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

2x2 LED Recessed Interior Luminaires

Model: ELL22-3735LCO-1

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ15070025f/R1

This report is replaced the old report No. HZ15070025f dated Sep. 07, 2015

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

Review by: April Zou

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: **ELL22-3735LCO-1**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
91.5	2628.7	28.74	0.9945

CCT (K)	CRI	Stabilization Time (Light & Power)
3612	83.7	60

Table 1: Executive Data Summary

Test specifications:

Date of Receipt	: Jul. 15, 2015
Date of Test	: Sep. 06, 2015 to Sep. 07, 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

TABLE OF CONTENT

Sample Photo

Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: 2x2 LED Recessed Interior Luminaires
Model	: ELL22-3735LCO-1
Brand Name	: A.L.P Lighting
Electrical Ratings	: AC120~277V, 50/60Hz, 37W
Product Description	: 2x2 Panel Light, 3500K, Dimmable Driver: PIFC-C201R (Consist of PIFC-C201B with Resistor 511 Ohm) Manufacturer of light source: LG Model of light source: LGITLED1-28-35K Quantity of light source: 56pcs
Manufacturer	: A.L.P. Lighting Components, Inc.
Address	: 6333 Gross Point Road, Niles, IL 60714

TEST RESULTS

Test ambient temperature was 25.1℃.

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)	0.241	0.114
Power Factor	0.9945	0.9262
Test Power (W)	28.74	29.16
Off-State Power (W)	0	0
THD A%	6.18	18.35
Luminous Efficacy (lm/W)	91.5	90.1
Total Luminous Flux (lm)	2628.7	2625.9
Color Rendering Index (CRI)	83.7	
R9	11	
Correlated Color Temperature (CCT) (K)	3612	
Chromaticity (Chroma x, Chroma y)	(0.3977, 0.3833)	
Chromaticity (Chroma u, Chroma v)	(0.2338, 0.3380)	
Chromaticity (Chroma u', Chroma v')	(0.2338, 0.5070)	
Duv	0.0016	
Average Beam Angle (°)	106.4	
Center Beam Candle Power (cd)	993	
Spacing Criteria	1.21 (0°-180°)/ 1.25 (90°-270°)	
Zonal Lumens in the 0°-60°Zone	81.03%	
Zonal Lumens in the 60°-90°Zone	18.86%	
Zonal Lumens in the 90°-120°Zone	0.04%	
Zonal Lumens in the 120°-180°Zone	0.07%	

Special Color Rendering Indices	
R1	82
R2	92
R3	96
R4	81
R5	83
R6	89
R7	84
R8	63
R9	11
R10	81
R11	80
R12	70
R13	85
R14	98

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

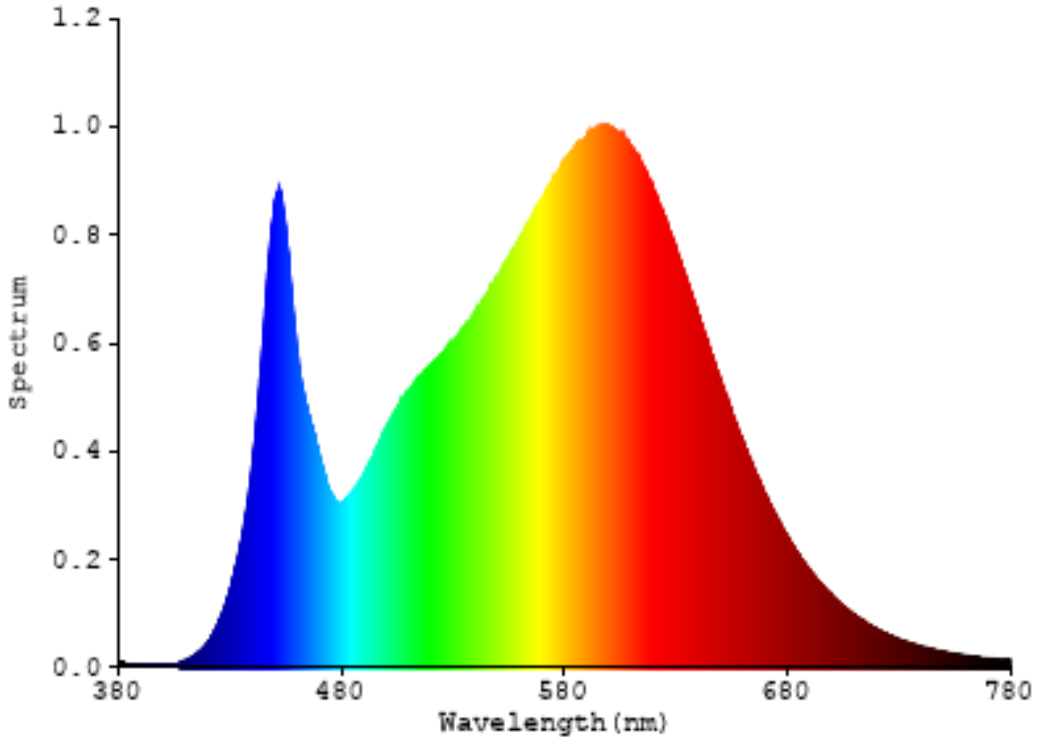


Chart 1: Spectral Power Distribution

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	93.835	3.57%
10- 20	267.875	10.19%
20- 30	401.772	15.28%
30- 40	474.365	18.05%
40- 50	477.609	18.17%
50- 60	414.628	15.77%
60- 70	301.739	11.48%
70- 80	163.37	6.21%
80- 90	30.578	1.16%
90-100	0.234	0.01%
100-110	0.331	0.01%
110-120	0.394	0.01%
120-130	0.437	0.02%
130-140	0.464	0.02%
140-150	0.417	0.02%
150-160	0.332	0.01%
160-170	0.215	0.01%
170-180	0.078	0.00%
Total	2628.7	100%

γ(°)	Lumens	% Total
0- 60	2130.084	81.03%
60- 90	495.687	18.86%
0-90	2625.771	99.89%
90- 180	2.902	0.11%
0- 180	2628.7	100%

Table 3: Zonal Lumen Data

Illuminance Plots

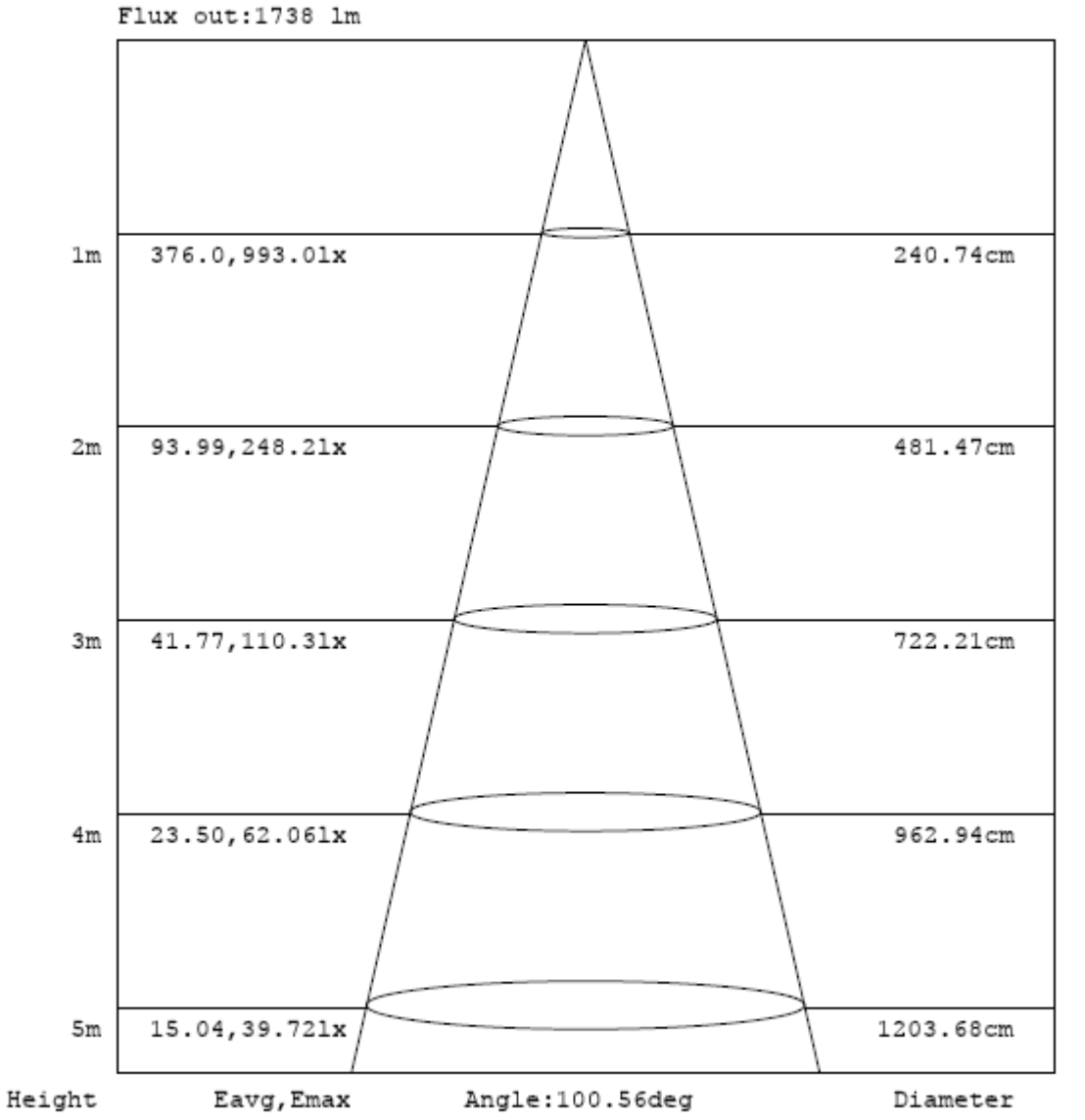


Chart 2: Beam angle

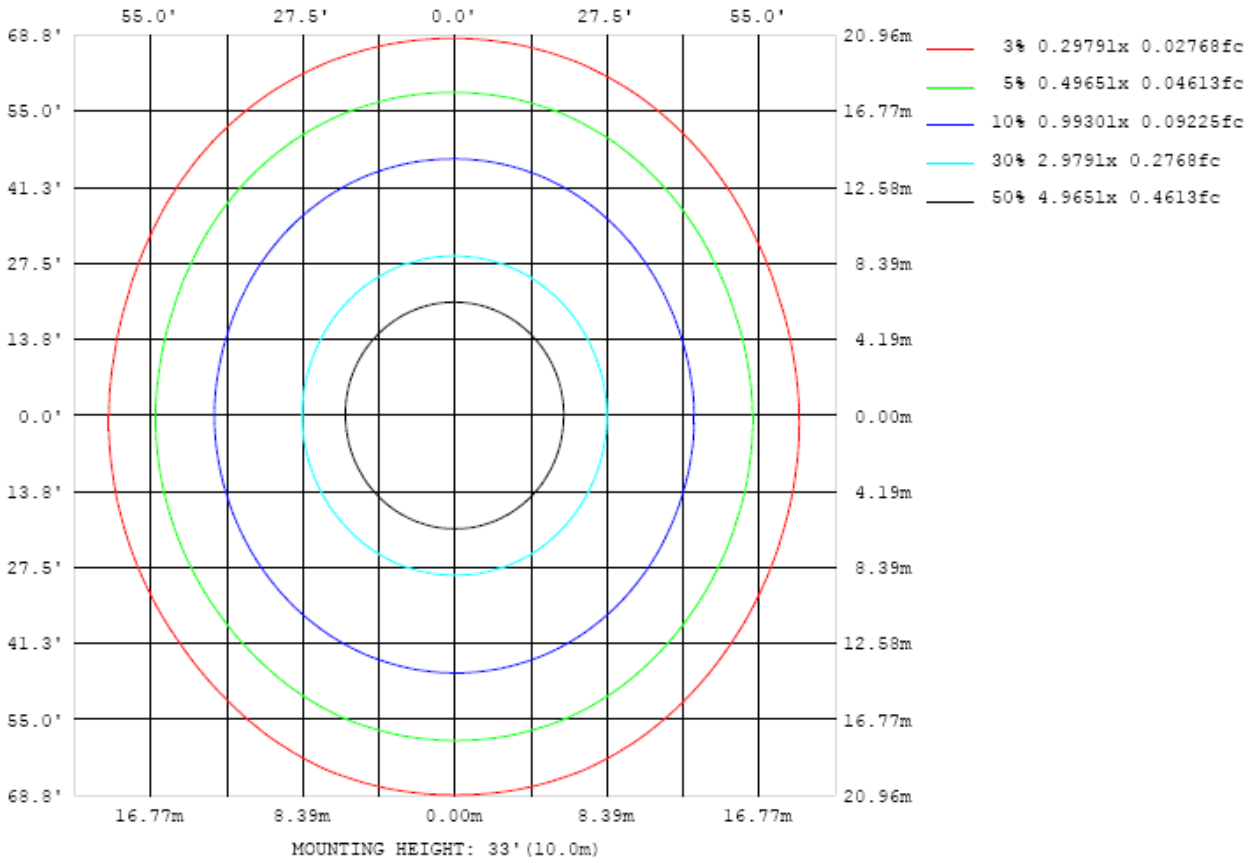


Chart 3: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots

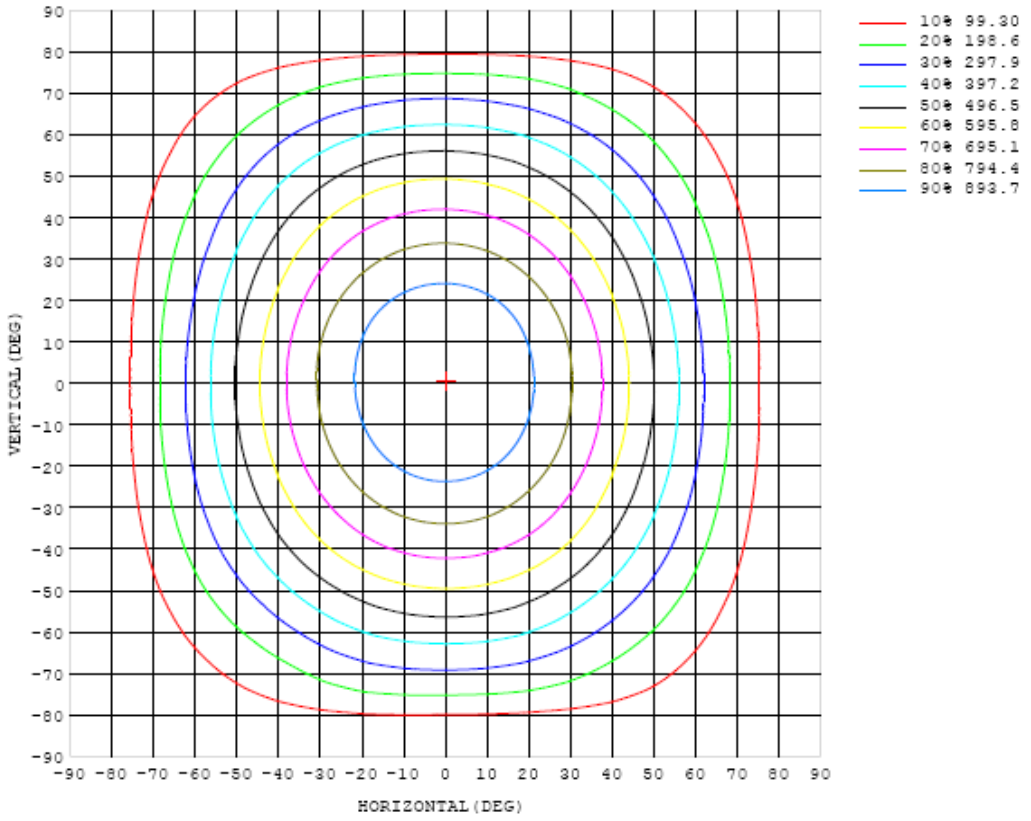


Chart 4: Isocandla Plot

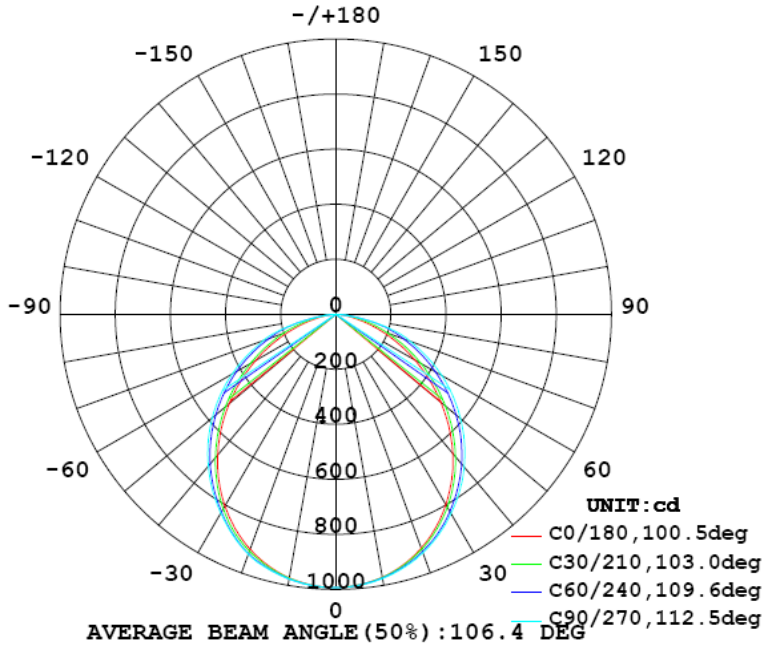


Chart 5: Polar Candela Distribution

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	993	993	993	993	993	993	993	993	993	993	993	993	993	993	993	993	993	993	993
5	986	986	987	987	987	987	987	988	988	988	988	988	988	988	988	988	988	988	988
10	970	970	971	971	972	972	973	974	974	975	975	974	974	973	973	973	972	972	972
15	943	943	944	945	947	949	950	951	952	953	952	952	951	950	949	948	947	946	946
20	905	905	907	909	913	915	918	920	921	922	922	921	919	917	914	912	910	909	909
25	856	857	859	863	868	873	877	881	882	883	883	882	879	875	871	866	863	861	862
30	798	800	804	809	815	822	827	832	835	836	835	832	828	824	818	812	807	805	805
35	733	735	739	746	754	762	771	778	782	783	782	778	771	763	755	749	744	741	740
40	660	662	666	675	687	699	710	718	723	724	723	718	709	698	687	678	671	668	667
45	581	582	587	599	614	630	642	652	658	660	657	651	641	628	615	602	593	589	589
50	497	500	506	519	537	555	570	581	588	591	587	580	568	554	538	522	511	506	505
55	413	417	424	437	455	475	494	509	516	519	515	506	492	474	456	440	428	422	420
60	330	334	342	356	373	394	416	434	441	443	440	432	414	392	372	357	346	339	336
65	249	253	262	276	295	317	339	356	363	364	362	355	336	311	291	277	266	258	254
70	172	176	185	200	220	241	262	278	285	287	285	278	259	235	214	200	189	181	176
75	103	108	118	133	152	172	190	203	205	204	207	206	190	165	144	130	119	111	106
80	48.9	52.9	61.0	74.9	90.5	99.9	102	101	99.3	98.4	103	107	105	98.8	87.7	73.8	61.7	55.0	51.7
85	16.3	18.5	21.8	24.6	26.5	26.9	25.9	24.8	24.3	24.4	25.2	26.4	28.4	29.7	28.6	25.8	22.9	20.0	16.7
90	0.20	0.19	0.20	0.23	0.24	0.25	0.28	0.31	0.34	0.36	0.34	0.32	0.30	0.29	0.32	0.30	0.23	0.16	0.11
95	0.25	0.27	0.27	0.28	0.30	0.32	0.33	0.35	0.37	0.38	0.35	0.31	0.30	0.29	0.29	0.28	0.25	0.19	0.11
100	0.29	0.30	0.29	0.30	0.32	0.34	0.35	0.36	0.38	0.40	0.44	0.48	0.48	0.45	0.41	0.38	0.33	0.25	0.15
105	0.35	0.35	0.34	0.34	0.36	0.38	0.39	0.40	0.40	0.41	0.48	0.54	0.55	0.52	0.49	0.46	0.42	0.33	0.22
110	0.38	0.39	0.39	0.39	0.39	0.40	0.41	0.42	0.43	0.44	0.47	0.51	0.54	0.55	0.55	0.53	0.49	0.43	0.34
115	0.40	0.40	0.40	0.40	0.40	0.41	0.42	0.43	0.43	0.44	0.45	0.47	0.51	0.55	0.58	0.57	0.52	0.45	0.36
120	0.40	0.41	0.41	0.42	0.42	0.43	0.43	0.43	0.42	0.42	0.44	0.48	0.53	0.58	0.61	0.63	0.61	0.54	0.42
125	0.40	0.42	0.44	0.45	0.46	0.47	0.48	0.48	0.45	0.43	0.44	0.47	0.54	0.60	0.59	0.51	0.45	0.48	0.59
130	0.51	0.49	0.48	0.50	0.52	0.53	0.52	0.50	0.48	0.48	0.51	0.56	0.60	0.64	0.63	0.59	0.55	0.55	0.61
135	0.58	0.57	0.55	0.55	0.57	0.58	0.59	0.58	0.58	0.58	0.61	0.64	0.65	0.64	0.65	0.70	0.73	0.68	0.56
140	0.56	0.60	0.65	0.65	0.64	0.63	0.64	0.64	0.64	0.64	0.67	0.69	0.69	0.69	0.71	0.77	0.80	0.77	0.68
145	0.62	0.58	0.56	0.58	0.63	0.66	0.67	0.67	0.66	0.66	0.68	0.70	0.70	0.68	0.69	0.72	0.74	0.73	0.72
150	0.63	0.63	0.64	0.68	0.72	0.73	0.69	0.66	0.69	0.71	0.71	0.70	0.71	0.73	0.74	0.74	0.73	0.69	0.65
155	0.84	0.85	0.84	0.81	0.76	0.74	0.72	0.69	0.66	0.64	0.68	0.73	0.74	0.73	0.74	0.75	0.73	0.70	0.64
160	0.89	0.89	0.87	0.83	0.77	0.75	0.75	0.76	0.76	0.76	0.79	0.80	0.78	0.74	0.70	0.66	0.64	0.63	0.64
165	0.75	0.75	0.76	0.81	0.85	0.83	0.78	0.74	0.73	0.74	0.75	0.76	0.76	0.75	0.77	0.83	0.86	0.82	0.72
170	0.79	0.79	0.80	0.82	0.84	0.84	0.84	0.82	0.80	0.78	0.79	0.80	0.81	0.82	0.84	0.88	0.90	0.85	0.75
175	0.82	0.82	0.82	0.83	0.83	0.83	0.83	0.83	0.84	0.84	0.85	0.86	0.86	0.86	0.85	0.83	0.80	0.77	0.74
180	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78

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	993	993	993	993	993	993	993	993	993	993	993	993	993	993	993	993	993		
5	988	988	989	989	989	989	989	989	989	989	988	988	988	987	987	987	987		
10	973	973	974	975	975	976	977	977	977	976	975	974	973	972	972	971	971		
15	947	948	950	952	954	955	956	957	956	956	954	953	951	948	946	944	943		
20	910	913	916	920	923	926	927	928	928	927	925	923	919	916	911	908	905		
25	865	868	873	877	880	882	884	885	885	883	881	878	875	871	866	861	858		
30	809	812	817	821	826	830	833	835	835	833	829	825	819	814	809	805	801		
35	742	746	751	758	765	772	777	780	780	778	773	766	758	750	743	738	734		
40	668	672	680	690	700	709	716	719	720	717	711	702	691	680	669	662	660		
45	589	594	604	616	629	641	650	654	655	651	644	632	619	604	591	582	579		
50	506	511	523	539	555	569	580	585	585	581	573	559	542	525	509	499	496		
55	420	426	440	458	477	494	506	512	512	508	499	483	463	443	426	414	411		
60	335	342	358	378	399	416	429	434	435	431	422	405	384	362	343	331	327		
65	254	262	279	300	320	337	349	355	355	352	343	327	307	285	265	251	247		
70	179	187	203	223	242	259	271	279	281	276	265	249	230	210	190	176	171		
75	111	120	134	151	168	182	191	193	192	192	188	176	158	139	123	110	104		
80	57.1	64.3	74.0	83.3	88.8	90.3	89.7	87.7	85.9	88.1	90.3	89.6	85.9	78.0	66.9	56.7	50.7		
85	20.0	22.0	22.7	22.1	20.6	18.6	16.9	15.9	15.5	16.1	17.1	18.3	19.5	20.2	20.0	18.9	17.3		
90	0.05	0.04	0.10	0.09	0.10	0.11	0.13	0.13	0.13	0.11	0.10	0.09	0.09	0.08	0.08	0.09	0.14		
95	0.11	0.11	0.12	0.13	0.13	0.14	0.16	0.18	0.19	0.17	0.15	0.14	0.13	0.12	0.10	0.12	0.19		
100	0.14	0.15	0.19	0.22	0.25	0.25	0.23	0.19	0.15	0.14	0.13	0.13	0.13	0.11	0.10	0.13	0.21		
105	0.24	0.25	0.27	0.28	0.28	0.26	0.23	0.20	0.18	0.17	0.17	0.16	0.16	0.16	0.15	0.19	0.27		
110	0.34	0.33	0.33	0.32	0.30	0.27	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.21	0.21	0.25	0.32		
115	0.42	0.45	0.44	0.41	0.38	0.34	0.31	0.29	0.28	0.29	0.29	0.28	0.27	0.27	0.28	0.31	0.35		
120	0.46	0.51	0.53	0.50	0.46	0.41	0.37	0.35	0.35	0.35	0.35	0.36	0.36	0.36	0.35	0.35	0.37		
125	0.66	0.69	0.67	0.60	0.54	0.51	0.48	0.45	0.42	0.42	0.42	0.44	0.45	0.45	0.43	0.40	0.39		
130	0.55	0.50	0.52	0.59	0.62	0.59	0.54	0.51	0.49	0.50	0.52	0.53	0.52	0.52	0.52	0.51	0.51		
135	0.63	0.69	0.69	0.64	0.61	0.62	0.62	0.60	0.58	0.59	0.59	0.58	0.55	0.54	0.56	0.58	0.59		
140	0.77	0.81	0.78	0.71	0.66	0.65	0.64	0.62	0.61	0.60	0.59	0.60	0.62	0.61	0.59	0.57	0.56		
145	0.76	0.76	0.72	0.66	0.63	0.65	0.67	0.65	0.64	0.63	0.64	0.65	0.66	0.60	0.51	0.49	0.56		
150	0.68	0.72	0.74	0.75	0.73	0.67	0.63	0.63	0.64	0.62	0.61	0.68	0.75	0.74	0.67	0.62	0.62		
155	0.69	0.70	0.65	0.59	0.64	0.79	0.87	0.75	0.62	0.65	0.72	0.73	0.73	0.73	0.74	0.76	0.80		
160	0.63	0.62	0.61	0.59	0.61	0.66	0.71	0.71	0.70	0.69	0.67	0.66	0.67	0.73	0.81	0.86	0.87		
165	0.70	0.73	0.75	0.77	0.76	0.72	0.69	0.67	0.66	0.67	0.69	0.71	0.75	0.79	0.82	0.82	0.78		
170	0.66	0.67	0.72	0.78	0.83	0.83	0.80	0.77	0.74	0.76	0.78	0.79	0.79	0.79	0.78	0.78	0.79		
175	0.72	0.72	0.74	0.75	0.75	0.79	0.83	0.82	0.78	0.80	0.82	0.84	0.84	0.83	0.82	0.82	0.82		
180	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78		

Table 5: Luminous Intensity Data

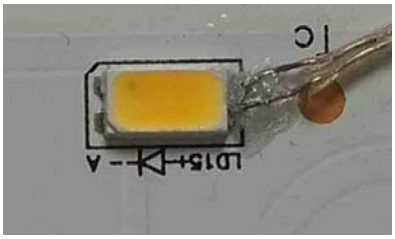
ISTMT TEST DATA:

Sample Tested**: ELL22-3735LCO-1**

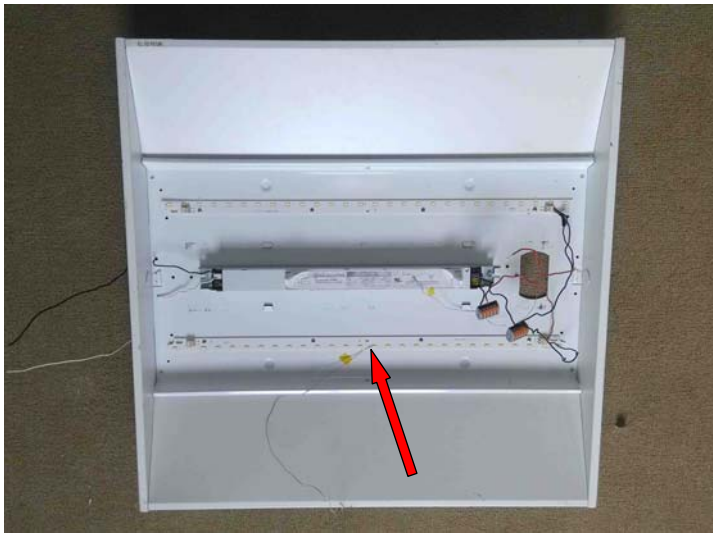
Test ambient temperature was 27.8℃.

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℃)	Measured In-Situ Maximum Temperature (Corrected to Ta=25℃)
120.0	28.74	137.5	49.0	49.3
277.0	29.16	139.0	48.8	49.5

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.

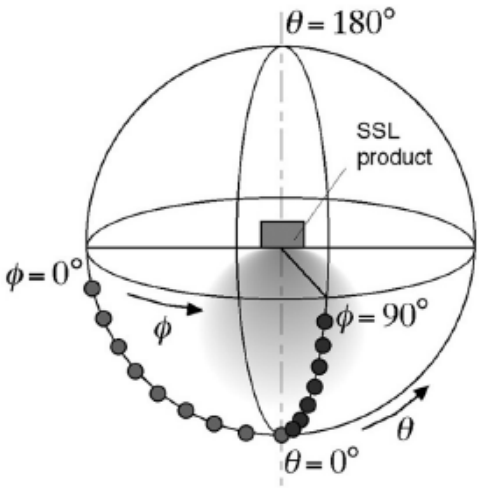
The uncertainty of goniophotometer system reported in this document is expended uncertainty is 1.94% with a coverage factor k=2.

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 werea 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 ***