

LM-79-08 TEST REPORT

for

IDEAL INDUSTRIES LIGHTING LLC, DBA CREE LIGHTING

4401 SILICON DRIVE, DURHAM, NC 27703, USA

LED Tube

Model: C-T848-B-32W-35K-B1

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Hangzhou, Zhejiang Province, China 311100

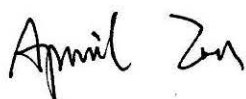
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Report No.: HZ22030014a

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

Review by:



Engineer: April Zou

Mar. 04, 2022

Approved by:



Manager: Jim Zhang

Mar. 04, 2022

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: **C-T848-B-32W-35K-B1**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
155.4	1879.9	12.10	0.9836
CCT (K)	CRI	Stabilization Time (Light & Power)	
3463	82.2	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	: Nov. 30, 2021
Date of Test	: Dec. 02, 2021
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/IES TM-30-18 IES Method for Evaluating Light Source Color Rendition

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SAMPLE PHOTO

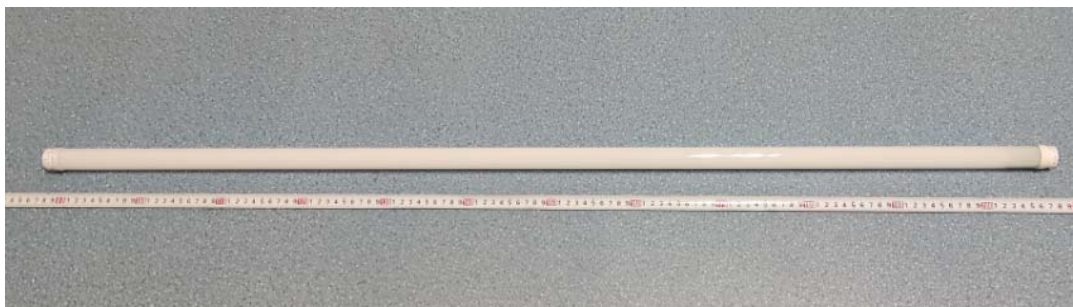


Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: C-T848-B-32W-35K-B1
Electrical Ratings	: 120-277V, 50/60Hz, 12W
Product Description	: 3500K
	: Manufacturer of light source: Bridgelux Inc.
	: Model of LED light source: BXVN-35E-11L-3EJ-000-00-00-0

TEST RESULTS

Test ambient temperature was 26.0°C.

Base orientation was horizontal. 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	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.103	0.047
Power Factor	0.9836	0.9424
Test Power (W)	12.10	12.20
THD A%	17.32	18.57
Luminous Efficacy (lm/W)	155.4	154.4
Total Luminous Flux (lm)	1879.9	1883.1
Color Rendering Index (CRI)	82.2	
R9	5.6	
Correlated Color Temperature (CCT)(K)	3463	
Chromaticity Chroma x	0.4076	
Chromaticity Chroma y	0.3926	
Chromaticity Chroma u	0.2364	
Chromaticity Chroma v	0.3416	
Duv	0.0003	
Chromaticity Chroma u'	0.2364	
Chromaticity Chroma v'	0.5124	

Special Color Rendering Indices	
R1	80.4
R2	88.6
R3	95.5
R4	81.5
R5	80.5
R6	85.1
R7	84.7
R8	61.5
R9	5.6
R10	73.8
R11	80.9
R12	65
R13	82.2
R14	97.6

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 24.9°C.

The photometric distance is 30 m.

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)	0.103
Power Factor	0.9795
Power (W)	12.12
Luminous Efficacy (lm/W)	152.5
Total Luminous Flux (lm)	1847.7
Beam Angle (°)	116.4 (0°-180°) / 249.1 (90°-270°)
Center Beam Candle Power (cd)	275
Maximum Beam Candle Power (cd)	275.7 (At: C=60.0, Gamma=3.0)
Spacing Criteria	1.29 (0°-180°) / 1.44 (90°-270°)
Zonal Lumens in the 0°-60°Zone	39.54%
Zonal Lumens in the 60°-90°Zone	26.23%
Zonal Lumens in the 90°-120°Zone	18.73%
Zonal Lumens in the 120°-180°Zone	15.50%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

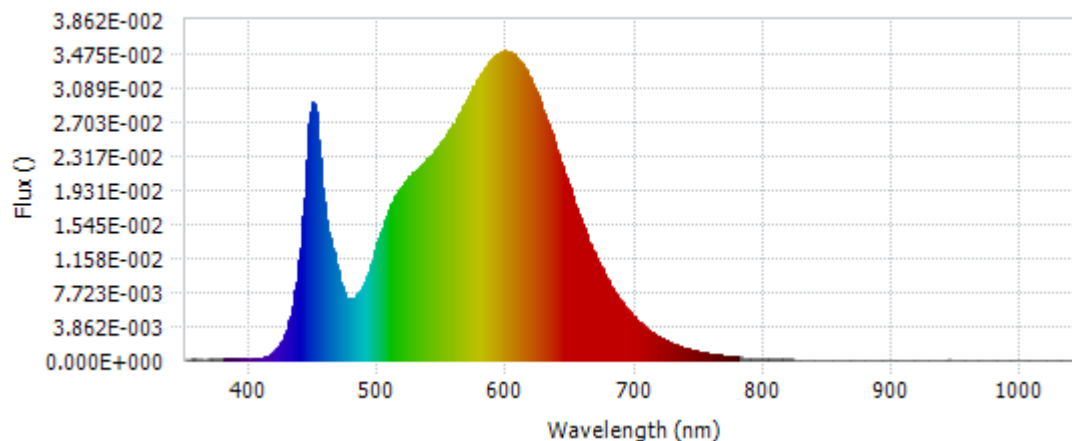
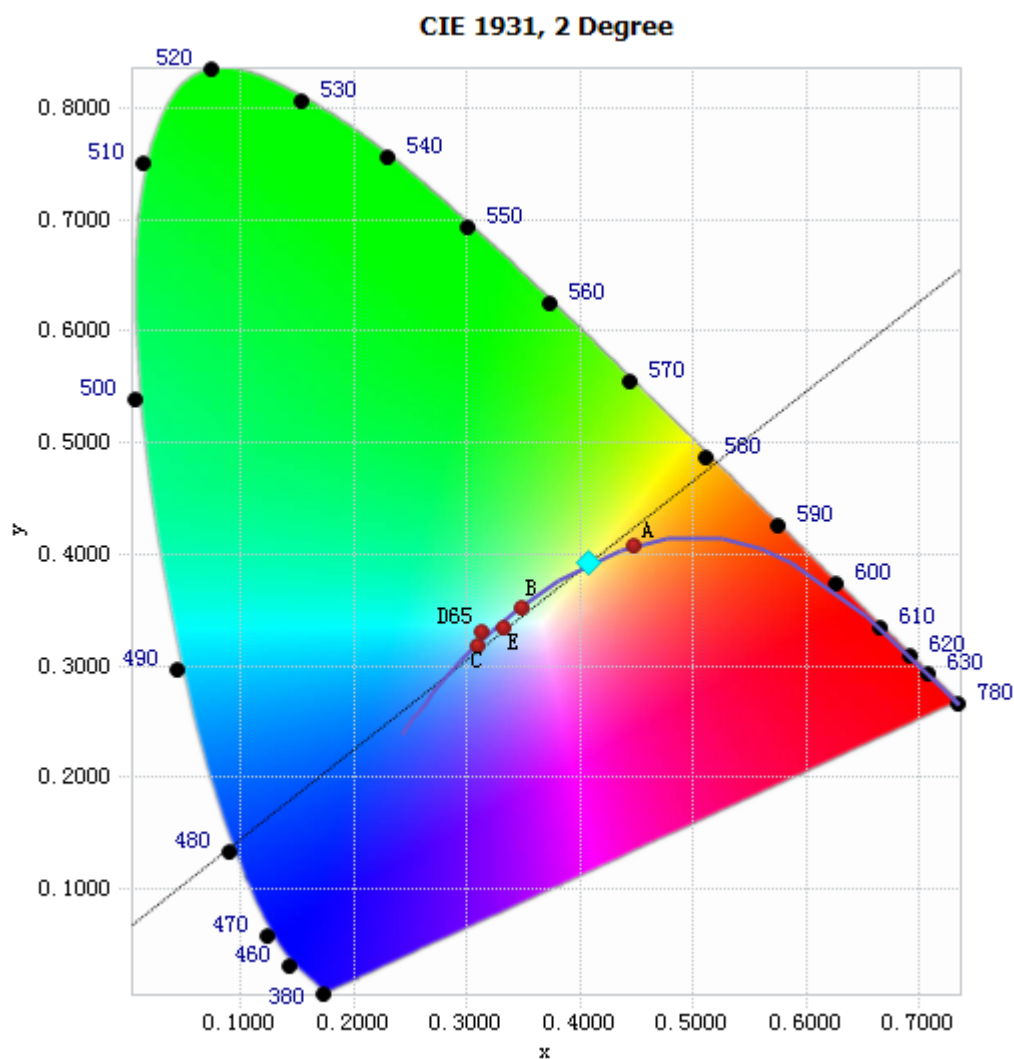


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.42E-04	485	7.74E-03	590	3.45E-02	695	5.58E-03
385	1.21E-04	490	9.20E-03	595	3.50E-02	700	4.79E-03
390	1.37E-04	495	1.14E-02	600	3.50E-02	705	4.09E-03
395	1.26E-04	500	1.38E-02	605	3.47E-02	710	3.47E-03
400	1.01E-04	505	1.59E-02	610	3.39E-02	715	2.98E-03
405	1.49E-04	510	1.76E-02	615	3.29E-02	720	2.57E-03
410	2.92E-04	515	1.91E-02	620	3.13E-02	725	2.20E-03
415	6.38E-04	520	2.02E-02	625	2.96E-02	730	1.85E-03
420	1.26E-03	525	2.10E-02	630	2.76E-02	735	1.57E-03
425	2.38E-03	530	2.17E-02	635	2.56E-02	740	1.34E-03
430	4.43E-03	535	2.24E-02	640	2.34E-02	745	1.14E-03
435	7.92E-03	540	2.31E-02	645	2.12E-02	750	9.72E-04
440	1.44E-02	545	2.41E-02	650	1.90E-02	755	8.35E-04
445	2.49E-02	550	2.49E-02	655	1.70E-02	760	6.99E-04
450	2.91E-02	555	2.61E-02	660	1.50E-02	765	6.11E-04
455	2.12E-02	560	2.71E-02	665	1.32E-02	770	5.18E-04
460	1.52E-02	565	2.85E-02	670	1.15E-02	775	4.41E-04
465	1.22E-02	570	2.99E-02	675	1.00E-02	780	3.78E-04
470	8.94E-03	575	3.12E-02	680	8.70E-03		
475	7.14E-03	580	3.25E-02	685	7.53E-03		
480	7.07E-03	585	3.37E-02	690	6.49E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4076, 0.3926)

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

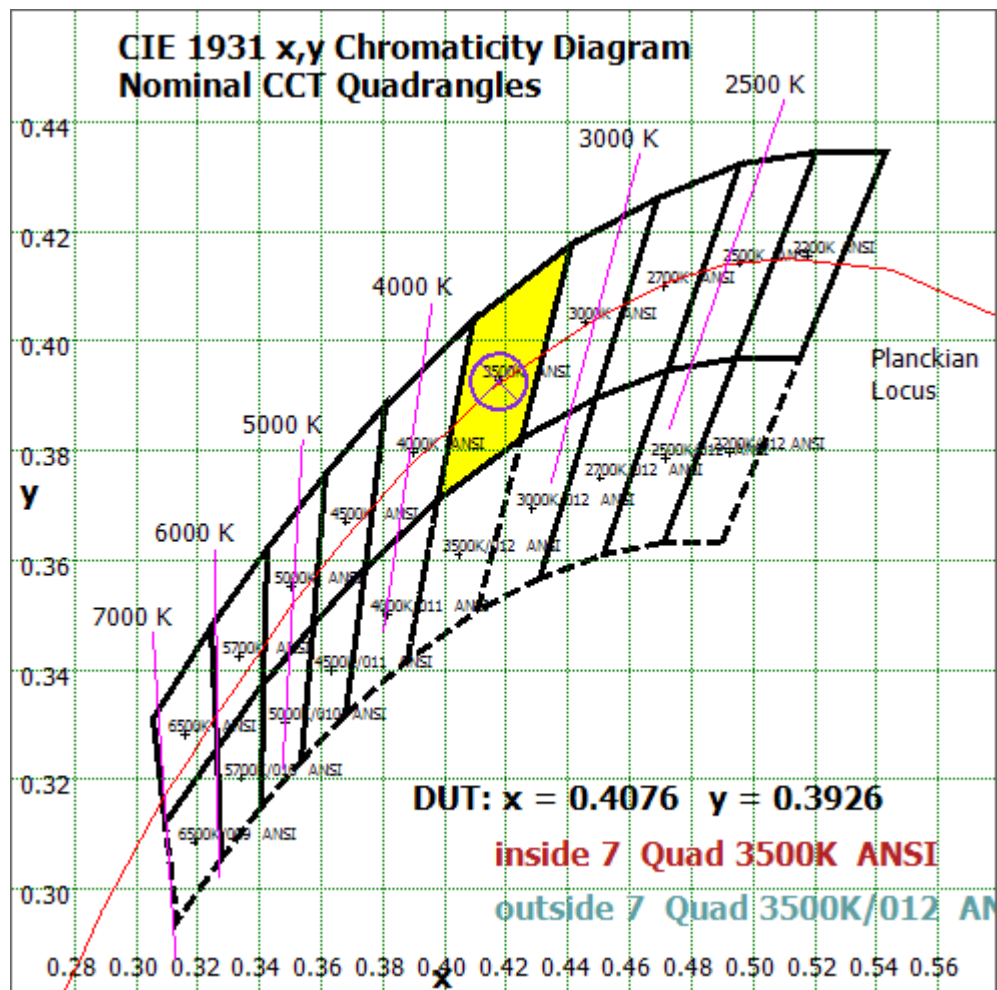


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

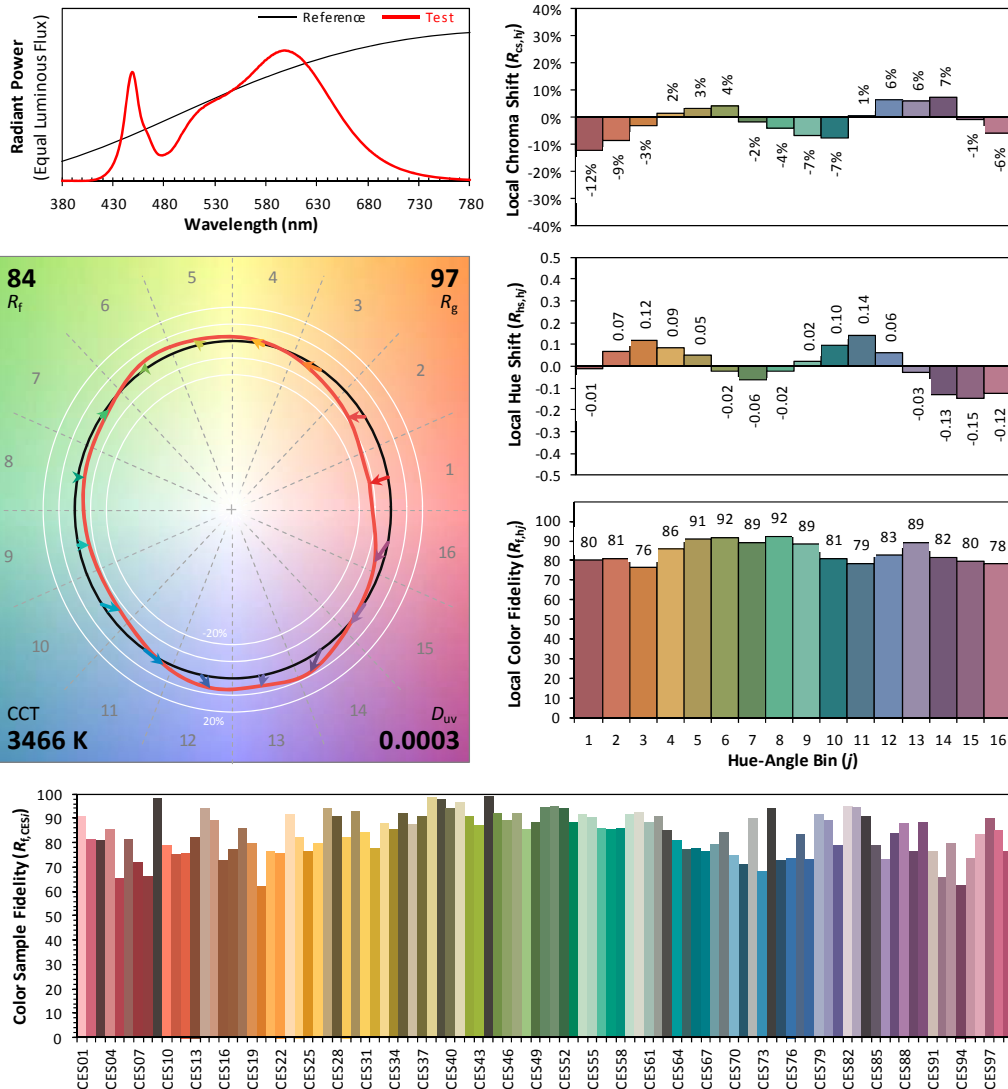
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: IDEAL INDUSTRIES LIGHTING LLC,
DBA CREE LIGHTING

Date: 2021/12/02

Model: C-T848-B-32W-35K-B1



Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x 0.4076
 y 0.3926
 u' 0.2364
 v' 0.5124

CIE 13.3-1995
(CRI)

R_a 82
 R_g 6

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.

Chart 4: Full Report Created with the IES TM-30 Calculator

Note: The values in this diagram might be a little different from the values in Table 2 due to rounding.

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Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	26.142	1.41%
10- 20	76.18	4.12%
20- 30	119.687	6.48%
30- 40	153.074	8.28%
40- 50	173.966	9.42%
50- 60	181.548	9.83%
60- 70	176.79	9.57%
70- 80	162.746	8.81%
80- 90	145.108	7.85%
90-100	129.605	7.01%
100-110	115.249	6.24%
110-120	101.211	5.48%
120-130	87.147	4.72%
130-140	72.619	3.93%
140-150	57.122	3.09%
150-160	40.57	2.20%
160-170	22.383	1.21%
170-180	6.538	0.35%
Total	1847.7	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	730.597	39.54%
60- 90	484.644	26.23%
0-90	1215.24	65.77%
90- 180	632.444	34.23%
0- 180	1847.7	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

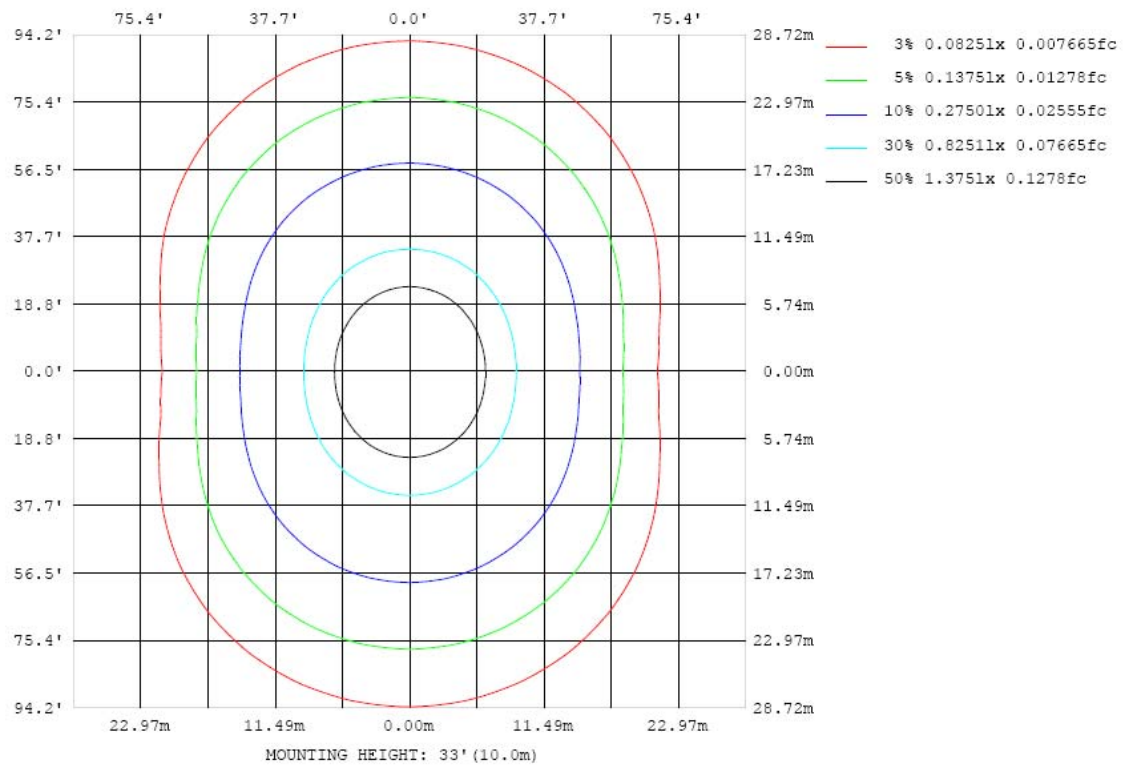


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

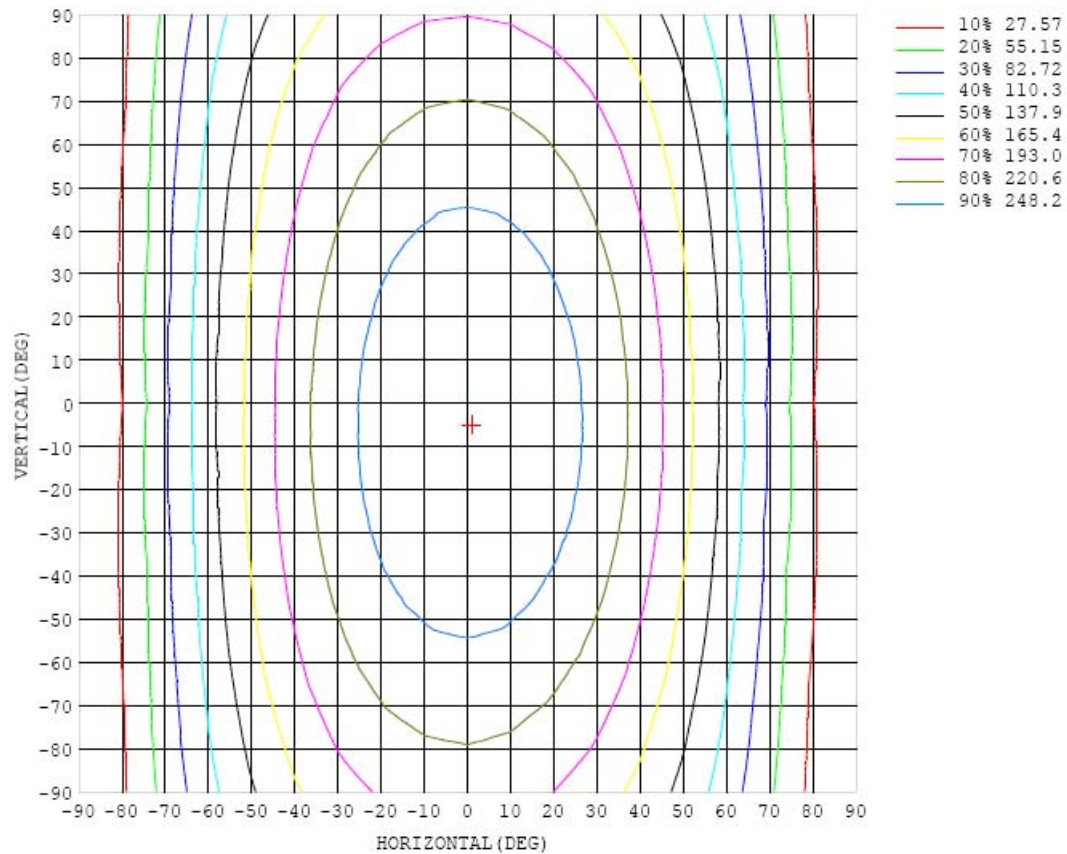


Chart 6: Isocandela Plot

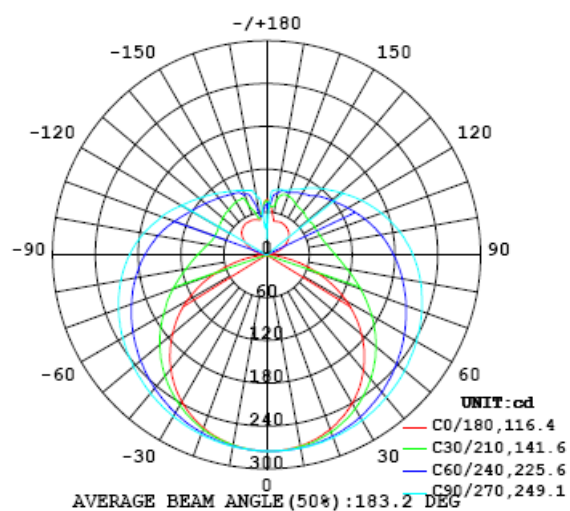


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

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	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275
5	274	274	275	275	275	275	275	276	275	275	275	275	275	275	275	274	274	274	274
10	272	272	272	273	274	274	275	275	275	275	275	274	274	274	273	272	271	271	271
15	267	267	268	270	271	272	273	274	274	274	274	273	272	271	269	268	266	266	265
20	260	261	262	264	266	269	271	272	272	273	272	271	269	267	265	262	260	259	258
25	251	252	254	257	260	264	267	269	270	270	270	268	266	262	259	255	252	250	249
30	240	242	245	249	253	258	263	266	267	268	267	265	261	257	252	246	241	239	238
35	227	229	233	239	245	252	257	261	264	265	264	261	256	250	244	236	230	226	224
40	211	214	219	227	235	244	251	257	260	261	260	256	251	243	234	225	217	211	209
45	193	197	204	214	225	236	245	252	255	257	256	251	245	235	224	213	202	194	191
50	174	178	187	200	214	227	238	246	251	253	251	246	238	227	214	199	186	176	172
55	152	157	169	185	202	217	231	240	246	247	246	241	231	218	203	185	168	156	152
60	129	135	150	170	190	208	223	234	240	243	241	235	224	210	192	171	150	134	129
65	104	112	131	155	178	199	216	227	235	237	235	229	217	201	181	156	132	111	104
70	78.2	88.2	112	140	167	190	208	221	228	231	230	223	210	193	170	143	113	88.1	77.8
75	53.3	65.5	94.1	127	156	181	201	214	222	225	223	216	203	185	160	130	96.3	65.9	51.6
80	28.8	44.8	78.5	115	147	173	193	208	216	219	217	210	196	177	151	119	81.5	46.0	27.2
85	9.29	28.7	67.0	105	138	165	186	200	209	213	211	203	189	169	143	109	71.4	31.0	7.89
90	0.59	20.4	58.9	96.7	130	157	178	193	202	205	203	196	182	162	135	102	63.5	23.5	0.44
95	2.20	18.4	54.0	90.4	123	150	171	185	194	197	196	188	175	155	129	96.0	59.1	22.1	2.87
100	6.92	21.0	51.8	85.4	116	142	163	177	186	189	187	180	167	148	122	91.2	57.3	25.2	8.16
105	12.9	25.0	51.8	81.7	110	135	155	169	177	180	179	172	159	140	117	87.7	57.4	30.6	14.5
110	19.4	30.7	53.5	79.5	106	128	147	160	168	171	170	163	151	134	111	85.4	59.6	37.0	21.2
115	25.8	36.7	55.4	78.5	101	122	139	151	159	162	161	154	143	127	107	84.4	62.6	44.2	27.8
120	32.0	43.3	56.6	78.1	98.2	116	132	143	150	153	152	146	136	121	104	84.5	65.0	50.8	34.8
125	36.8	50.5	59.8	77.5	95.8	112	125	135	141	144	143	138	128	116	101	84.6	68.0	57.4	40.8
130	40.8	56.7	64.7	76.6	93.5	107	119	128	133	135	135	130	122	112	99.2	83.6	72.4	63.9	45.4
135	43.8	62.4	67.5	77.0	89.7	103	114	121	126	128	127	123	117	108	95.8	84.0	76.3	68.7	48.7
140	46.2	67.2	71.9	79.6	88.0	98.1	108	115	119	121	120	117	111	103	94.1	85.9	79.5	72.5	51.2
145	47.8	72.3	78.1	80.2	88.2	94.8	102	109	113	114	113	110	105	99.3	93.1	87.3	81.7	76.5	52.5
150	49.0	76.5	81.6	82.1	87.8	93.8	98.9	103	106	107	106	104	101	97.0	93.0	86.7	84.6	79.7	52.7
155	49.7	71.6	84.3	86.2	87.5	91.7	96.6	99.9	101	101	101	99.9	98.0	95.3	92.1	85.8	84.4	78.3	53.0
160	49.5	62.1	86.5	88.1	89.6	90.4	92.9	95.3	96.8	97.1	97.0	96.3	94.9	93.3	85.7	83.4	76.0	69.9	52.4
165	48.7	53.0	73.2	87.7	88.5	91.5	93.0	93.6	93.8	93.9	94.1	94.0	93.3	91.8	76.2	68.7	65.1	59.5	50.9
170	53.5	53.0	58.3	73.4	85.2	86.7	87.4	92.3	92.6	92.9	92.6	87.0	72.7	66.1	66.1	65.5	62.6	54.3	51.4
175	68.4	68.0	66.8	67.5	71.9	71.7	74.8	78.8	89.0	89.6	67.8	51.2	59.4	67.2	66.2	69.1	65.6	66.4	66.3
180	77.4	77.2	76.0	74.1	71.5	64.8	64.5	60.0	60.7	22.3	47.3	60.0	62.5	68.5	70.7	73.8	75.6	76.8	77.3

Table 6: Luminous Intensity Data

Table--2

UNIT: cd

C (DEG) γ (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275		
5	274	273	274	274	274	274	274	274	274	274	275	275	274	274	274	274	275		
10	271	270	271	271	271	272	273	272	273	273	273	273	272	272	272	272	272		
15	266	266	266	267	268	269	270	270	271	271	271	270	269	269	268	267	267		
20	258	259	260	262	264	265	267	267	268	268	267	266	265	264	262	261	260		
25	249	250	252	255	258	261	263	264	265	265	264	262	260	257	255	252	252		
30	238	240	243	247	252	256	259	261	262	261	260	257	253	249	245	242	241		
35	225	228	233	239	245	250	254	257	258	257	254	251	246	241	235	230	228		
40	210	214	222	229	237	244	249	252	253	252	249	245	238	231	223	217	213		
45	194	200	209	219	229	238	244	248	248	247	244	238	230	220	210	202	196		
50	175	183	196	208	220	231	238	242	244	242	238	230	221	209	196	185	177		
55	156	166	181	197	212	223	232	237	239	237	231	223	211	197	182	167	157		
60	134	149	167	186	203	217	226	231	233	231	225	215	202	185	167	150	136		
65	111	130	154	175	194	209	220	225	227	225	218	208	193	174	153	131	113		
70	87.8	112	140	164	185	201	213	219	221	218	211	200	183	163	139	112	89.1		
75	65.1	94.5	127	155	177	194	206	213	214	212	204	192	174	153	125	94.3	66.3		
80	44.9	79.7	115	145	168	187	199	206	207	205	197	184	166	143	113	79.0	45.9		
85	29.8	68.0	105	136	160	179	191	198	200	197	189	176	158	134	103	66.7	30.2		
90	21.9	59.9	96.8	128	153	171	183	190	192	189	181	168	150	125	94.0	58.1	21.5		
95	19.4	54.2	89.8	120	145	163	175	182	184	181	173	160	142	117	86.6	52.0	18.3		
100	21.8	51.0	83.7	113	137	155	166	173	175	172	164	152	133	109	80.3	48.2	19.8		
105	27.3	51.1	79.3	106	129	146	157	163	165	162	156	143	125	102	75.6	47.5	24.8		
110	34.1	53.3	77.3	101	121	138	149	155	157	154	147	134	118	96.7	72.9	49.0	31.2		
115	41.2	56.9	76.9	96.7	115	129	140	146	148	145	138	126	111	92.7	71.9	52.2	37.4		
120	48.3	61.0	77.4	94.3	110	123	132	137	138	136	129	119	106	90.0	72.3	56.6	43.5		
125	55.0	65.2	78.7	92.7	106	117	125	129	130	128	123	114	102	88.4	73.7	61.2	49.5		
130	61.0	69.4	80.1	91.8	103	112	119	122	124	122	117	109	99.3	87.5	75.8	65.4	55.5		
135	64.6	73.1	81.8	91.2	100	108	113	117	117	116	112	105	96.9	87.5	78.1	69.2	60.3		
140	66.8	76.4	82.4	90.9	98.0	104	109	111	112	111	107	102	95.1	87.6	80.3	72.4	64.7		
145	69.1	79.4	84.3	89.4	96.1	101	105	106	107	106	103	99.0	93.8	88.2	82.0	75.7	68.1		
150	69.1	81.8	85.8	87.9	94.7	98.3	101	102	103	102	99.9	96.9	93.0	88.6	83.4	78.8	70.3		
155	64.8	76.8	86.1	86.9	89.9	96.1	98.0	99.0	99.4	98.7	97.3	95.2	92.2	88.5	85.0	80.0	65.6		
160	58.0	67.7	74.2	82.8	87.3	90.0	95.3	96.0	96.4	96.0	95.1	93.4	91.2	88.9	86.3	81.7	58.0		
165	51.7	53.3	61.2	63.6	76.0	82.5	89.2	90.6	93.2	92.9	92.4	91.7	90.7	87.2	83.3	77.3	51.6		
170	51.2	50.9	53.2	55.4	58.1	56.9	66.7	80.1	83.0	89.0	88.3	85.3	82.1	82.2	75.3	60.6	52.6		
175	66.0	65.5	63.7	65.8	59.7	59.5	51.5	40.8	48.6	77.8	71.9	67.7	68.8	68.2	69.8	65.6	66.5		
180	77.3	76.9	76.2	74.4	71.6	70.9	61.3	60.3	55.5	13.2	48.5	59.8	64.3	68.3	71.4	74.1	75.8		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 05, 2021	Aug. 04, 2022
Digital Power Meter	PF2010A	HZTE028-01	Aug. 05, 2021	Aug. 04, 2022
AC Power Supply	DPS1060	HZTE001-06	Aug. 05, 2021	Aug. 04, 2022
DC Power Supply	WY12010	HZTE004-03	Aug. 05, 2021	Aug. 04, 2022
Temperature recorder	JM624U	HZTE018-08	Aug. 05, 2021	Aug. 04, 2022
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 05, 2021	Aug. 04, 2022
Standard source	D908	HZTE012-01	Aug. 05, 2021	Aug. 04, 2022
Integrate Sphere system	3M	HZTE015-04	Aug. 05, 2021	Aug. 04, 2022
Digital Power Meter	WT210	HZTE008-01	Aug. 05, 2021	Aug. 04, 2022
AC Power Supply	PCR 500L	HZTE001-07	Aug. 05, 2021	Aug. 04, 2022
DC Power Supply	IT6154	HZTE004-04	Aug. 05, 2021	Aug. 04, 2022
Standard source	SCL-1400	HZTE012-02	Aug. 05, 2021	Aug. 04, 2022
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 05, 2021	Aug. 04, 2022
Temperature Meter	TES1310	HZTE017-01	Aug. 05, 2021	Aug. 04, 2022

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

Color Characteristics Measurements

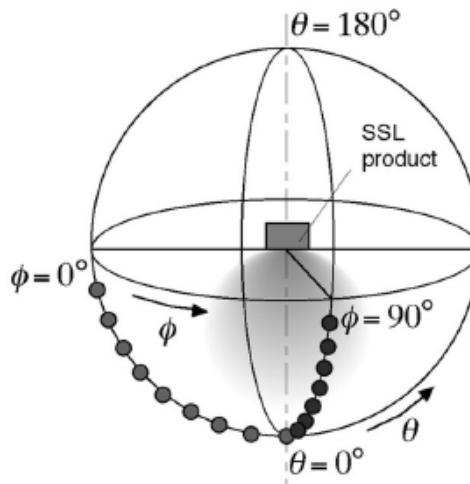
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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