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

2x4 LED Recessed Interior Luminaires

Model: ELNV24-4835-1

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

No.1805, DongLiu road, BinJiang District, Hangzhou, China

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Report No.: HZ15070025m

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

Review by: April Zou

Engineer: April Zou

Sep. 08, 2015

Approved by: Jim Zhang

Manager: Jim Zhang

Sep. 08, 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: **ELNV24-4835-1**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
93.0	4461.6	47.99	0.9956

CCT (K)	CRI	Stabilization Time (Light & Power)
3622	83.7	60

Table 1: Executive Data Summary

Test specifications:

Date of Receipt	: Jul. 15, 2015
Date of Test	: Jul. 29, 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	: 2x4 LED Recessed Interior Luminaires
Model	: ELNV24-4835-1
Brand Name	: A.L.P Lighting
Electrical Ratings	: AC120~277V, 50/60Hz, 48W
Product Description	: 2x4 Panel Light, 3500K, Dimmable Driver: PIFN-X048A Manufacturer of light source: LG Model of light source: LGITLED1-28-35K Quantity of light source: 112pcs
Manufacturer	: A.L.P. Lighting Components, Inc.
Address	: 6333 Gross Point Road, Niles, IL 60714

TEST RESULTS

Test ambient temperature was 25.2℃.

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)	0.401	0.179
Power Factor	0.9956	0.9481
Test Power (W)	47.99	46.98
Off-State Power (W)	0	0
THD A%	7.09	11.85
Luminous Efficacy (lm/W)	93.0	95.0
Total Luminous Flux (lm)	4461.6	4461.5
Color Rendering Index (CRI)	83.7	
R9	11	
Correlated Color Temperature (CCT) (K)	3622	
Chromaticity (Chroma x, Chroma y)	(0.3971, 0.3827)	
Chromaticity (Chroma u, Chroma v)	(0.2336, 0.3378)	
Chromaticity (Chroma u', Chroma v')	(0.2336, 0.5067)	
Duv	0.0016	
Average Beam Angle (°)	110.9	
Center Beam Candle Power (cd)	1595	
Spacing Criteria	1.27 (0°-180°)/ 1.25 (90°-270°)	
Zonal Lumens in the 0°-60°Zone	79.19%	
Zonal Lumens in the 60°-90°Zone	20.69%	
Zonal Lumens in the 90°-120°Zone	0.07%	
Zonal Lumens in the 120°-180°Zone	0.05%	

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

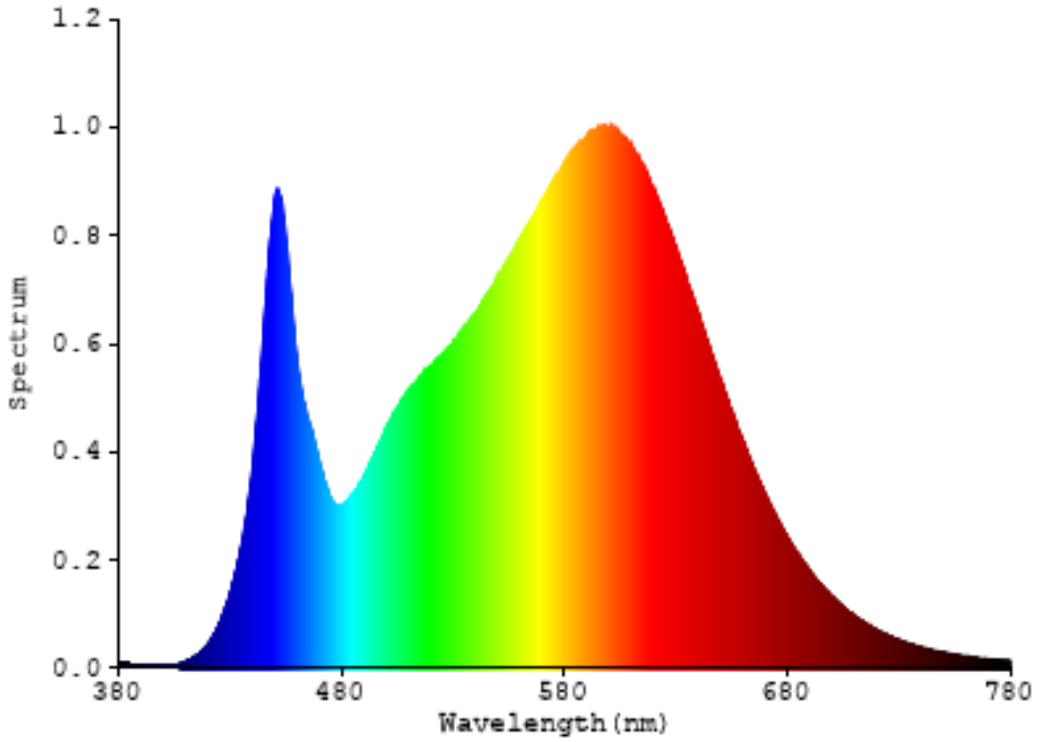


Chart 1: Spectral Power Distribution

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	150.742	3.38%
10- 20	430.472	9.65%
20- 30	649.096	14.55%
30- 40	777.617	17.43%
40- 50	802.496	17.99%
50- 60	722.845	16.20%
60- 70	549.126	12.31%
70- 80	307.306	6.89%
80- 90	66.439	1.49%
90-100	1.287	0.03%
100-110	1.044	0.02%
110-120	0.797	0.02%
120-130	0.652	0.01%
130-140	0.585	0.01%
140-150	0.473	0.01%
150-160	0.352	0.01%
160-170	0.231	0.01%
170-180	0.085	0.00%
Total	4461.6	100%

γ(°)	Lumens	% Total
0- 60	3533.268	79.19%
60- 90	922.871	20.69%
0-90	4456.139	99.88%
90- 180	5.506	0.12%
0- 180	4461.6	100%

Table 3: Zonal Lumen Data

Illuminance Plots

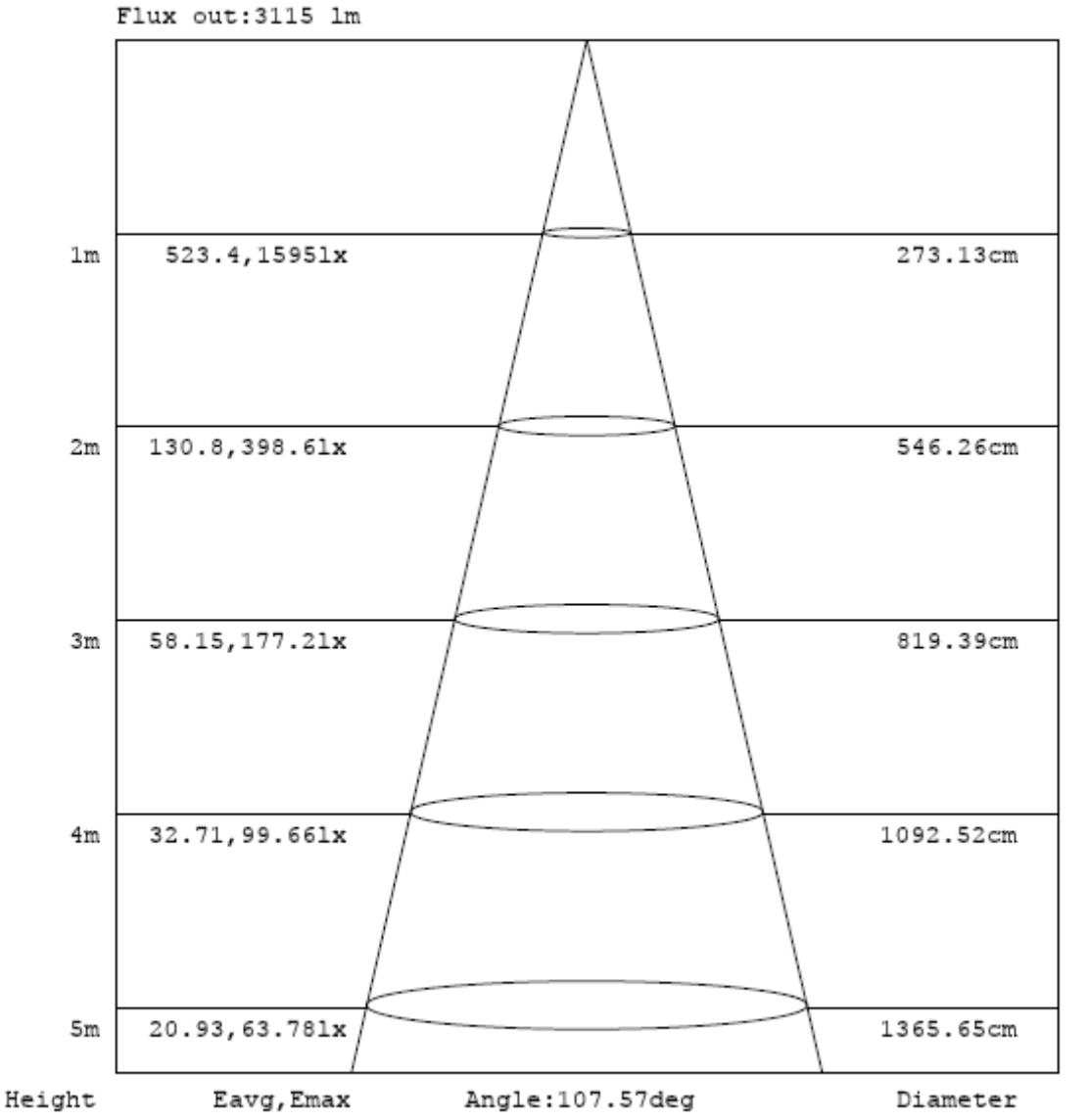


Chart 2: Beam angle

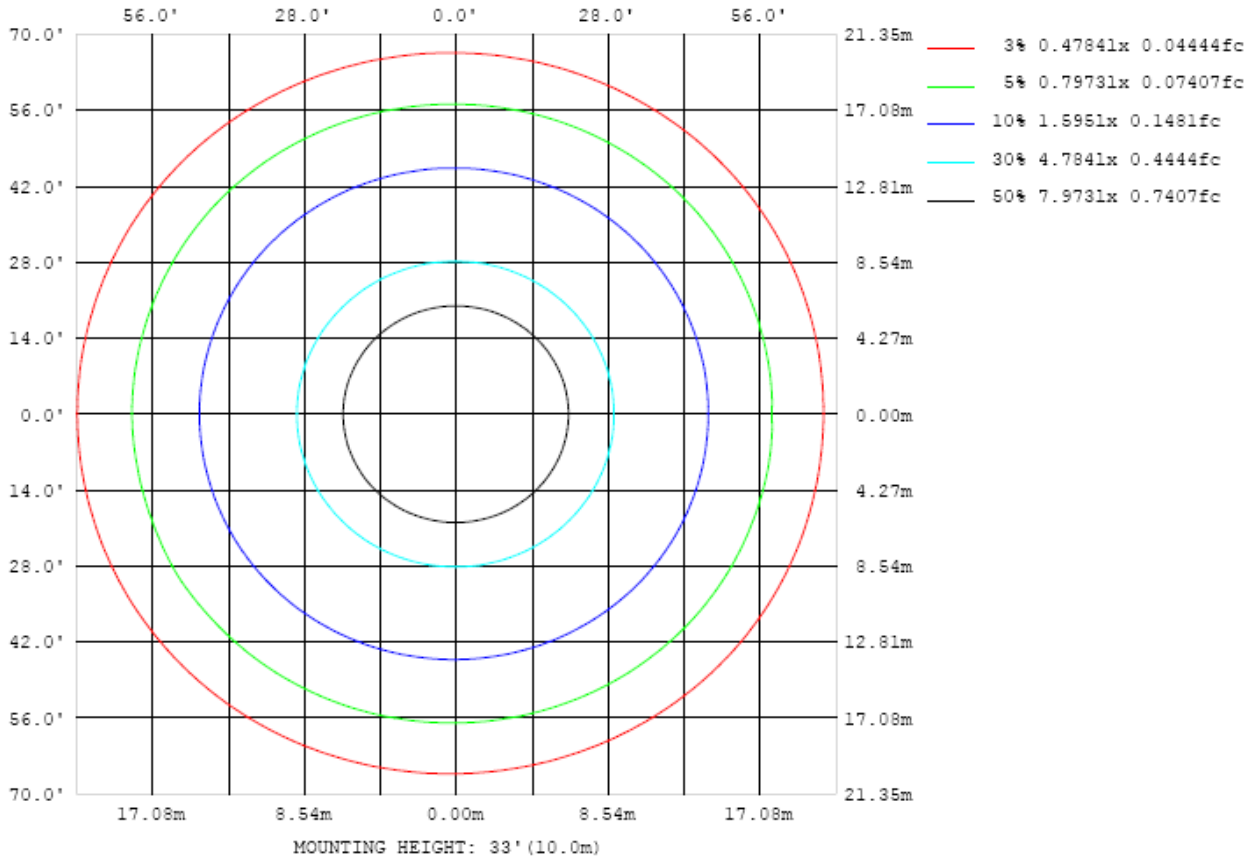


Chart 3: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots

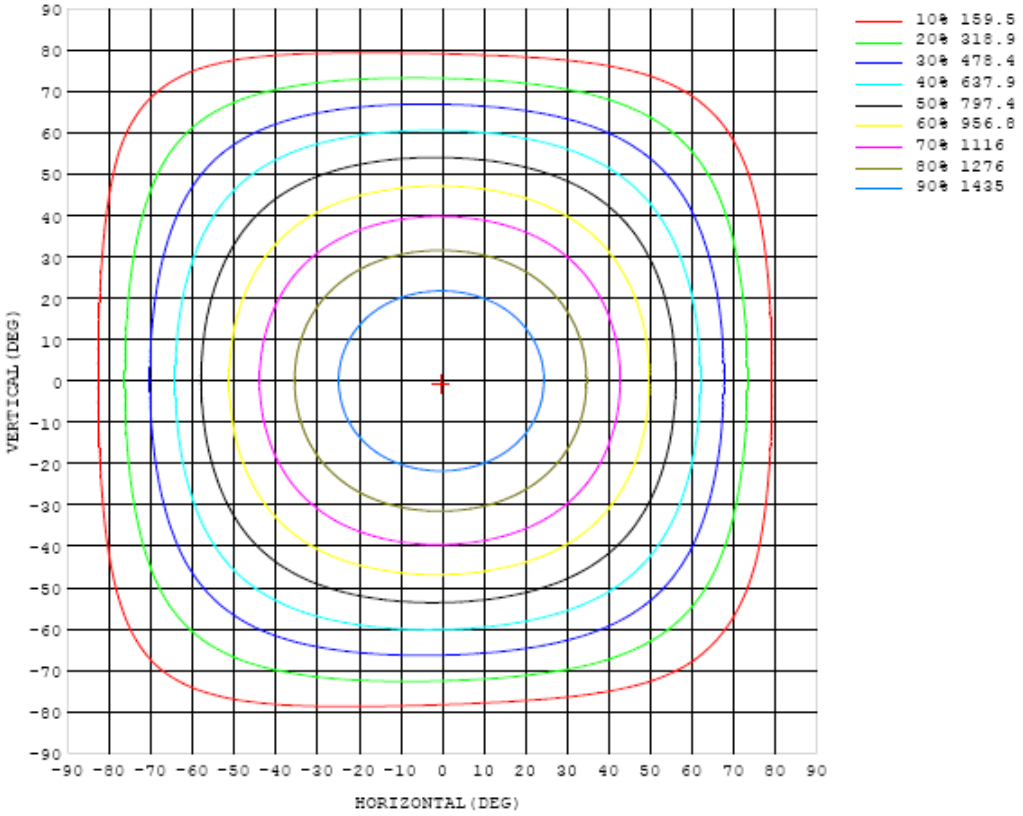


Chart 4: Isocandla Plot

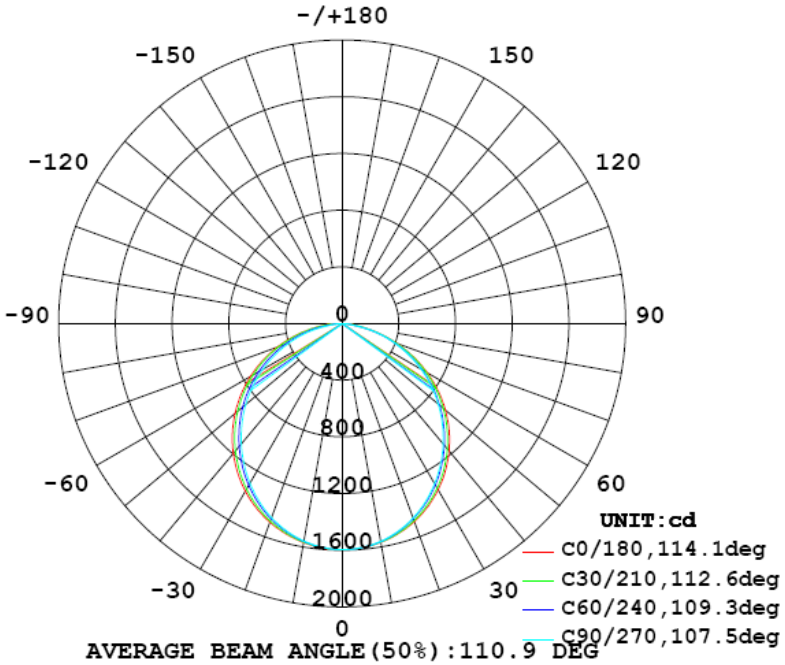


Chart 5: Polar Candela Distribution

Luminous Intensity Data

Table--1 UNIT: cd

C(DEG) / γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595
5	1588	1588	1588	1588	1587	1587	1587	1587	1586	1587	1587	1587	1587	1588	1588	1589	1588	1589	1588
10	1568	1567	1567	1566	1565	1563	1562	1562	1561	1561	1562	1562	1563	1565	1567	1568	1569	1570	1569
15	1534	1533	1532	1530	1527	1524	1522	1520	1518	1518	1519	1521	1524	1527	1530	1533	1536	1537	1536
20	1487	1486	1484	1480	1475	1470	1466	1462	1460	1460	1461	1465	1470	1475	1480	1485	1489	1491	1492
25	1427	1425	1422	1416	1409	1403	1396	1391	1388	1388	1390	1395	1401	1409	1417	1425	1430	1434	1435
30	1354	1352	1348	1340	1331	1322	1314	1308	1304	1304	1307	1313	1321	1332	1342	1352	1360	1364	1366
35	1269	1267	1261	1252	1242	1231	1222	1215	1210	1210	1214	1222	1231	1244	1256	1269	1278	1284	1286
40	1173	1170	1164	1154	1143	1131	1121	1113	1108	1108	1113	1121	1133	1147	1161	1175	1186	1193	1196
45	1066	1064	1057	1047	1036	1024	1012	1003	999	1000	1004	1014	1027	1043	1058	1073	1085	1093	1096
50	950	948	941	932	920	908	897	888	884	885	890	901	915	932	949	963	976	984	988
55	824	822	816	809	798	787	775	767	763	765	771	782	797	815	832	848	859	867	872
60	692	698	686	679	671	660	650	643	640	642	649	661	675	693	711	726	737	745	749
65	552	551	550	545	538	528	519	513	511	514	522	535	551	569	585	600	610	616	620
70	410	409	409	406	400	394	387	382	382	385	394	407	422	440	456	470	480	484	488
75	269	270	270	268	264	260	253	249	248	254	264	279	296	311	326	339	347	351	355
80	139	147	139	137	130	119	110	106	107	113	125	144	166	185	201	212	221	223	227
85	33.1	32.8	28.1	21.6	18.4	18.2	19.2	20.8	22.3	24.7	28.5	35.7	46.7	58.6	77.0	94.7	103	106	110
90	1.30	1.56	1.27	1.26	0.95	0.66	0.37	0.19	0.14	0.15	0.25	1.07	2.66	4.11	4.99	5.72	8.09	12.5	19.1
95	1.30	1.84	1.92	1.46	1.08	0.70	0.39	0.24	0.20	0.19	0.20	0.24	0.34	0.62	0.93	1.17	1.43	1.41	1.61
100	1.65	2.60	2.40	1.43	0.96	0.61	0.36	0.26	0.22	0.22	0.22	0.26	0.37	0.65	0.95	1.11	1.56	1.20	1.71
105	1.30	1.56	1.26	1.50	0.95	0.53	0.37	0.30	0.25	0.24	0.26	0.31	0.36	0.66	0.95	1.06	1.28	1.13	2.02
110	1.17	1.73	1.20	1.01	0.70	0.52	0.43	0.32	0.29	0.28	0.30	0.34	0.38	0.74	0.80	1.13	1.14	1.02	1.47
115	1.08	1.23	1.07	0.88	0.68	0.54	0.47	0.37	0.33	0.33	0.35	0.39	0.45	0.59	0.82	0.93	1.52	0.95	1.25
120	1.00	1.16	0.96	0.86	0.70	0.60	0.52	0.43	0.40	0.40	0.42	0.47	0.52	0.61	0.76	0.92	0.98	0.93	1.08
125	0.90	1.11	0.92	0.82	0.77	0.66	0.54	0.49	0.47	0.47	0.48	0.53	0.55	0.68	0.76	0.87	0.96	0.92	0.99
130	0.83	0.93	0.92	0.88	0.80	0.66	0.57	0.55	0.52	0.53	0.54	0.57	0.59	0.73	0.84	0.84	0.93	0.87	0.92
135	0.92	0.92	0.96	0.91	0.77	0.66	0.65	0.59	0.56	0.59	0.58	0.60	0.63	0.68	0.82	0.88	0.88	0.85	0.86
140	0.95	0.92	1.19	0.86	0.70	0.65	0.66	0.61	0.60	0.61	0.60	0.62	0.65	0.67	0.79	0.86	0.87	0.90	0.89
145	0.83	0.84	0.85	0.77	0.71	0.73	0.68	0.64	0.65	0.64	0.61	0.64	0.70	0.70	0.70	0.81	0.86	0.85	0.87
150	0.76	0.76	0.81	0.79	0.81	0.76	0.68	0.67	0.66	0.66	0.65	0.66	0.75	0.78	0.74	0.76	0.74	0.71	0.76
155	0.84	0.85	0.86	0.85	0.80	0.71	0.68	0.68	0.66	0.66	0.67	0.68	0.73	0.77	0.80	0.80	0.74	0.73	0.73
160	0.88	0.89	0.86	0.86	0.80	0.72	0.70	0.69	0.67	0.68	0.68	0.71	0.76	0.80	0.81	0.80	0.82	0.83	0.81
165	0.87	0.90	0.87	0.87	0.84	0.78	0.73	0.73	0.73	0.72	0.73	0.78	0.81	0.83	0.82	0.84	0.86	0.85	0.80
170	0.90	0.92	0.91	0.88	0.84	0.77	0.76	0.80	0.77	0.81	0.81	0.84	0.86	0.88	0.90	0.89	0.90	0.87	0.84
175	0.90	0.94	0.97	0.97	0.94	0.90	0.86	0.81	0.81	0.86	0.89	0.88	0.87	0.88	0.90	0.91	0.91	0.92	0.92
180	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96

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	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595	1595		
5	1588	1588	1587	1587	1587	1586	1585	1585	1585	1585	1585	1585	1585	1586	1587	1587	1587		
10	1568	1567	1566	1564	1562	1561	1559	1558	1558	1558	1558	1560	1561	1562	1564	1565	1567		
15	1535	1533	1530	1527	1523	1520	1517	1515	1515	1515	1516	1518	1521	1524	1528	1530	1532		
20	1491	1488	1483	1477	1471	1466	1463	1459	1458	1458	1461	1464	1470	1474	1479	1483	1486		
25	1434	1429	1422	1414	1406	1398	1392	1388	1386	1386	1390	1395	1402	1409	1416	1422	1426		
30	1364	1358	1349	1339	1329	1319	1310	1305	1302	1303	1307	1314	1322	1331	1340	1348	1353		
35	1283	1276	1266	1253	1241	1229	1219	1213	1209	1210	1215	1222	1232	1242	1253	1262	1268		
40	1193	1185	1173	1159	1145	1131	1120	1112	1109	1110	1114	1123	1133	1144	1155	1165	1172		
45	1093	1084	1072	1057	1042	1027	1015	1006	1002	1002	1007	1016	1026	1038	1049	1059	1065		
50	985	976	963	948	933	917	904	894	889	889	894	902	913	924	935	944	950		
55	869	860	848	834	818	801	787	777	771	771	775	783	794	804	814	820	825		
60	746	738	728	714	698	681	667	656	649	648	651	658	668	678	685	690	693		
65	618	612	603	589	573	556	542	531	523	521	524	530	538	545	551	554	554		
70	487	483	474	461	446	430	416	404	397	394	395	399	404	410	413	415	413		
75	355	352	344	332	319	304	290	277	269	266	267	270	273	275	277	277	274		
80	228	229	218	208	193	175	156	141	132	127	128	134	142	148	149	148	146		
85	117	108	100	82.8	65.3	52.3	42.9	35.9	31.6	28.9	27.3	26.6	28.9	30.3	33.4	37.8	37.9		
90	19.3	15.0	9.66	6.53	4.65	2.41	1.01	0.42	0.40	0.36	0.41	0.55	0.88	1.24	1.43	1.55	1.62		
95	2.07	1.67	1.45	1.12	0.86	0.59	0.49	0.46	0.46	0.46	0.53	0.65	0.99	1.41	1.68	2.35	1.60		
100	1.86	1.88	1.49	1.20	0.90	0.67	0.55	0.53	0.53	0.54	0.58	0.68	0.99	1.33	1.61	1.89	1.52		
105	2.58	2.47	1.79	1.15	0.87	0.68	0.61	0.58	0.58	0.59	0.64	0.81	1.09	1.21	1.74	1.63	1.41		
110	1.82	1.39	1.65	1.12	0.81	0.67	0.60	0.58	0.58	0.57	0.61	0.65	0.83	1.05	1.22	1.71	1.27		
115	1.46	1.26	1.08	0.92	0.72	0.63	0.56	0.54	0.53	0.53	0.55	0.63	0.74	0.87	1.02	1.19	1.11		
120	1.19	1.05	0.94	0.75	0.61	0.57	0.51	0.48	0.47	0.48	0.51	0.56	0.67	0.80	0.88	1.12	1.03		
125	1.09	0.97	0.87	0.72	0.61	0.51	0.47	0.44	0.43	0.45	0.50	0.54	0.68	0.82	0.84	1.00	0.97		
130	1.01	1.04	0.85	0.78	0.64	0.53	0.51	0.50	0.52	0.51	0.57	0.56	0.68	0.81	0.86	0.86	0.84		
135	0.94	0.89	0.89	0.80	0.66	0.62	0.59	0.60	0.62	0.61	0.64	0.65	0.69	0.81	0.90	0.93	0.91		
140	0.90	0.93	0.89	0.78	0.70	0.69	0.66	0.68	0.69	0.69	0.71	0.75	0.69	0.75	0.84	0.88	0.91		
145	0.89	0.99	0.83	0.74	0.74	0.74	0.70	0.72	0.76	0.75	0.73	0.75	0.77	0.72	0.73	0.78	0.79		
150	0.76	0.76	0.77	0.75	0.77	0.75	0.72	0.75	0.78	0.74	0.73	0.74	0.81	0.82	0.79	0.73	0.71		
155	0.70	0.74	0.80	0.80	0.78	0.72	0.73	0.75	0.76	0.76	0.76	0.76	0.78	0.82	0.86	0.84	0.80		
160	0.79	0.81	0.80	0.81	0.81	0.76	0.74	0.77	0.77	0.79	0.81	0.80	0.81	0.83	0.86	0.85	0.87		
165	0.78	0.78	0.80	0.82	0.82	0.81	0.78	0.78	0.81	0.83	0.82	0.81	0.82	0.84	0.85	0.83	0.83		
170	0.84	0.85	0.86	0.88	0.90	0.89	0.87	0.89	0.87	0.89	0.88	0.94	0.89	0.85	0.87	0.89	0.91		
175	0.93	0.94	0.95	0.95	0.94	0.93	0.94	0.92	0.89	0.88	0.87	0.87	0.89	0.92	0.89	0.88	0.92		
180	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96		

Table 5: Luminous Intensity Data

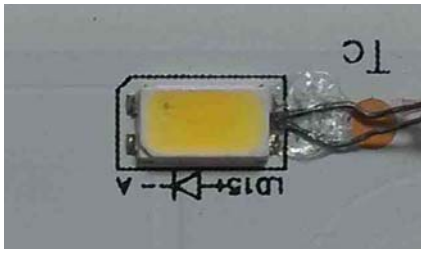
ISTMT TEST DATA:

Sample Tested**: ELNV24-4835-1**

Test ambient temperature was 26.8℃.

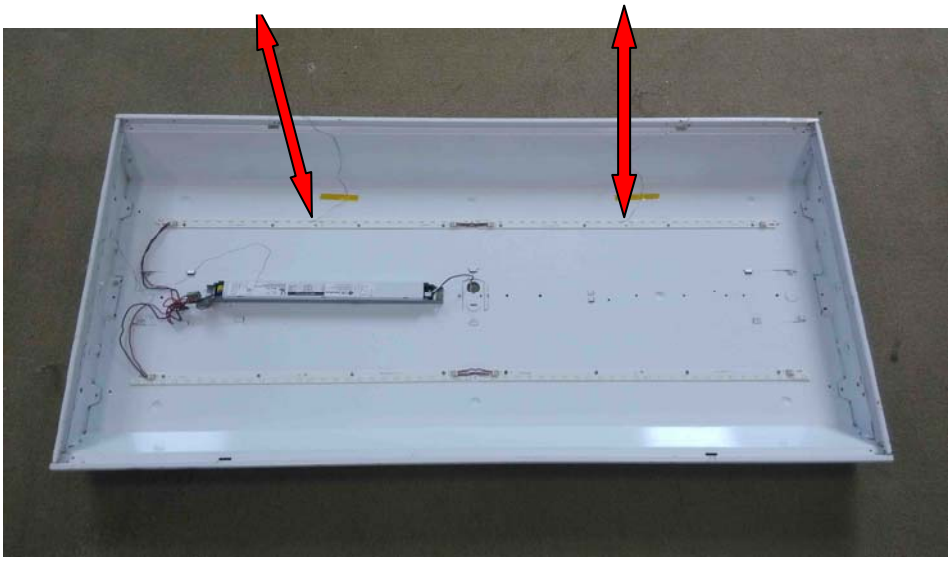
Test orientation was Light Down.

The stabilization time of the sample was 7.5 hours.



View of In-Situ Point- Ts

Point A Location Point B Location



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	47.99	107.4	51.1	44.9	41.6
277.0	46.98	107.4	51.0	45.1	41.8

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.

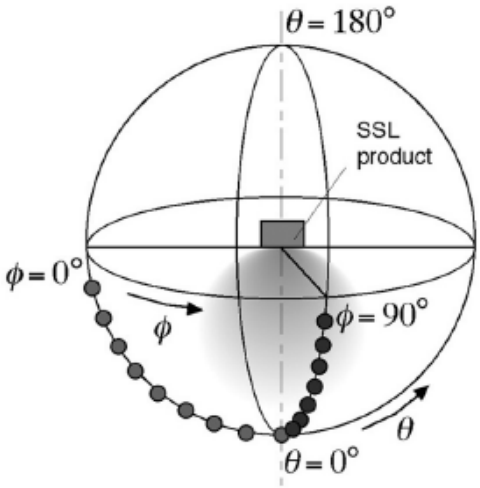
The uncertainty of goniophotometer system reported in this document is expended uncertainty is 1.94% with a coverage factor k=2.

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.



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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 ***