



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-7318-35A

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ17060051a

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

Review by:

April Zou

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Jul. 05, 2017

Approved by:



Jim 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-7318-35A**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
75.3	1157.0	15.37	0.9937
CCT (K)	CRI	Stabilization Time (Light & Power)	
3477	83.9	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

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Sample Photos

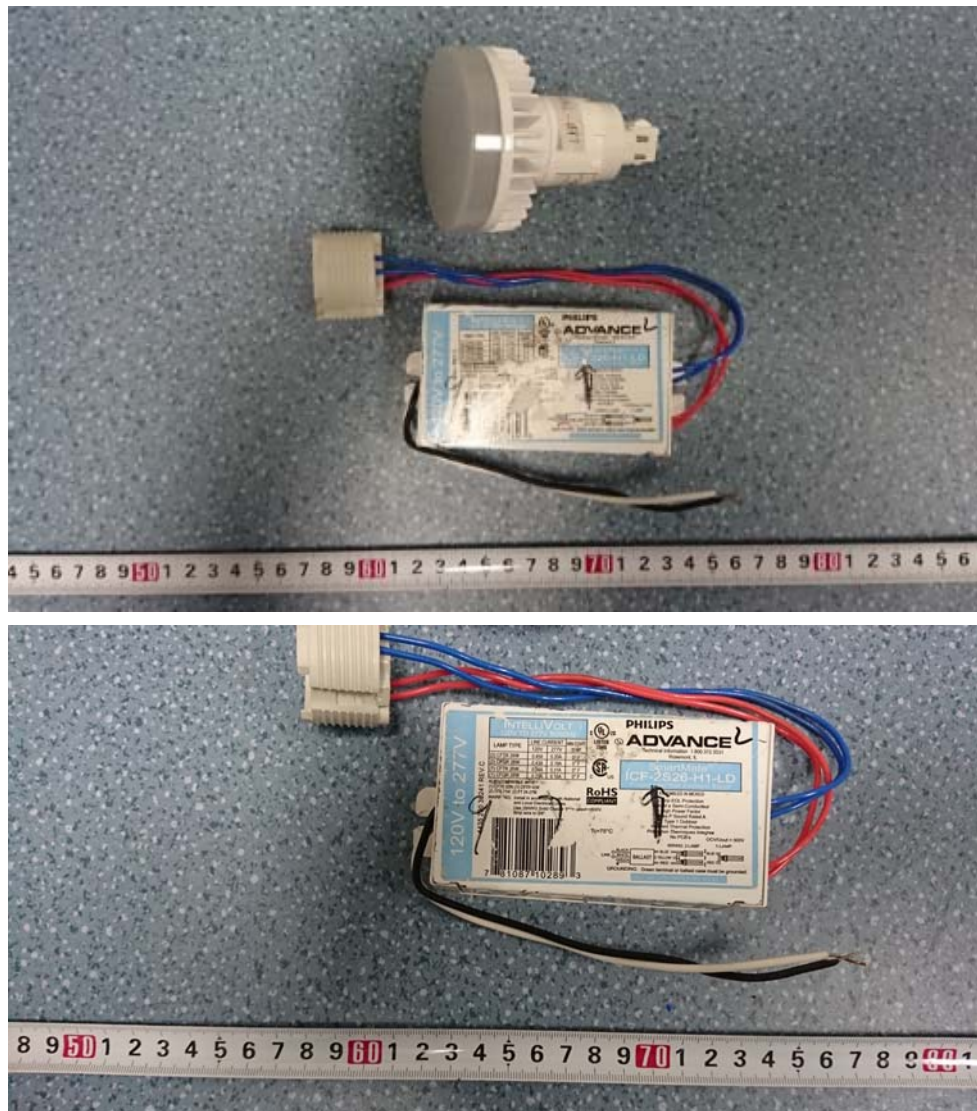


Figure 1- Overview of the sample

Equipment Under Test (EUT)

Name	: PL
Model	: LED-7318-35A
Electrical Ratings	: AC100-277V, 60Hz, 12W
Product Description	: G24Q base, 3500K 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°C.

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	82.1
Voltage frequency (Hz)	60	60	60	R2	91.3
Test Current (A)	0.129	0.154	0.064	R3	96.6
Power Factor	0.9937	0.9952	0.9040	R4	81.7
Test Power (W)	15.37	15.33	15.89	R5	82.3
THD A%	6.77	7.54	16.34	R6	88.8
Luminous Efficacy (lm/W)	75.3	75.4	72.8	R7	84.9
Total Luminous Flux (lm)	1157.0	1156.0	1156.0	R8	63.1
Color Rendering Index (CRI)	83.9			R9	11.7
R9	11.7			R10	79.7
Correlated Color Temperature (CCT)(K)	3477			R11	80.7
Chromaticity Chroma x	0.4074			R12	70
Chromaticity Chroma y	0.3937			R13	84.5
Chromaticity Chroma u	0.2358			R14	98.6
Chromaticity Chroma v	0.3419				
Duv	0.0006				
Chromaticity Chroma u'	0.2358				
Chromaticity Chroma v'	0.5128				

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°C.

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)	0.129
Power Factor	0.9929
Test Power (W)	15.34
Luminous Efficacy (lm/W)	76.7
Total Luminous Flux (lm)	1175.8
Beam Angle (°)	104.5
Center Beam Candle Power (cd)	378
Spacing Criteria	1.21 (0°-180°)/ 1.20 (90°-270°)
Zonal Lumens in the 0°-60°Zone	67.28%
Zonal Lumens in the 60°-90°Zone	22.37%
Zonal Lumens in the 90°-120°Zone	7.16%
Zonal Lumens in the 120°-180°Zone	3.19%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

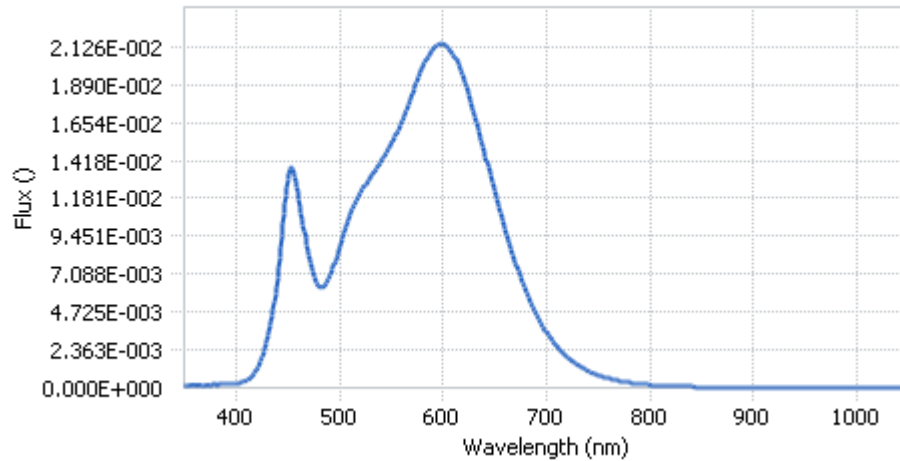


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.89E-04	485	6.35E-03	590	2.11E-02	695	3.99E-03
385	1.87E-04	490	6.85E-03	595	2.14E-02	700	3.46E-03
390	1.86E-04	495	7.76E-03	600	2.15E-02	705	2.98E-03
395	2.13E-04	500	8.80E-03	605	2.12E-02	710	2.58E-03
400	2.45E-04	505	9.83E-03	610	2.08E-02	715	2.22E-03
405	3.17E-04	510	1.08E-02	615	2.01E-02	720	1.93E-03
410	4.69E-04	515	1.15E-02	620	1.92E-02	725	1.67E-03
415	7.30E-04	520	1.22E-02	625	1.82E-02	730	1.42E-03
420	1.17E-03	525	1.27E-02	630	1.71E-02	735	1.22E-03
425	1.85E-03	530	1.32E-02	635	1.60E-02	740	1.05E-03
430	2.98E-03	535	1.36E-02	640	1.47E-02	745	9.06E-04
435	4.53E-03	540	1.41E-02	645	1.34E-02	750	7.78E-04
440	6.92E-03	545	1.46E-02	650	1.22E-02	755	6.71E-04
445	1.02E-02	550	1.52E-02	655	1.10E-02	760	5.79E-04
450	1.30E-02	555	1.59E-02	660	9.90E-03	765	5.02E-04
455	1.36E-02	560	1.66E-02	665	8.84E-03	770	4.33E-04
460	1.22E-02	565	1.74E-02	670	7.79E-03	775	3.72E-04
465	1.01E-02	570	1.83E-02	675	6.89E-03	780	3.18E-04
470	8.24E-03	575	1.91E-02	680	6.02E-03		
475	7.01E-03	580	1.99E-02	685	5.27E-03		
480	6.31E-03	585	2.07E-02	690	4.59E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method

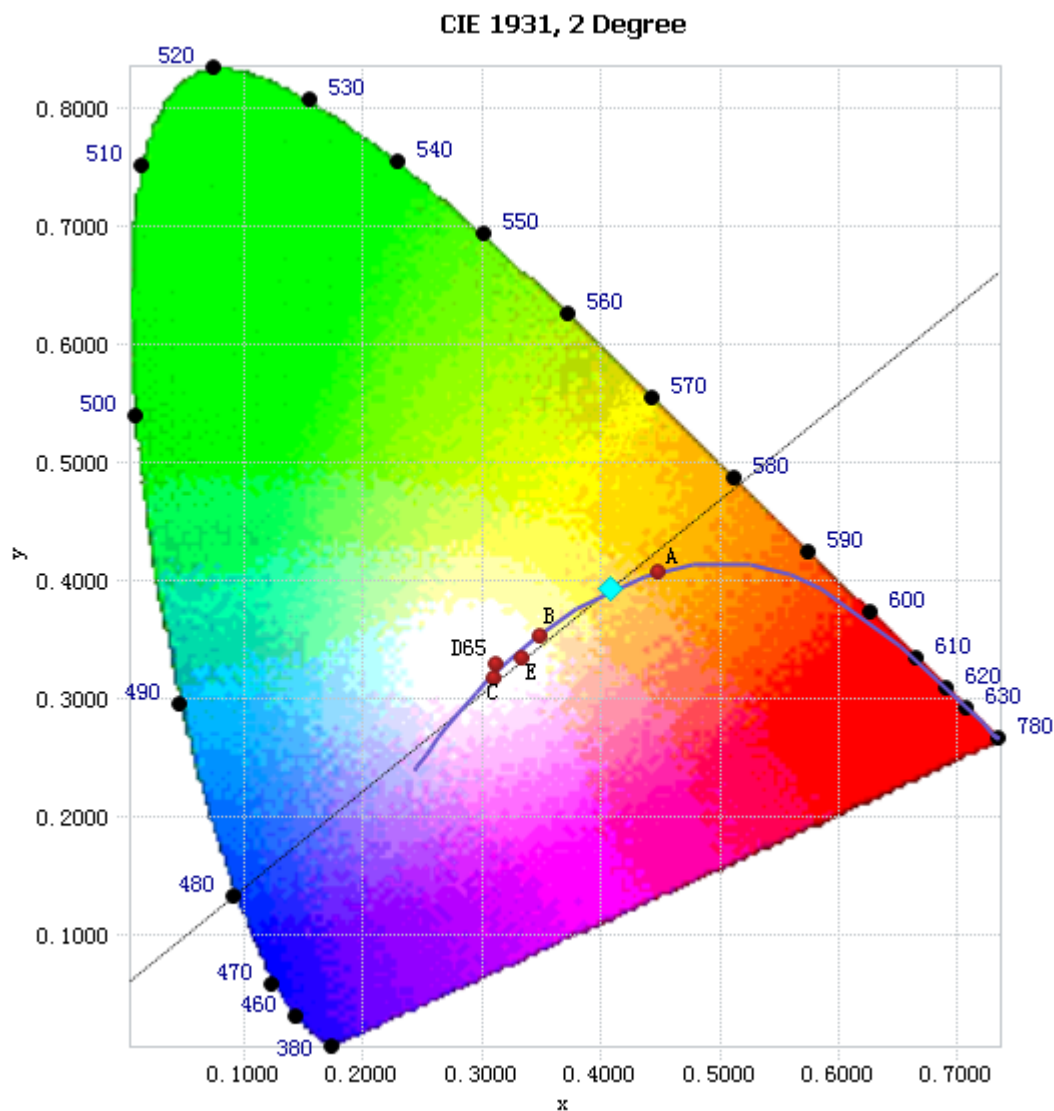


Chart 2: Chromaticity Diagram per Sphere - Spectroradiometer Method

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

Nominal CCT Quadrangles – Sphere Spectroradiometer Method

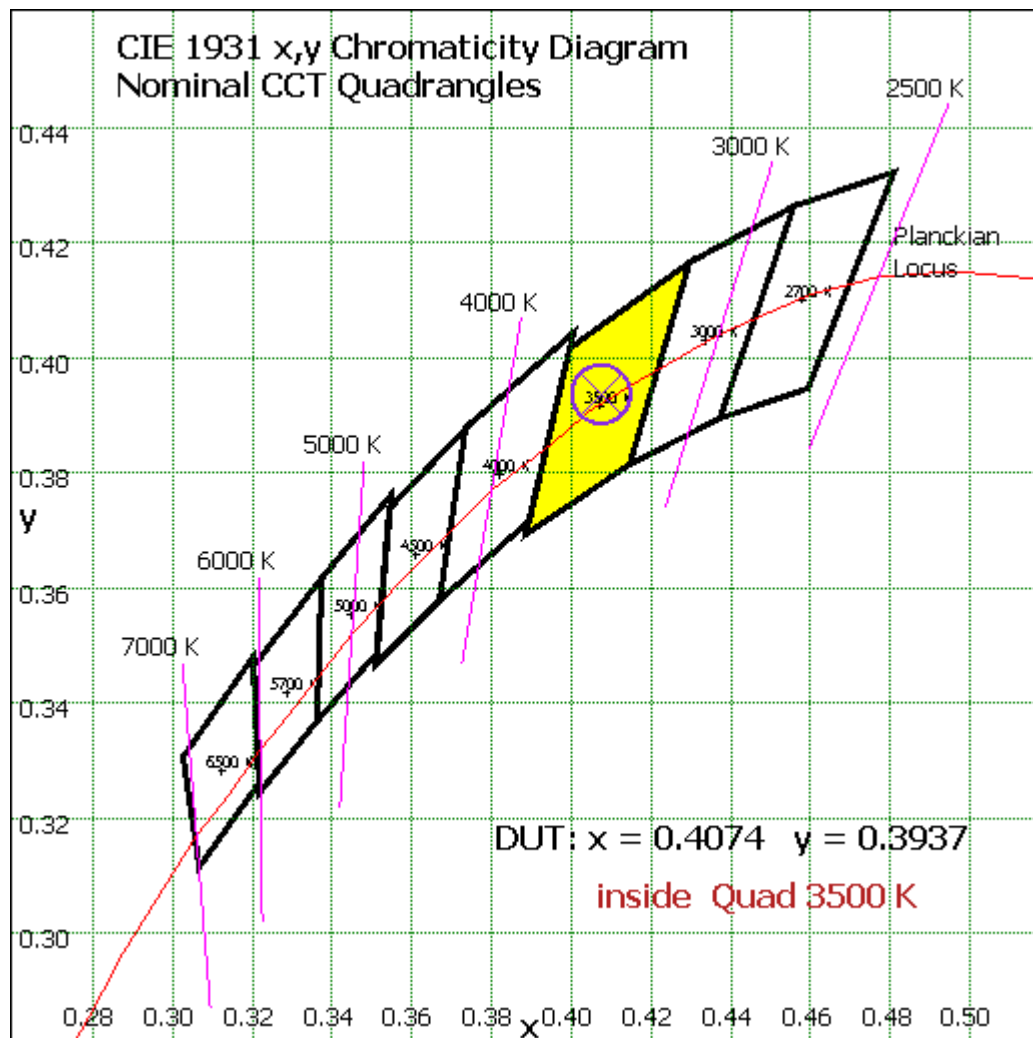


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	35.663	3.03%
10- 20	101.108	8.60%
20- 30	149.461	12.71%
30- 40	173.767	14.78%
40- 50	174.297	14.82%
50- 60	156.777	13.33%
60- 70	126.532	10.76%
70- 80	87.205	7.42%
80- 90	49.265	4.19%
90-100	34.329	2.92%
100-110	27.965	2.38%
110-120	21.934	1.87%
120-130	16.215	1.38%
130-140	10.928	0.93%
140-150	6.431	0.55%
150-160	2.984	0.25%
160-170	0.837	0.07%
170-180	0.075	0.01%
Total	1175.8	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	791.073	67.28%
60- 90	263.002	22.37%
0-90	1054.075	89.65%
90- 180	121.698	10.35%
0- 180	1175.8	100%

Table 5: Zonal Lumen Data

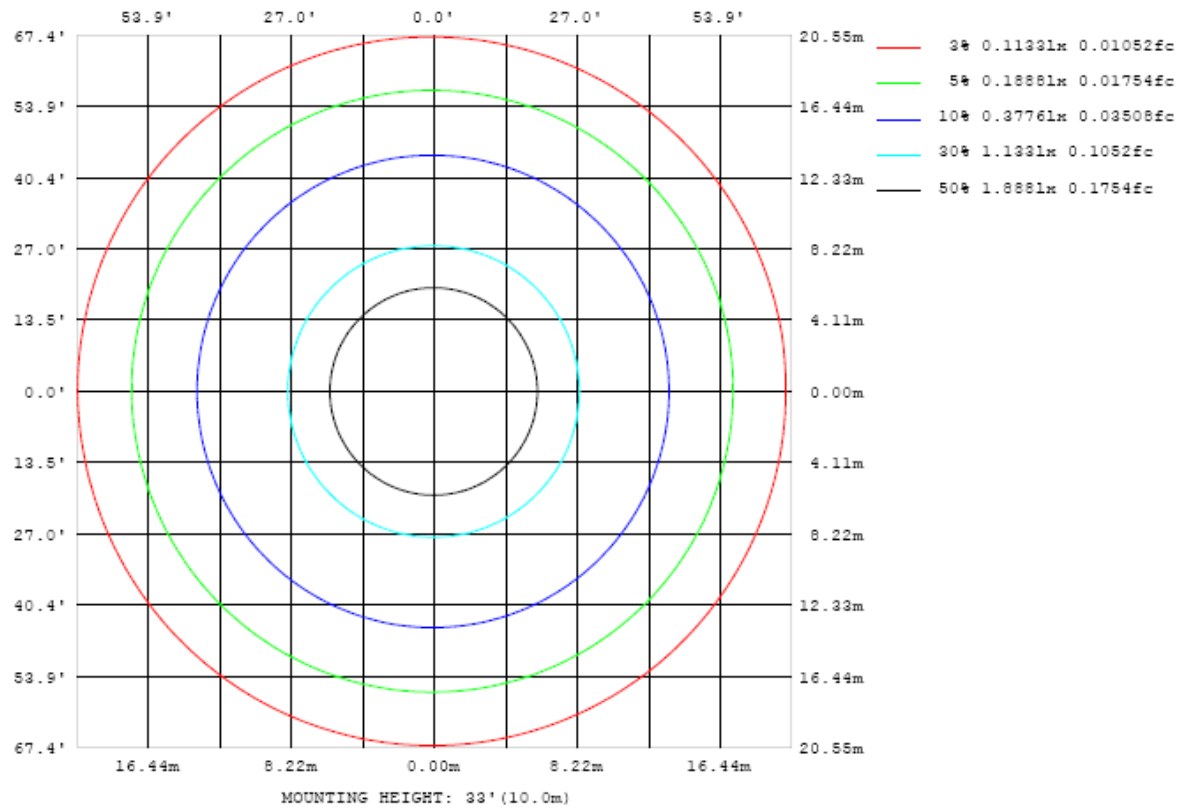


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

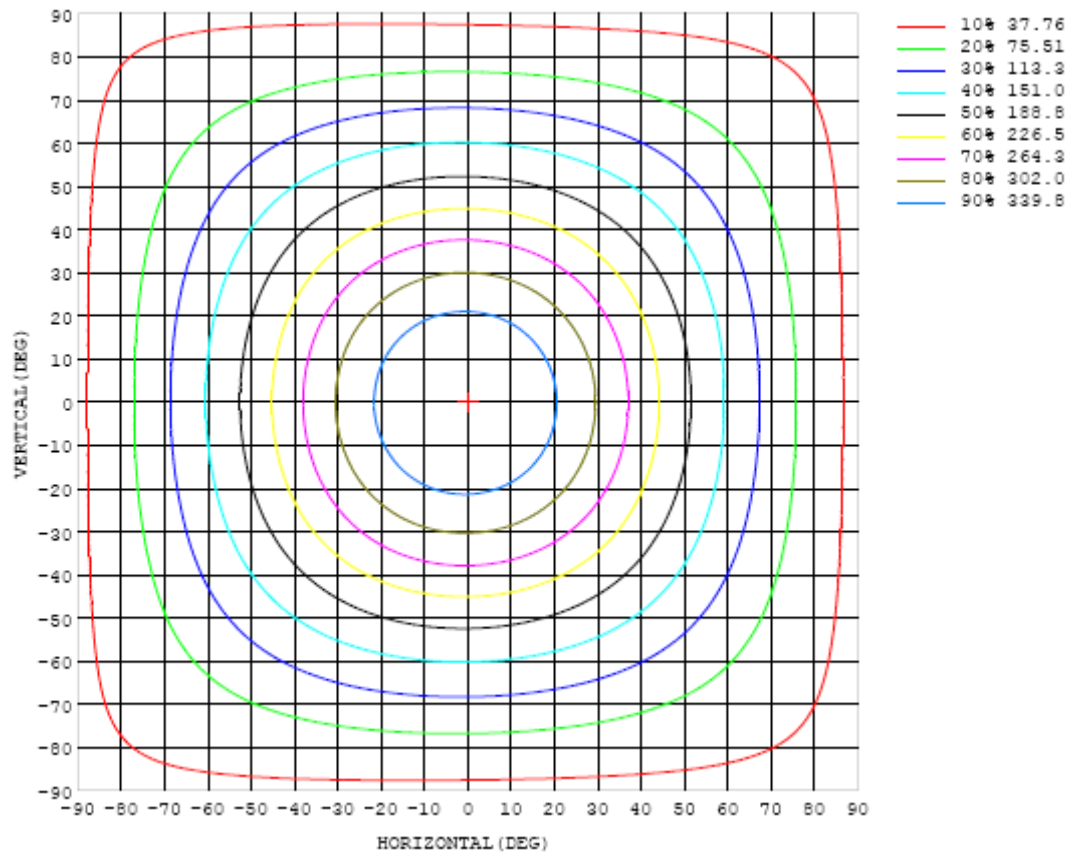


Chart 5: Isocandela Plot

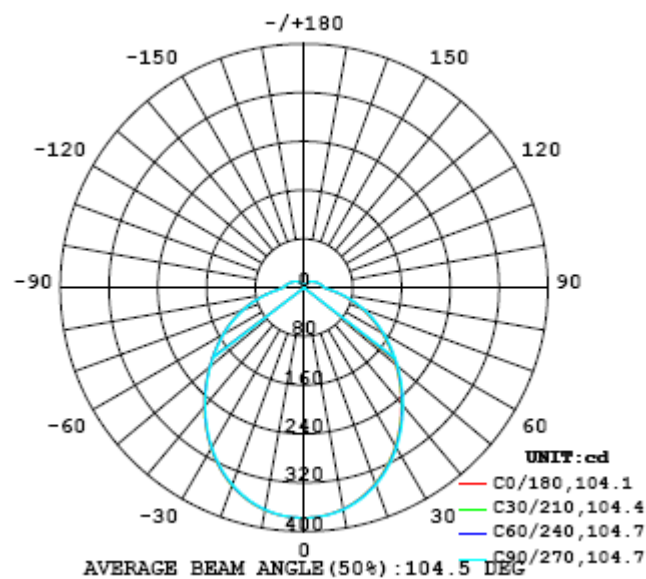


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DEG) y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378
5	375	375	375	375	375	375	376	376	376	376	376	376	376	376	376	376	376	376	376
10	369	369	368	369	369	369	369	369	369	370	370	370	370	371	371	371	371	371	371
15	357	357	357	358	358	358	358	359	359	359	360	360	360	360	360	360	360	360	360
20	342	342	342	342	342	343	343	344	344	344	345	345	345	345	346	346	346	346	346
25	322	322	322	323	323	324	324	325	325	326	326	326	327	327	327	327	327	327	327
30	300	300	300	300	301	301	302	302	303	303	304	304	305	305	305	305	305	305	305
35	275	275	275	275	276	277	277	278	278	279	279	280	280	280	280	280	280	280	280
40	248	249	249	249	250	251	251	252	253	253	254	254	254	254	254	254	254	254	254
45	222	222	222	223	224	224	225	226	226	227	227	228	228	228	228	228	228	228	228
50	196	196	197	197	198	198	199	200	200	201	202	202	202	202	202	202	202	202	202
55	171	171	171	172	173	173	174	175	175	176	176	177	177	177	177	177	177	177	177
60	147	147	147	148	149	149	150	151	151	152	152	153	153	153	153	153	153	153	154
65	124	124	124	125	125	126	127	127	128	128	129	129	129	130	130	130	129	130	130
70	101	101	101	102	102	103	104	104	105	105	106	106	107	107	107	107	107	107	107
75	78.9	79.0	79.3	79.7	80.2	80.8	81.4	82.0	82.6	83.1	83.4	83.8	84.2	84.3	84.4	84.3	84.2	84.2	84.9
80	58.7	58.9	59.1	59.6	60.0	60.5	61.0	61.5	62.0	62.4	62.8	63.1	63.4	63.5	63.6	63.5	63.5	63.4	63.6
85	41.8	41.9	42.0	42.3	42.7	43.0	43.4	43.7	44.1	44.4	44.7	45.0	45.2	45.3	45.4	45.3	45.3	45.2	45.4
90	33.3	33.3	33.3	33.3	33.5	33.6	33.7	33.8	33.9	34.0	34.2	34.3	34.4	34.5	34.5	34.5	34.6	34.5	34.7
95	30.7	30.7	30.7	30.7	30.8	30.9	31.0	31.0	31.1	31.2	31.3	31.4	31.5	31.5	31.5	31.5	31.5	31.5	31.6
100	28.3	28.2	28.2	28.3	28.3	28.4	28.5	28.5	28.6	28.6	28.7	28.8	28.8	28.9	28.9	28.8	28.8	28.8	28.9
105	26.0	26.0	26.0	26.0	26.0	26.1	26.1	26.2	26.2	26.3	26.3	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4
110	23.9	23.8	23.8	23.9	23.9	23.9	24.0	24.0	24.0	24.1	24.1	24.2	24.2	24.2	24.2	24.2	24.2	24.2	24.2
115	21.8	21.8	21.8	21.8	21.8	21.9	21.9	21.9	22.0	22.0	22.0	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1
120	19.8	19.8	19.8	19.8	19.9	19.9	19.9	19.9	20.0	20.0	20.0	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1
125	17.9	17.9	17.9	17.9	17.9	17.9	17.9	18.0	18.0	18.0	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.2
130	15.9	15.9	15.9	15.9	16.0	16.0	16.0	16.0	16.0	16.1	16.1	16.1	16.1	16.1	16.2	16.2	16.2	16.1	16.2
135	14.0	14.0	14.0	14.0	14.0	14.1	14.1	14.1	14.1	14.1	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2
140	12.0	12.1	12.1	12.1	12.1	12.1	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
145	10.1	10.1	10.2	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
150	8.18	8.22	8.25	8.27	8.29	8.31	8.33	8.35	8.36	8.37	8.38	8.38	8.38	8.37	8.36	8.34	8.33	8.30	8.32
155	6.25	6.28	6.31	6.34	6.36	6.39	6.41	6.42	6.44	6.45	6.44	6.44	6.43	6.42	6.40	6.38	6.36	6.33	6.36
160	4.46	4.50	4.53	4.56	4.58	4.59	4.61	4.64	4.64	4.62	4.64	4.64	4.63	4.62	4.60	4.58	4.55	4.51	4.51
165	2.82	2.84	2.87	2.87	2.89	2.57	1.93	1.15	0.52	1.27	2.12	2.77	2.97	2.94	2.91	2.89	2.86	2.83	2.79
170	1.43	1.43	1.39	1.34	1.38	1.48	1.55	1.53	1.51	1.48	1.47	1.47	1.49	1.48	1.47	1.45	1.42	1.39	1.35
175	0.48	0.47	0.44	0.42	0.43	0.45	0.48	0.48	0.47	0.47	0.48	0.49	0.50	0.49	0.47	0.45	0.43	0.42	0.41
180	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36

Table 6: 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	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378		
5	376	376	376	376	376	376	376	376	376	375	375	375	375	375	375	375	375		
10	371	370	370	370	370	370	370	369	369	369	369	369	369	368	368	368	368		
15	360	360	360	360	360	359	359	359	359	358	358	358	357	357	357	357	357		
20	346	346	345	345	345	345	344	344	343	343	343	342	342	342	342	342	342		
25	327	327	327	326	326	326	325	325	324	324	323	323	323	322	322	322	322		
30	305	305	305	304	304	304	303	303	302	302	301	301	300	300	300	299	300		
35	280	280	280	280	280	279	279	278	278	277	277	276	275	275	275	275	275		
40	254	254	254	254	254	254	253	253	252	251	251	250	250	249	249	249	249		
45	228	228	228	228	228	228	227	227	226	225	225	224	223	223	223	222	222		
50	202	202	202	202	202	202	202	201	200	200	199	198	198	197	197	196	196		
55	177	178	178	178	177	177	177	176	176	175	174	174	173	172	172	172	171		
60	154	154	154	154	154	154	153	153	152	151	151	150	149	149	148	148	148		
65	130	131	131	131	130	130	130	129	128	128	127	126	126	125	125	124	124		
70	107	108	108	107	107	107	106	106	105	104	104	103	102	102	102	102	102		
75	84.8	85.0	84.9	84.8	84.5	84.2	83.6	83.1	82.4	81.8	81.2	80.6	80.2	79.9	79.5	79.4	79.4		
80	63.5	63.6	63.6	63.4	63.2	62.7	62.3	61.7	61.2	60.7	60.2	59.8	59.4	59.1	58.9	58.7	58.8		
85	45.3	45.4	45.4	45.4	45.2	44.9	44.5	44.1	43.7	43.4	43.0	42.7	42.4	42.1	42.0	41.8	41.9		
90	34.8	35.0	35.2	35.3	35.4	35.3	35.2	35.1	34.9	34.7	34.5	34.3	34.1	33.9	33.7	33.5	33.4		
95	31.7	31.9	32.1	32.2	32.3	32.2	32.2	32.0	31.9	31.8	31.7	31.5	31.3	31.2	31.1	30.9	30.8		
100	29.0	29.1	29.3	29.4	29.4	29.4	29.3	29.2	29.1	29.0	28.9	28.8	28.7	28.5	28.4	28.4			
105	26.5	26.6	26.8	26.8	26.9	26.9	26.8	26.8	26.7	26.6	26.5	26.4	26.4	26.3	26.2	26.1	26.1		
110	24.3	24.4	24.4	24.5	24.5	24.5	24.4	24.4	24.3	24.3	24.2	24.1	24.1	24.0	24.0	23.9			
115	22.2	22.2	22.3	22.3	22.3	22.3	22.2	22.2	22.1	22.1	22.0	22.0	22.0	21.9	21.9	21.9			
120	20.2	20.2	20.2	20.2	20.2	20.2	20.1	20.1	20.1	20.0	20.0	19.9	19.9	19.9	19.9	19.9			
125	18.2	18.2	18.2	18.2	18.2	18.2	18.1	18.1	18.1	18.0	18.0	18.0	17.9	17.9	17.9	17.9			
130	16.2	16.2	16.2	16.2	16.2	16.1	16.1	16.1	16.0	16.0	16.0	15.9	15.9	15.9	15.9	15.9			
135	14.1	14.1	14.1	14.1	14.1	14.0	14.0	13.9	13.9	13.9	13.9	13.8	13.8	13.8	13.9	13.9			
140	12.2	12.2	12.2	12.1	12.1	12.0	12.0	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9			
145	10.3	10.2	10.2	10.2	10.1	10.1	10.0	10.0	9.98	9.97	9.96	9.95	9.95	9.97	10.00	10.0	10.1		
150	8.34	8.30	8.26	8.21	8.17	8.13	8.09	8.07	8.05	8.03	8.03	8.03	8.05	8.07	8.10	8.14	8.16		
155	6.44	6.38	6.34	6.29	6.26	6.22	6.19	6.17	6.15	6.14	6.15	6.16	6.17	6.20	6.24	6.28	6.26		
160	4.60	4.52	4.48	4.44	4.41	4.37	4.35	4.34	4.33	4.33	4.35	4.36	4.39	4.42	4.46	4.51	4.45		
165	2.88	2.80	2.75	2.72	2.69	2.67	2.66	2.66	2.66	2.67	2.69	2.71	2.74	2.78	2.82	2.86	2.79		
170	1.37	1.41	1.31	1.29	1.28	1.25	1.24	1.24	1.25	1.26	1.29	1.31	1.34	1.38	1.42	1.40	1.40		
175	0.41	0.42	0.43	0.44	0.43	0.42	0.42	0.42	0.41	0.41	0.41	0.42	0.43	0.46	0.47	0.48	0.48		
180	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36		

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 expanded 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 expanded uncertainty is 2.3% with a coverage factor $k=2$.

Color Characteristics Measurements

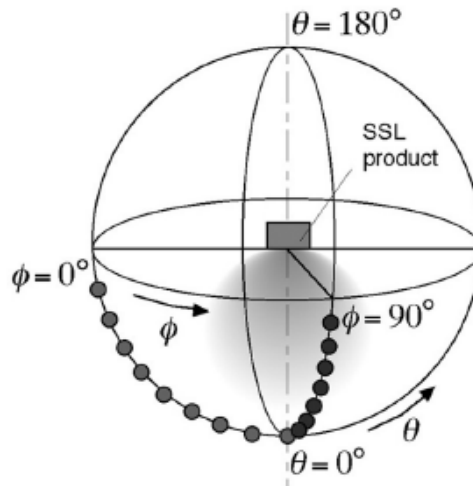
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as 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 ($C=0^\circ/180^\circ$ and $C=90^\circ/270^\circ$) 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, $\Delta u'v'$, 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.



*** End of Report ***

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