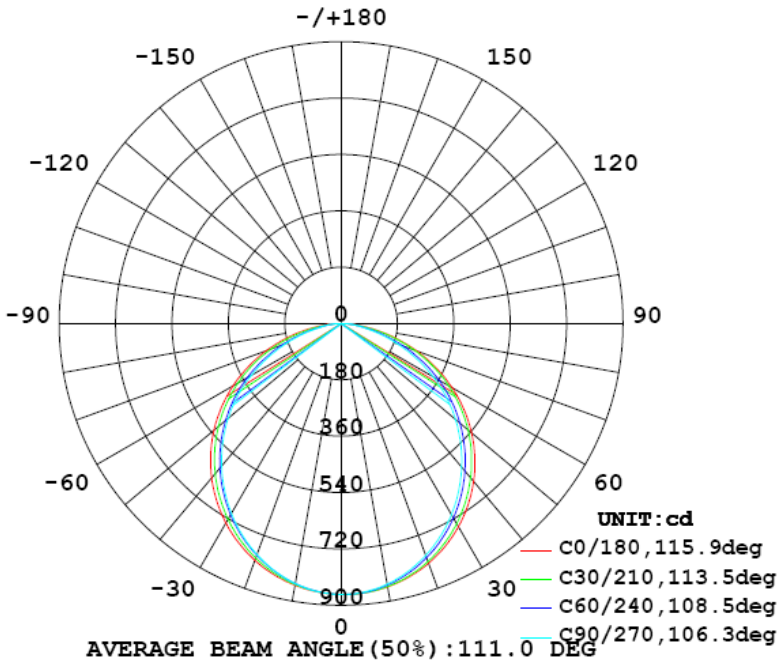


Chart 5: Polar Candela Distribution

Luminous Intensity Data

Table--1 UNIT: cd

γ (DEG) \ C (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	865	865	865	865	865	865	865	865	865	865	865	865	865	865	865	865	865	865	865
5	863	863	863	863	863	862	862	861	861	860	860	860	860	860	860	860	860	860	861
10	854	854	854	853	851	850	848	847	846	845	845	845	845	846	846	847	847	847	849
15	838	838	836	835	832	829	826	824	822	821	820	821	822	823	824	826	827	828	830
20	815	815	813	809	805	801	796	793	790	789	788	789	790	793	795	798	800	801	805
25	785	785	781	777	771	765	759	755	751	750	749	750	752	756	759	763	767	769	774
30	749	748	744	738	731	723	717	711	707	705	704	706	709	713	718	722	727	730	736
35	707	705	700	693	685	677	669	662	656	654	654	656	660	665	671	676	682	685	693
40	658	656	651	643	634	624	615	607	602	599	599	601	606	613	619	625	631	635	644
45	604	601	596	588	578	567	557	549	542	540	540	543	548	555	563	570	575	579	589
50	544	542	536	529	518	506	495	486	480	477	477	480	487	494	503	511	516	520	530
55	479	476	472	464	453	441	430	420	413	410	411	415	421	429	439	447	453	455	467
60	408	407	404	396	384	372	360	349	342	339	340	344	352	361	371	379	386	387	399
65	334	333	332	323	312	299	285	275	268	265	266	271	279	289	300	309	315	315	328
70	257	258	256	248	236	222	211	201	195	193	194	198	205	215	225	236	242	244	255
75	179	183	179	170	159	148	139	131	127	125	126	129	135	142	151	161	168	171	181
80	105	107	103	94.9	86.6	78.7	73.3	71.7	70.5	69.4	69.3	69.7	71.0	75.2	82.0	89.1	95.9	100	111
85	38.8	38.5	34.6	32.7	33.8	34.4	34.8	34.7	34.3	33.9	33.9	33.7	33.3	32.5	31.4	30.2	31.9	35.5	45.9
90	0.88	0.85	0.44	1.56	1.49	1.25	1.95	1.84	0.22	1.79	1.84	1.89	1.95	2.06	1.93	2.15	0.78	0.88	0.96
95	1.05	1.00	0.51	0.44	0.45	0.28	0.26	0.30	0.38	0.38	0.37	0.24	0.25	0.35	0.27	0.55	0.80	0.91	1.00
100	1.26	1.01	0.45	0.43	0.48	0.30	0.37	0.45	0.46	0.46	0.46	0.35	0.28	0.36	0.29	0.51	0.62	0.81	1.23
105	1.04	1.09	0.45	0.42	0.49	0.43	0.50	0.54	0.52	0.53	0.53	0.47	0.38	0.38	0.32	0.48	0.61	0.97	1.10
110	0.79	0.98	0.51	0.58	0.64	0.53	0.63	0.59	0.57	0.58	0.59	0.55	0.49	0.44	0.38	0.48	0.57	0.77	0.89
115	0.65	0.66	0.50	0.63	0.65	0.86	0.68	0.62	0.62	0.63	0.63	0.60	0.58	0.68	0.50	0.47	0.54	0.65	0.73
120	0.73	0.69	0.55	0.66	0.74	0.71	0.69	0.65	0.66	0.68	0.68	0.65	0.62	0.64	0.56	0.47	0.59	0.65	0.71
125	0.77	0.66	0.58	0.74	0.83	0.72	0.73	0.71	0.71	0.72	0.73	0.71	0.67	0.63	0.63	0.54	0.56	0.57	0.65
130	0.87	0.74	0.67	0.84	0.84	0.75	0.75	0.76	0.75	0.76	0.77	0.75	0.71	0.67	0.68	0.61	0.59	0.62	0.69
135	0.94	0.79	0.74	0.83	0.81	0.78	0.77	0.79	0.77	0.80	0.79	0.78	0.73	0.69	0.71	0.63	0.68	0.68	0.72
140	0.80	0.73	0.74	0.81	0.75	0.77	0.78	0.79	0.78	0.80	0.79	0.78	0.75	0.71	0.71	0.65	0.67	0.66	0.77
145	0.88	0.76	0.69	0.83	0.74	0.77	0.80	0.81	0.82	0.82	0.80	0.80	0.77	0.73	0.71	0.69	0.64	0.68	0.71
150	0.61	0.55	0.66	0.77	0.80	0.79	0.80	0.81	0.82	0.83	0.80	0.79	0.78	0.75	0.75	0.69	0.56	0.57	0.62
155	0.67	0.74	0.64	0.71	0.81	0.89	0.84	0.82	0.83	0.80	0.79	0.82	0.82	0.84	0.73	0.64	0.64	0.66	0.66
160	0.70	0.79	0.69	0.70	0.72	0.81	0.84	0.84	0.88	0.87	0.86	0.82	0.78	0.73	0.67	0.61	0.67	0.66	0.69
165	0.73	0.80	0.77	0.65	0.65	0.68	0.67	0.72	0.74	0.75	0.72	0.73	0.74	0.62	0.68	0.70	0.72	0.71	0.71
170	0.76	0.78	0.78	0.79	0.73	0.71	0.77	0.76	0.74	0.76	0.68	0.72	0.81	0.80	0.78	0.76	0.75	0.76	0.78
175	0.95	0.96	0.96	0.97	0.97	0.96	0.94	0.94	0.96	0.78	0.94	0.84	0.93	0.91	0.90	0.91	0.92	0.93	0.95
180	0.94	0.95	0.95	0.96	0.96	0.97	0.97	0.96	0.89	1.00	0.90	0.95	0.93	0.93	0.91	0.91	0.91	0.93	0.94

Table 4: Luminous Intensity Data

Table--2 UNIT: cd

γ (DEG) \ C (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	865	865	865	865	865	865	865	865	865	865	865	865	865	865	865	865	865		
5	860	860	860	859	859	859	859	859	859	860	860	861	861	862	863	863	864		
10	848	847	846	845	844	843	843	843	843	844	845	847	849	851	852	854	855		
15	829	827	825	823	821	819	818	818	818	819	822	824	828	831	834	837	840		
20	804	801	797	794	791	788	786	785	785	787	790	794	799	804	809	814	817		
25	771	768	763	758	754	750	747	746	746	749	752	757	763	770	777	783	788		
30	733	728	722	716	711	706	702	701	701	704	708	715	722	730	739	746	752		
35	689	683	677	670	663	656	652	649	650	653	658	666	675	685	694	703	710		
40	640	633	626	618	610	602	597	594	594	597	604	612	623	635	645	654	662		
45	585	578	571	562	552	544	538	535	534	538	545	554	566	579	591	600	609		
50	526	520	512	501	491	482	475	472	471	475	482	492	505	518	532	542	550		
55	462	457	448	437	426	417	409	405	404	408	416	427	440	454	468	479	485		
60	395	390	381	370	358	347	338	333	332	336	344	357	371	385	399	411	417		
65	325	320	310	299	286	274	265	260	259	263	270	282	297	313	327	339	344		
70	254	248	238	225	212	201	193	188	187	190	197	208	221	237	252	263	270		
75	181	174	164	152	141	131	125	121	121	123	128	137	148	161	174	186	194		
80	110	102	92.4	82.9	73.5	69.0	67.7	67.1	67.0	67.7	69.3	71.5	78.9	88.8	99.7	111	119		
85	43.2	36.6	32.1	32.0	31.8	31.7	31.7	31.6	31.6	31.9	32.6	33.0	33.5	33.9	34.4	40.5	47.6		
90	0.97	0.43	0.45	0.49	0.30	0.26	0.21	0.25	0.24	0.24	0.21	0.25	0.35	0.27	0.49	0.85	1.16		
95	1.07	0.59	0.56	0.57	0.42	0.40	0.42	0.51	0.52	0.51	0.36	0.39	0.49	0.40	0.56	1.00	1.15		
100	0.98	0.55	0.57	0.61	0.45	0.47	0.57	0.62	0.61	0.61	0.57	0.43	0.52	0.46	0.64	0.88	1.17		
105	1.18	0.57	0.56	0.57	0.52	0.59	0.66	0.69	0.69	0.68	0.69	0.62	0.56	0.48	0.62	0.87	1.40		
110	0.87	0.53	0.57	0.66	0.61	0.66	0.69	0.72	0.72	0.71	0.72	0.72	0.68	0.61	0.59	0.77	1.05		
115	0.69	0.51	0.62	0.64	0.71	0.67	0.68	0.72	0.72	0.71	0.70	0.77	0.86	0.66	0.57	0.67	0.79		
120	0.66	0.53	0.60	0.64	0.65	0.66	0.67	0.71	0.71	0.70	0.69	0.73	0.78	0.68	0.57	0.68	0.76		
125	0.60	0.58	0.62	0.68	0.65	0.67	0.69	0.72	0.71	0.71	0.71	0.72	0.76	0.72	0.62	0.68	0.71		
130	0.56	0.61	0.70	0.70	0.70	0.71	0.73	0.76	0.75	0.74	0.75	0.73	0.74	0.75	0.67	0.76	0.79		
135	0.61	0.71	0.73	0.74	0.74	0.75	0.78	0.81	0.81	0.80	0.79	0.76	0.76	0.80	0.68	0.84	0.88		
140	0.62	0.73	0.76	0.77	0.78	0.80	0.82	0.85	0.85	0.84	0.84	0.82	0.78	0.81	0.70	0.87	0.81		
145	0.65	0.70	0.82	0.79	0.81	0.84	0.87	0.89	0.90	0.89	0.89	0.86	0.82	0.78	0.76	0.78	0.84		
150	0.57	0.65	0.84	0.86	0.84	0.86	0.89	0.91	0.98	0.91	0.92	0.88	0.84	0.85	0.75	0.53	0.69		
155	0.67	0.61	0.72	0.87	0.96	0.91	0.91	0.92	0.93	0.93	0.93	0.96	0.98	0.87	0.69	0.71	0.76		
160	0.69	0.62	0.67	0.73	0.90	0.94	0.97	1.02	1.00	1.03	0.98	0.91	0.89	0.76	0.78	0.76	0.80		
165	0.72	0.73	0.65	0.71	0.75	0.76	0.85	0.90	0.92	0.92	0.89	0.81	0.79	0.80	0.82	0.77	0.77		
170	0.78	0.78	0.81	0.77	0.76	0.79	0.79	0.79	0.80	0.86	0.84	0.86	0.88	0.83	0.82	0.79	0.77		
175	0.95	0.95	0.96	0.97	0.97	1.00	0.87	0.83	0.94	0.82	0.98	0.96	0.97	0.96	0.95	0.94	0.92		
180	0.94	0.95	0.95	0.96	0.96	0.97	0.96	0.97	0.88	1.00	0.88	0.95	0.93	0.93	0.91	0.91	0.91		

Table 5: Luminous Intensity Data

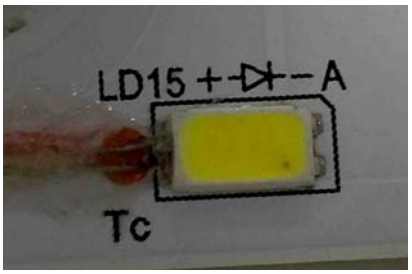
ISTMT TEST DATA:

Sample Tested**: ELNV14-3750-1**

Test ambient temperature was 21.5℃.

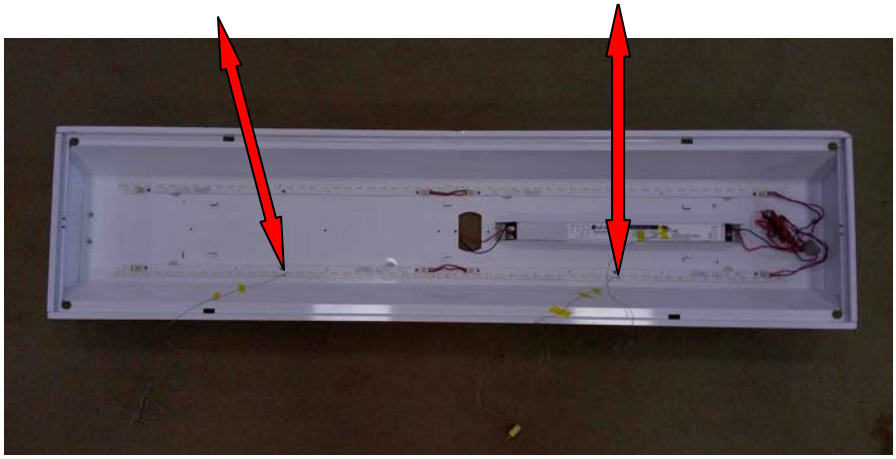
Test orientation was Light Down.

The stabilization time of the sample was 7.5 hours.



View of In-Situ Point- Ts

Point B Location-In middle of the LED board Point A Location- Near LED driver



Location of In-Situ Point from overall view

Input Voltage (V)	Input Power (W)	Tested LED source current (mA)	Measured Driver Temp Maximum Temperature (Corrected to Ta=25℃)	Measured In-Situ Maximum Temperature (Corrected to Ta=25℃)	
				Point A	Point B
120.0	27.14	148.7	39.8	42.2	38.7
277.0	27.56	148.7	39.9	42.3	38.7

Table 6: ISTMT test data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Jul. 17, 2015	Jul. 16, 2016
Digital Power Meter	PF2010A	HZTE028-01	Jul. 17, 2015	Jul. 16, 2016
AC Power Supply	PCR 500L	HZTE001-08	Jul. 17, 2015	Jul. 16, 2016
DC Power Supply	WY12010	HZTE004-03	Jul. 17, 2015	Jul. 16, 2016
Temperature Meter	TES1310	HZTE017-01	Jul. 17, 2015	Jul. 16, 2016
Standard source	D908	HZTE012-01	Jul. 23, 2015	Jul. 22, 2016
Digital Power Meter	WT210	HZTE008-01	Jul. 17, 2015	Jul. 16, 2016
AC Power Supply	PCR 500L	HZTE001-07	Jul. 17, 2015	Jul. 16, 2016
DC Power Supply	6154	HZTE004-04	Jul. 17, 2015	Jul. 16, 2016
Temperature and humidity recorder	JR900	HZTE018-01	Jul. 21, 2015	Jul. 20, 2016
Multi-Meter	FLUKE 289	HZTE020-03	Nov. 10, 2015	Nov. 09, 2016

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.

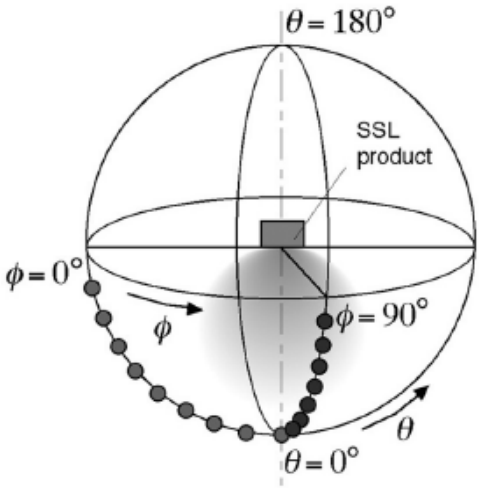
The uncertainty of goniophotometer system reported in this document is expended uncertainty is 1.94% with a coverage factor k=2.

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°/180° and C=90°/270°) and at 10° 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, Δu'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 ± 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 (0.21mm^2) and no smaller than No. 30 AWG (0.05mm^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 ***