LM-79-08 Test Report

for

LIGHT EFFICIENT DESIGN, DIV OF TADD LLC

188 S. Northwest Highway, Suite 301 Cary, IL 60013-2987, USA

PL

Model: LED-7318-40A

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ17060051b

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

Review by: April Zou

Engineer: April Zou

Jul. 05, 2017

Approved by: Zhang

Manager: Jim Zhang

Jul. 05, 2017

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: **LED-7318-40A**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
78.5	1198.0	15.27	0.9936

CCT (K)	CRI	Stabilization Time (Light & Power)
3923	84.1	60

Table 1: Executive Data Summary

Note: The above results are recorded/ derived from measurements made using an Integrating Sphere.

Test specifications:

Date of Receipt	: Jul. 03, 2017
Date of Test	: Jul. 04, 2017
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

TABLE OF CONTENT

Sample Photos

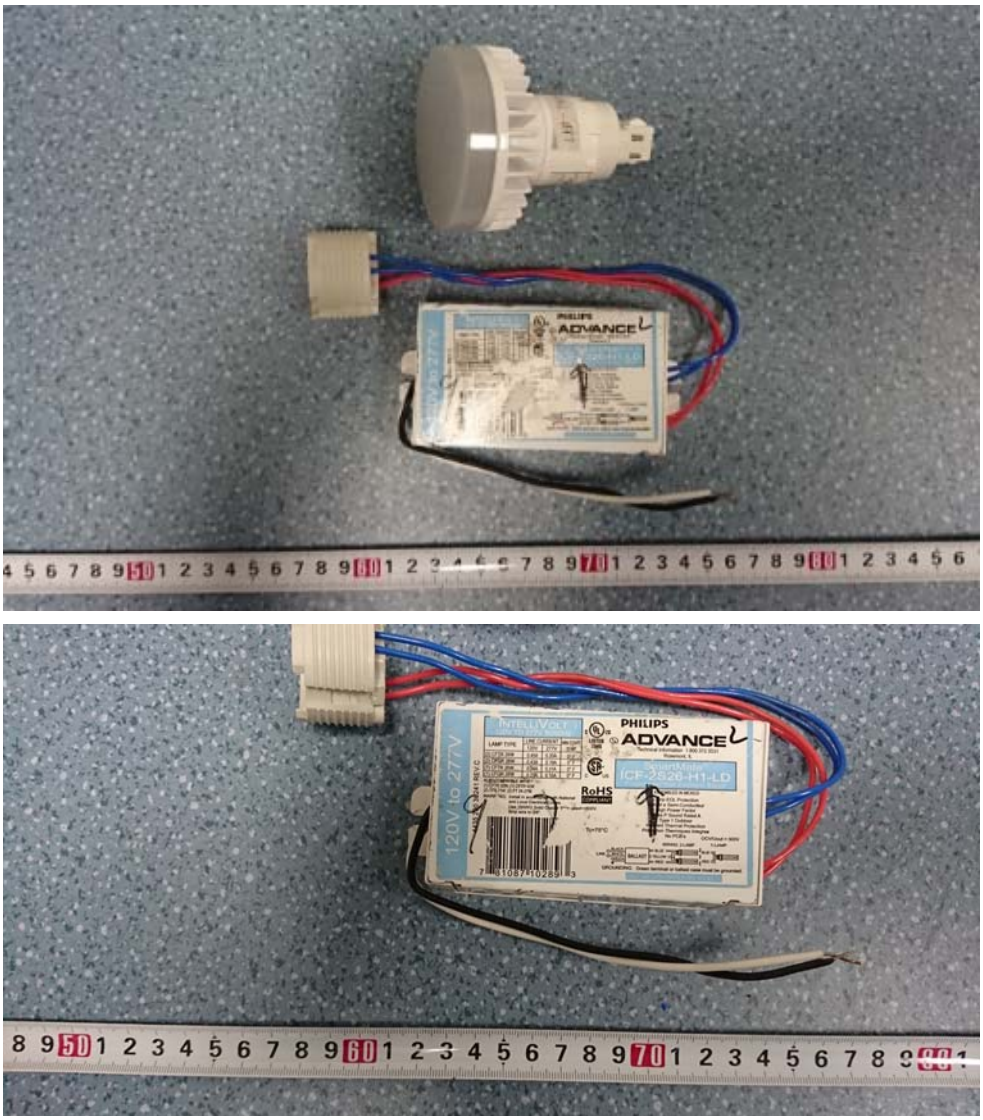


Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: PL
Model	: LED-7318-40A
Electrical Ratings	: AC100-277V, 60Hz, 12W
Product Description	: G24Q base, 4000K LED Tubes supplied by a high frequency fluorescent lamp ballast: ICF-2S26-H1-LD
Manufacturer	: LIGHT EFFICIENT DESIGN, DIV OF TADD LLC
Address	: 188 S. Northwest Highway, Suite 301 Cary, IL 60013-2987, USA

TEST RESULTS

Test ambient temperature was 25.0℃.

Base 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 65 minutes.

Sphere-Spectroradiometer Method

Parameter	Result			Special Color Rendering Indices	
Test Voltage (V)	120.0	100.0	277	R1	82.2
Voltage frequency (Hz)	60	60	60	R2	90.7
Test Current (A)	0.128	0.153	0.063	R3	96.3
Power Factor	0.9936	0.9952	0.9030	R4	82.3
Test Power (W)	15.27	15.23	15.79	R5	82.5
THD A%	6.73	7.56	16.48	R6	87.5
Luminous Efficacy (lm/W)	78.5	78.5	75.7	R7	86.3
Total Luminous Flux (lm)	1198.0	1196.0	1196.0	R8	65.2
Color Rendering Index (CRI)	84.1			R9	12
R9	12			R10	77.9
Correlated Color Temperature (CCT)(K)	3923			R11	81.2
Chromaticity Chroma x	0.3847			R12	68.9
Chromaticity Chroma y	0.3820			R13	84.4
Chromaticity Chroma u	0.2258			R14	98.3
Chromaticity Chroma v	0.3363				
Duv	0.0011				
Chromaticity Chroma u ’	0.2258				
Chromaticity Chroma v’	0.5045				

Table 2: Test data per Sphere-Spectroradiometer Method

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

Goniophotometer Method

Test ambient temperature was 25.1℃.

The photometric distance is 2.47m.

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

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.128
Power Factor	0.9929
Test Power (W)	15.27
Luminous Efficacy (lm/W)	79.6
Total Luminous Flux (lm)	1214.9
Beam Angle (°)	104.6
Center Beam Candle Power (cd)	389
Spacing Criteria	1.19 (0°-180°)/ 1.20 (90°-270°)
Zonal Lumens in the 0°-60°Zone	67.15%
Zonal Lumens in the 60°-90°Zone	22.49%
Zonal Lumens in the 90°-120°Zone	7.19%
Zonal Lumens in the 120°-180°Zone	3.17%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

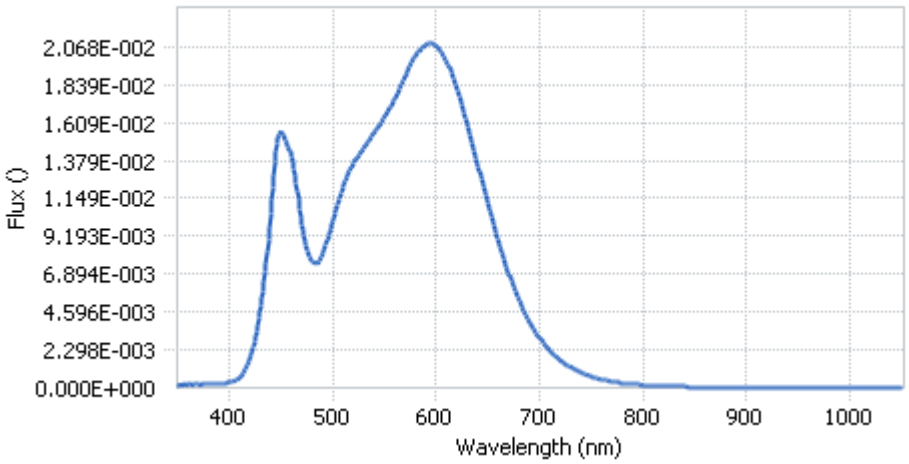
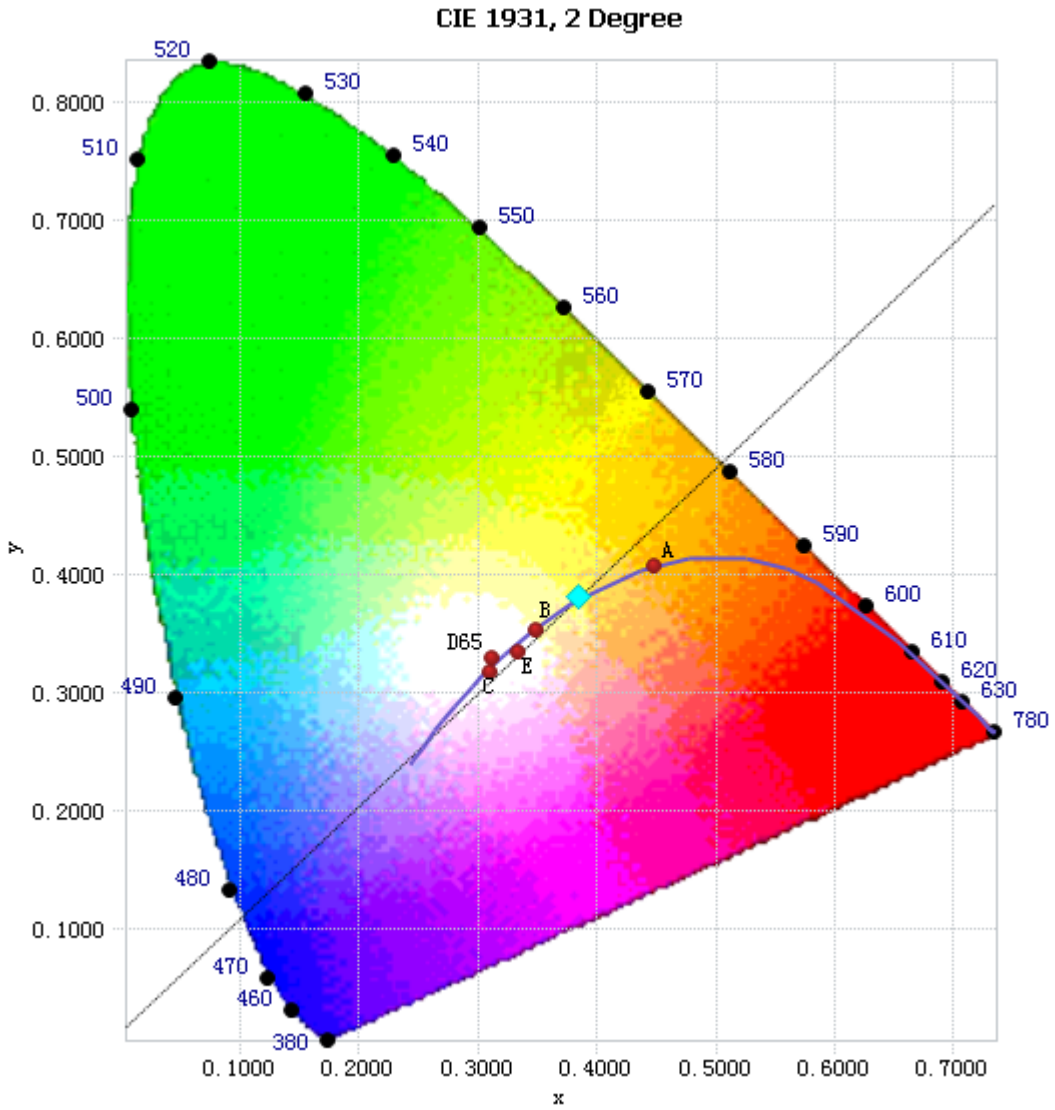


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.08E-04	485	7.51E-03	590	2.08E-02	695	3.48E-03
385	2.16E-04	490	7.98E-03	595	2.09E-02	700	3.03E-03
390	2.26E-04	495	8.97E-03	600	2.08E-02	705	2.60E-03
395	2.59E-04	500	1.01E-02	605	2.04E-02	710	2.23E-03
400	3.15E-04	505	1.11E-02	610	1.98E-02	715	1.93E-03
405	3.99E-04	510	1.22E-02	615	1.91E-02	720	1.67E-03
410	6.28E-04	515	1.30E-02	620	1.81E-02	725	1.43E-03
415	1.04E-03	520	1.36E-02	625	1.71E-02	730	1.24E-03
420	1.76E-03	525	1.41E-02	630	1.60E-02	735	1.07E-03
425	2.85E-03	530	1.46E-02	635	1.48E-02	740	9.07E-04
430	4.60E-03	535	1.50E-02	640	1.36E-02	745	7.85E-04
435	6.98E-03	540	1.54E-02	645	1.24E-02	750	6.72E-04
440	1.05E-02	545	1.59E-02	650	1.12E-02	755	5.79E-04
445	1.43E-02	550	1.64E-02	655	1.00E-02	760	5.00E-04
450	1.56E-02	555	1.70E-02	660	8.97E-03	765	4.37E-04
455	1.49E-02	560	1.75E-02	665	7.96E-03	770	3.69E-04
460	1.43E-02	565	1.82E-02	670	6.94E-03	775	3.22E-04
465	1.24E-02	570	1.89E-02	675	6.11E-03	780	2.79E-04
470	9.89E-03	575	1.95E-02	680	5.35E-03		
475	8.41E-03	580	2.01E-02	685	4.66E-03		
480	7.68E-03	585	2.06E-02	690	4.03E-03		

Table 4: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3847, 0.3820)

Chart 2: Chromaticity Diagram per Sphere - Spectroradiometer Method

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.

Nominal CCT Quadrangles – Sphere Spectroradiometer Method

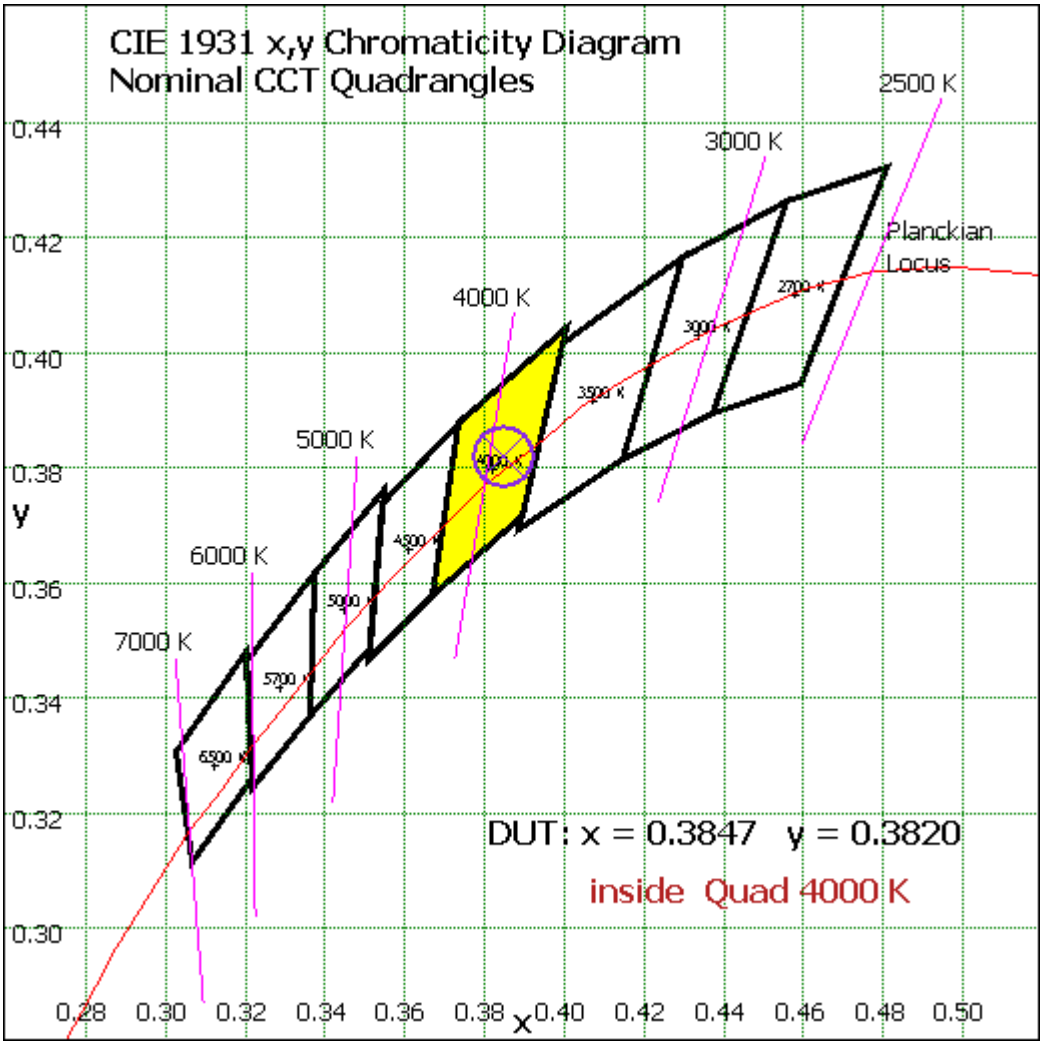


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	36.75	3.02%
10- 20	104.178	8.57%
20- 30	153.997	12.68%
30- 40	179.086	14.74%
40- 50	179.802	14.80%
50- 60	161.984	13.33%
60- 70	131.094	10.79%
70- 80	90.622	7.46%
80- 90	51.473	4.24%
90-100	35.771	2.94%
100-110	28.984	2.39%
110-120	22.643	1.86%
120-130	16.693	1.37%
130-140	11.239	0.93%
140-150	6.605	0.54%
150-160	3.067	0.25%
160-170	0.865	0.07%
170-180	0.077	0.01%
Total	1214.9	100%

γ(°)	Lumens	% Total
0- 60	815.797	67.15%
60- 90	273.189	22.49%
0-90	1088.986	89.63%
90- 180	125.944	10.37%
0- 180	1214.9	100%

Table 5: Zonal Lumen Data

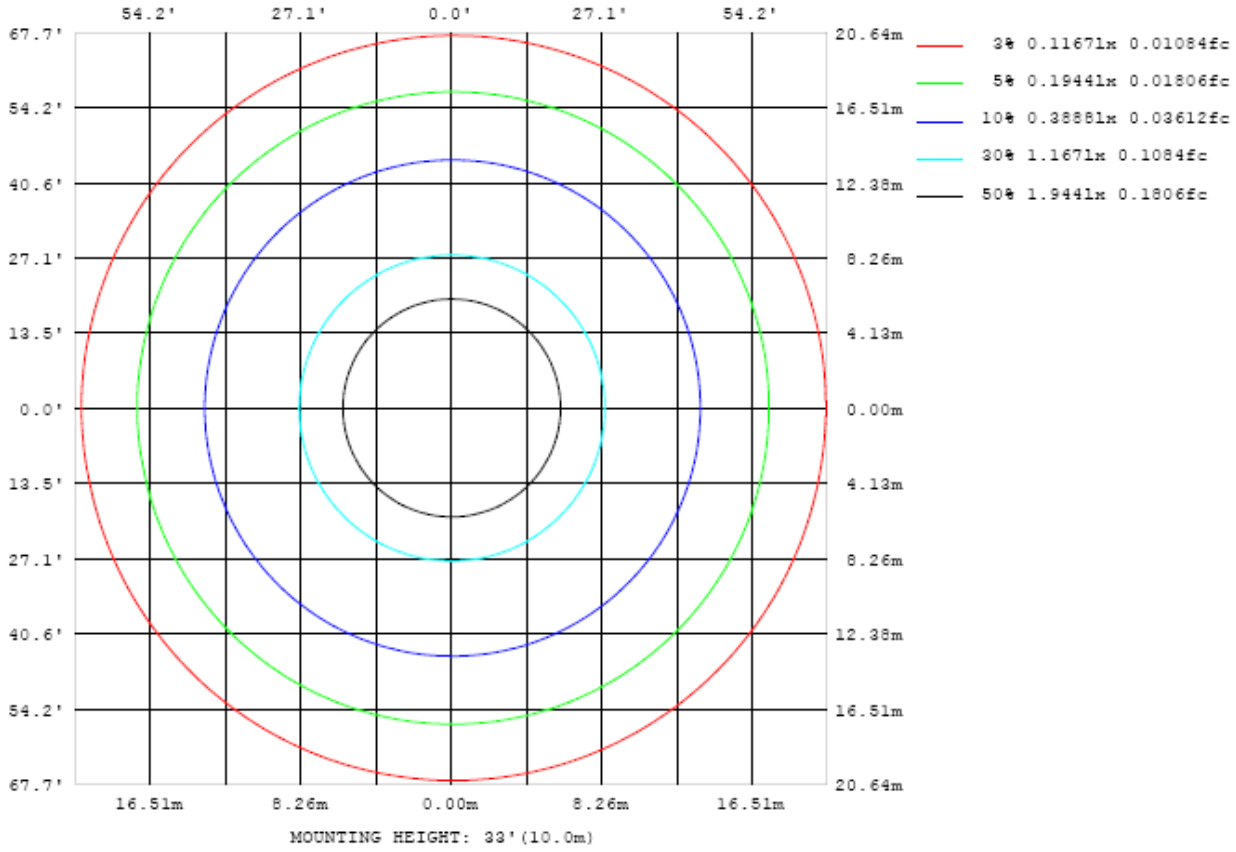


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

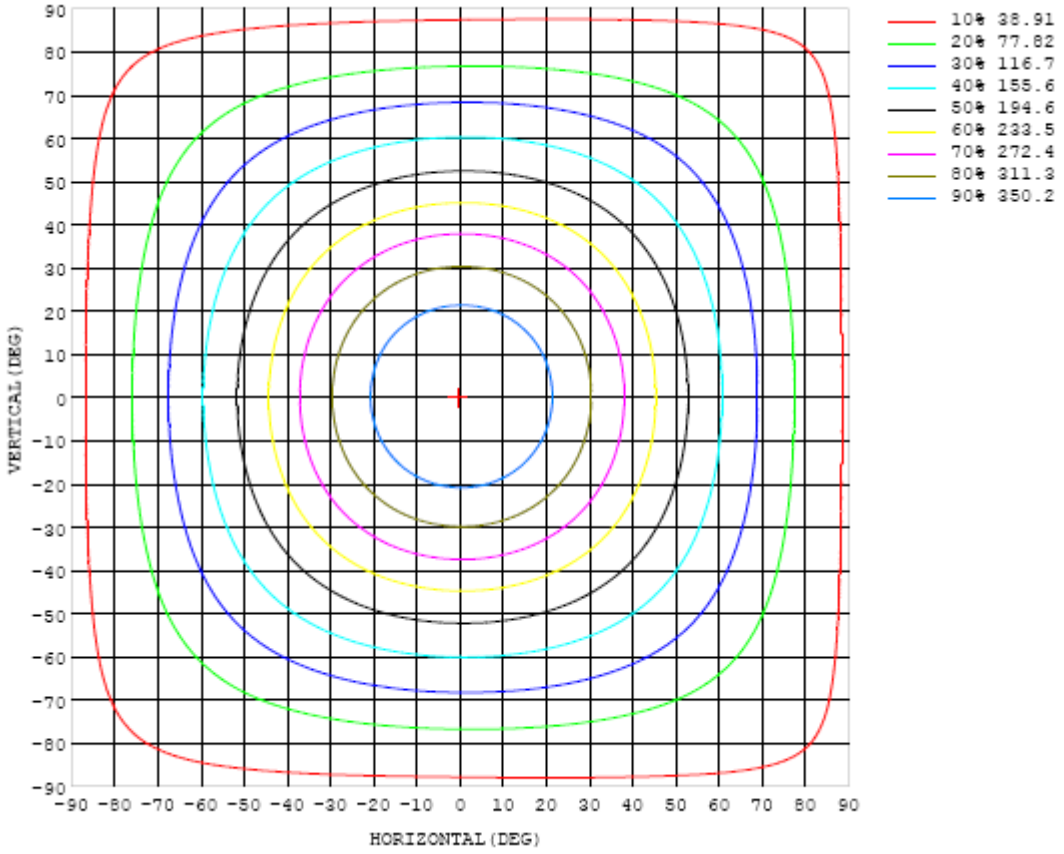


Chart 5: Isocandela Plot

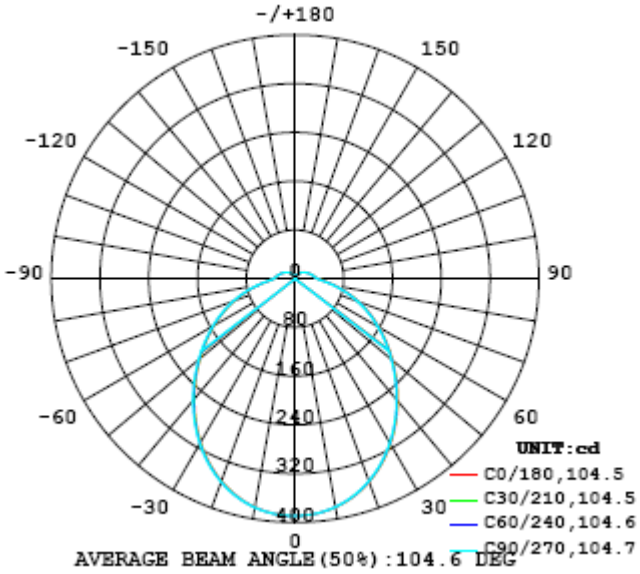


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

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	389	389	389	389	389	389	389	389	389	389	389	389	389	389	389	389	389	389	389
5	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387
10	381	381	381	381	381	381	380	380	380	380	380	380	380	380	380	380	380	380	381
15	370	370	370	370	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369
20	355	355	355	354	354	354	354	353	353	353	353	353	353	353	353	353	353	353	353
25	336	336	335	335	335	334	334	334	334	333	333	333	333	333	333	333	333	333	333
30	313	313	313	312	312	312	311	311	311	310	310	310	310	310	310	310	309	310	310
35	288	288	288	287	287	286	286	286	285	285	285	285	285	284	284	284	284	284	284
40	262	262	261	261	260	260	260	259	259	259	258	258	258	258	257	257	257	257	257
45	235	235	235	234	234	233	233	233	232	232	232	231	231	231	231	230	230	230	230
50	209	209	208	208	208	207	207	206	206	206	205	205	205	204	204	204	204	203	204
55	183	183	183	183	182	182	182	181	181	180	180	180	180	179	179	178	178	178	178
60	159	159	158	158	158	157	157	157	156	156	155	155	155	154	154	154	153	153	154
65	135	135	135	134	134	134	133	133	132	132	132	131	131	130	130	129	129	129	129
70	111	111	111	111	111	110	110	109	109	108	108	108	107	107	106	106	105	105	106
75	88.5	88.4	88.3	88.1	87.8	87.3	87.0	86.4	85.9	85.5	85.0	84.6	84.2	83.7	83.3	82.9	82.3	82.0	82.5
80	67.1	67.1	67.0	66.8	66.5	66.1	65.9	65.2	64.7	64.2	63.8	63.5	63.1	62.6	62.2	61.9	61.4	61.1	61.0
85	48.3	48.3	48.3	48.1	47.8	47.5	47.2	46.8	46.4	45.9	45.7	45.4	45.1	44.8	44.5	44.2	43.9	43.6	43.5
90	36.4	36.5	36.5	36.5	36.5	36.4	36.4	36.3	36.2	36.1	36.1	36.2	36.2	36.1	36.0	35.9	35.7	35.4	35.3
95	33.1	33.1	33.1	33.1	33.1	33.1	33.0	33.0	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.7	32.6	32.4	32.3
100	30.2	30.2	30.2	30.2	30.2	30.1	30.1	30.1	30.0	29.9	30.0	30.0	30.0	30.0	30.0	29.9	29.8	29.7	29.6
105	27.5	27.6	27.6	27.6	27.5	27.5	27.4	27.4	27.4	27.3	27.3	27.4	27.4	27.4	27.4	27.3	27.2	27.1	27.1
110	25.2	25.2	25.2	25.2	25.1	25.1	25.0	25.0	25.0	24.9	24.9	24.9	25.0	25.0	24.9	24.9	24.8	24.8	24.8
115	23.0	23.0	22.9	22.9	22.9	22.8	22.8	22.8	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.6	22.6	22.5	22.6
120	20.9	20.8	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.4	20.4	20.4
125	18.8	18.8	18.7	18.7	18.7	18.6	18.6	18.5	18.5	18.5	18.4	18.4	18.4	18.4	18.4	18.4	18.3	18.3	18.3
130	16.7	16.7	16.7	16.7	16.6	16.5	16.5	16.5	16.4	16.4	16.4	16.3	16.3	16.3	16.3	16.3	16.2	16.2	16.3
135	14.7	14.7	14.7	14.6	14.6	14.5	14.5	14.4	14.4	14.3	14.3	14.3	14.3	14.3	14.2	14.2	14.2	14.2	14.2
140	12.7	12.7	12.6	12.6	12.5	12.5	12.4	12.4	12.4	12.3	12.3	12.3	12.2	12.2	12.2	12.2	12.2	12.2	12.2
145	10.7	10.6	10.6	10.6	10.5	10.5	10.4	10.4	10.3	10.3	10.3	10.2	10.2	10.2	10.2	10.2	10.1	10.2	10.2
150	8.67	8.64	8.60	8.56	8.51	8.46	8.42	8.38	8.33	8.30	8.26	8.23	8.21	8.19	8.17	8.16	8.15	8.16	8.23
155	6.66	6.62	6.58	6.53	6.49	6.44	6.40	6.36	6.32	6.29	6.25	6.22	6.20	6.17	6.16	6.15	6.16	6.17	6.27
160	4.80	4.76	4.72	4.68	4.63	4.58	4.54	4.51	4.46	4.39	4.38	4.37	4.35	4.33	4.32	4.32	4.33	4.34	4.42
165	3.07	3.03	2.99	2.95	2.74	2.27	1.70	0.95	0.57	1.30	2.12	2.57	2.66	2.64	2.63	2.63	2.63	2.65	2.70
170	1.56	1.50	1.36	1.29	1.12	1.32	1.45	1.37	1.32	1.27	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.24	1.25
175	0.56	0.53	0.50	0.46	0.45	0.45	0.45	0.43	0.41	0.40	0.40	0.41	0.41	0.40	0.40	0.39	0.38	0.39	0.40
180	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37

Table 6: 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	389	389	389	389	389	389	389	389	389	389	389	389	389	389	389	389	389		
5	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387		
10	381	381	381	381	381	381	381	381	381	381	381	381	381	381	381	381	381		
15	369	369	370	370	370	370	370	371	371	371	371	371	371	371	371	370	370		
20	353	354	354	354	354	355	355	355	355	356	356	356	356	356	356	355	355		
25	333	334	334	334	335	335	335	336	336	336	336	336	336	336	336	336	336		
30	310	310	311	311	312	312	313	313	313	313	314	314	314	314	314	314	313		
35	284	285	285	286	286	287	287	288	288	288	288	289	289	289	289	289	288		
40	257	258	258	259	259	260	260	261	261	262	262	262	262	262	262	262	262		
45	230	231	231	231	232	233	233	234	234	235	235	235	235	236	236	236	235		
50	204	204	204	205	205	206	207	207	207	208	208	209	209	209	209	209	209		
55	178	178	178	179	179	180	181	181	182	182	182	183	183	184	184	184	184		
60	154	154	154	155	155	156	156	157	157	158	158	159	159	159	160	159	159		
65	129	129	130	130	131	131	132	132	133	133	134	134	135	135	135	136	136		
70	106	106	106	106	107	107	108	108	109	109	110	111	111	111	112	112	112		
75	82.4	82.5	82.7	83.1	83.6	84.1	84.7	85.2	85.7	86.3	86.8	87.4	87.9	88.2	88.6	88.8	88.9		
80	60.9	61.0	61.2	61.6	62.0	62.4	62.9	63.4	63.9	64.4	64.9	65.4	65.9	66.3	66.6	66.9	67.1		
85	43.4	43.4	43.5	43.8	44.1	44.4	44.7	45.1	45.5	45.9	46.3	46.7	47.2	47.5	47.8	48.0	48.2		
90	35.2	35.1	35.1	35.2	35.2	35.2	35.3	35.3	35.4	35.4	35.6	35.7	35.9	36.0	36.2	36.3	36.4		
95	32.3	32.2	32.2	32.3	32.3	32.4	32.4	32.4	32.5	32.5	32.6	32.7	32.8	32.9	32.9	33.0	33.0		
100	29.6	29.5	29.5	29.6	29.6	29.7	29.7	29.7	29.8	29.8	29.8	29.9	30.0	30.0	30.1	30.1	30.2		
105	27.1	27.1	27.1	27.1	27.2	27.2	27.2	27.3	27.3	27.3	27.3	27.4	27.5	27.5	27.5	27.5	27.6		
110	24.8	24.7	24.8	24.8	24.9	24.9	24.9	25.0	25.0	25.0	25.0	25.1	25.1	25.1	25.2	25.2	25.2		
115	22.6	22.5	22.6	22.6	22.7	22.7	22.7	22.8	22.8	22.8	22.8	22.9	22.9	22.9	23.0	23.0	23.0		
120	20.4	20.4	20.4	20.5	20.5	20.6	20.6	20.7	20.7	20.7	20.8	20.8	20.8	20.8	20.8	20.9	20.9		
125	18.3	18.3	18.4	18.4	18.5	18.5	18.6	18.6	18.7	18.7	18.7	18.8	18.8	18.8	18.8	18.8	18.8		
130	16.3	16.3	16.3	16.4	16.4	16.5	16.6	16.6	16.6	16.7	16.7	16.7	16.8	16.8	16.8	16.8	16.8		
135	14.2	14.2	14.2	14.3	14.3	14.4	14.4	14.5	14.5	14.6	14.6	14.6	14.6	14.7	14.6	14.6	14.6		
140	12.2	12.2	12.2	12.3	12.3	12.4	12.5	12.5	12.5	12.6	12.6	12.6	12.7	12.7	12.7	12.7	12.7		
145	10.2	10.2	10.3	10.3	10.4	10.4	10.5	10.5	10.6	10.6	10.7	10.7	10.7	10.7	10.7	10.7	10.7		
150	8.28	8.30	8.33	8.38	8.43	8.48	8.55	8.60	8.64	8.68	8.71	8.73	8.74	8.74	8.73	8.72	8.69		
155	6.37	6.38	6.42	6.46	6.51	6.57	6.62	6.68	6.72	6.76	6.79	6.81	6.82	6.82	6.81	6.81	6.74		
160	4.54	4.53	4.57	4.61	4.65	4.70	4.76	4.82	4.86	4.90	4.93	4.96	4.98	4.98	4.97	4.97	4.87		
165	2.84	2.79	2.83	2.87	2.91	2.96	3.02	3.07	3.12	3.16	3.19	3.22	3.24	3.25	3.25	3.24	3.11		
170	1.36	1.38	1.34	1.40	1.45	1.49	1.53	1.57	1.61	1.63	1.66	1.69	1.70	1.71	1.72	1.68	1.59		
175	0.42	0.44	0.50	0.48	0.50	0.47	0.51	0.55	0.56	0.57	0.58	0.59	0.59	0.59	0.59	0.59	0.59		
180	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Jul. 26, 2016	Jul. 25, 2017
Digital Power Meter	PF2010A	HZTE028-01	Jul. 26, 2016	Jul. 25, 2017
AC Power Supply	DPS1060	HZTE001-06	Dec. 25, 2016	Dec. 24, 2017
DC Power Supply	WY12010	HZTE004-03	Dec. 25, 2016	Dec. 24, 2017
Temperature Meter	TES1310	HZTE017-01	Aug. 08, 2016	Aug. 07, 2017
Standard source	D908	HZTE012-01	Jul. 28, 2016	Jul. 27, 2017
Integrate Sphere system	2M	HZTE015-01	Jul. 26, 2016	Jul. 25, 2017
Digital Power Meter	WT210	HZTE008-01	Jul. 26, 2016	Jul. 25, 2017
AC Power Supply	PCR 500L	HZTE001-07	Dec. 25, 2016	Dec. 24, 2017
DC Power Supply	IT6154	HZTE004-04	Jul. 27, 2016	Jul. 26, 2017
Temperature and humidity recorder	JR900	HZTE018-01	Dec. 25, 2016	Dec. 24, 2017
Standard source	SCL-1400	HZTE012-02	Jul. 28, 2016	Jul. 27, 2017

Table 8: 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.

Sphere-Spectroradiometer Method- Photometric and Electrical Measurements

A Labsphere Model CDS 2100 Spectroradiometer and Two Meter Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit. The coating reflectance of each sphere is 98%. The measure geometry is 4π. Self-absorption correction is conducted in testing. Bandwidth of spectroradiometer is 350nm-1050nm.

Ambient temperature was measured at a position inside the sphere. 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 PLs) 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 Yokogawa Power Analyzer.

The standard reference of the integrated sphere system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Standards and Technology.

The uncertainty of integrating sphere system reported in this document is expended uncertainty is 2.1% with a coverage factor k=2.

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 PLs) 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 2.3% with a coverage factor k=2.

Color Characteristics Measurements

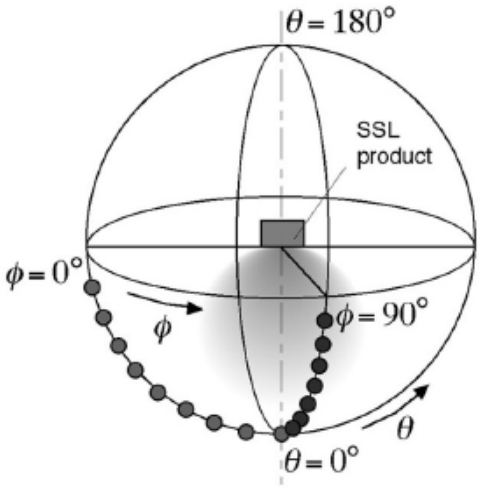
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as 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.



*** End of Report ***