LM-79-08 TEST REPORT

for

GREEN CREATIVE LTD

Room 3603, Level 36, Tower 1, Enterprise Square Five, 38 Wang Chiu Road, Kowloon Bay, KL, Hong Kong

LED Tube

Model: 16T8/4F/835/GL/BYP

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

3rd Floor, Bld. 2, NO. 96 Longchuanwu Rd Qianjiang Economy Dev. Zone, YuhangDist, Hangzhou, Zhejiang Province, China 311100

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Report No.: HZ20080026a

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

Review by: April Zou

Engineer: April Zou

Aug. 20, 2020

Approved by: Jim Zhang

Manager: Jim Zhang

Aug. 20, 2020

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: **16T8/4F/835/GL/BYP**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
143.5	2290.7	15.96	0.9781

CCT (K)	CRI	Stabilization Time (Light & Power)
3494	82.4	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 : Aug. 17, 2020

Date of Test : Aug. 17, 2020

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

TABLE OF CONTENT

SAMPLE PHOTO

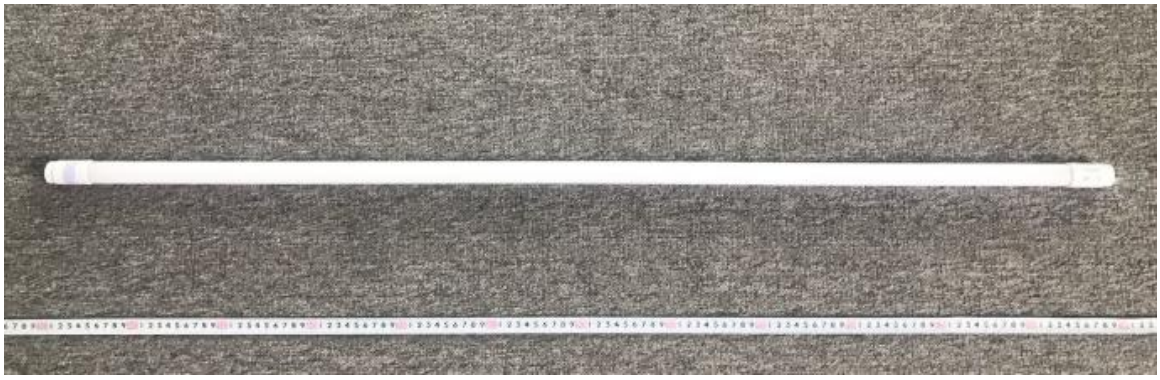


Figure 1- Overview of the sample

Equipment Under Test(EUT)	
Name	: LED Tube
Model	: 16T8/4F/835/GL/BYP
Electrical Ratings	: 120-277V, 50/60Hz, 16W
Product Description	: 3500K
Manufacturer	: GREEN CREATIVE LTD
Address	: Room 3603, Level 36, Tower 1, Enterprise Square Five, 38 Wang Chiu Road, Kowloon Bay, KL, Hong Kong

TEST RESULTS

Test ambient temperature was 25.2 ℃.

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	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.136	0.061
Power Factor	0.9781	0.9332
Test Power (W)	15.96	15.81
THD A%	17.89	12.17
Luminous Efficacy (lm/W)	143.5	145.6
Total Luminous Flux (lm)	2290.7	2302.3
Color Rendering Index (CRI)	82.4	
R9	5.6	
Correlated Color Temperature (CCT)(K)	3494	
Chromaticity Chroma x	0.4043	
Chromaticity Chroma y	0.3878	
Chromaticity Chroma u	0.2363	
Chromaticity Chroma v	0.3399	
Duv	-0.0011	
Chromaticity Chroma u ’	0.2363	
Chromaticity Chroma v’	0.5099	

Special Color Rendering Indices	
R1	80.7
R2	90.1
R3	95.9
R4	80.5
R5	81
R6	86.7
R7	83.7
R8	60.8
R9	5.6
R10	76.8
R11	79.5
R12	66.6
R13	83
R14	98.2

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 25.3 ℃.

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)	0.136
Power Factor	0.9809
Power (W)	16.00
Luminous Efficacy (lm/W)	141.0
Total Luminous Flux (lm)	2256.0
Beam Angle (°)	116.3 (0^o-180^o) / 252.0 (90^o-270^o)
Center Beam Candle Power (cd)	332
Maximum Beam Candle Power (cd)	332.0 (At: C=250.0, Gamma=2.0)
Spacing Criteria	1.29 (0^o-180^o) / 1.46 (90^o-270^o)
Zonal Lumens in the 0 °-60 °Zone	39.27%
Zonal Lumens in the 60 °-90 °Zone	26.43%
Zonal Lumens in the 90 °-120 °Zone	18.90%
Zonal Lumens in the 120 °-180 °Zone	15.40%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

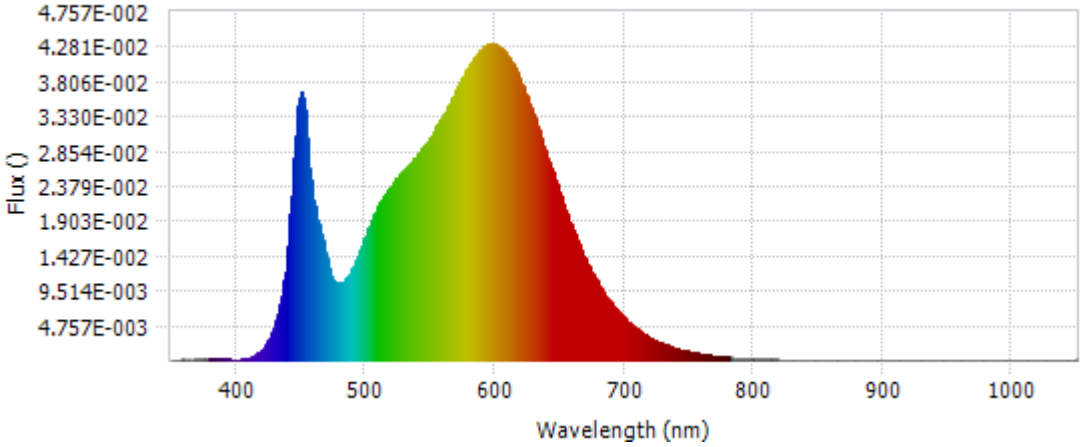
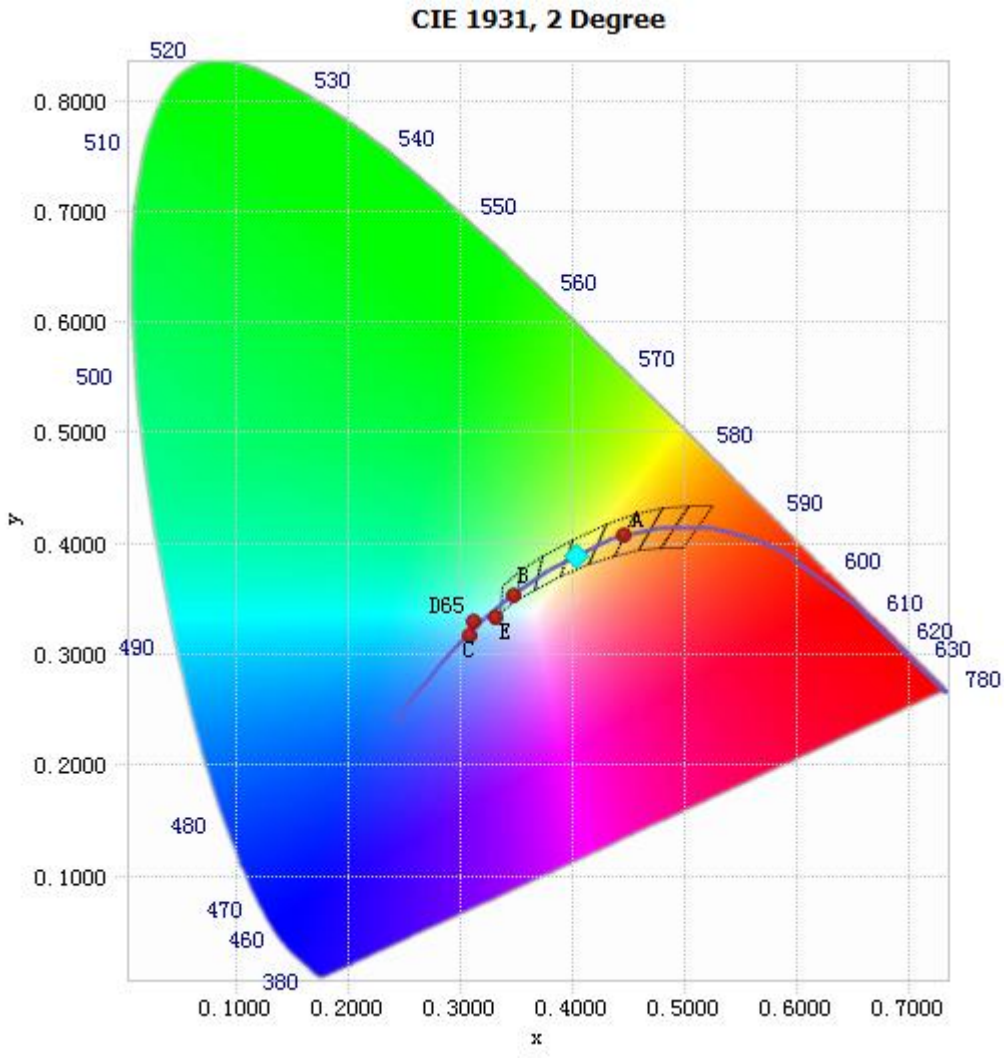


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.63E-04	485	1.11E-02	590	4.23E-02	695	6.74E-03
385	1.66E-04	490	1.25E-02	595	4.29E-02	700	5.79E-03
390	1.63E-04	495	1.46E-02	600	4.29E-02	705	4.96E-03
395	1.48E-04	500	1.70E-02	605	4.24E-02	710	4.24E-03
400	1.29E-04	505	1.92E-02	610	4.14E-02	715	3.64E-03
405	1.69E-04	510	2.09E-02	615	3.99E-02	720	3.13E-03
410	3.56E-04	515	2.26E-02	620	3.80E-02	725	2.68E-03
415	7.48E-04	520	2.38E-02	625	3.59E-02	730	2.28E-03
420	1.46E-03	525	2.48E-02	630	3.34E-02	735	1.94E-03
425	2.80E-03	530	2.58E-02	635	3.08E-02	740	1.65E-03
430	5.03E-03	535	2.68E-02	640	2.81E-02	745	1.42E-03
435	8.69E-03	540	2.78E-02	645	2.54E-02	750	1.21E-03
440	1.55E-02	545	2.90E-02	650	2.28E-02	755	1.03E-03
445	2.75E-02	550	3.02E-02	655	2.03E-02	760	8.86E-04
450	3.63E-02	555	3.17E-02	660	1.80E-02	765	7.53E-04
455	3.01E-02	560	3.32E-02	665	1.59E-02	770	6.46E-04
460	2.18E-02	565	3.49E-02	670	1.39E-02	775	5.56E-04
465	1.78E-02	570	3.66E-02	675	1.21E-02	780	4.74E-04
470	1.38E-02	575	3.84E-02	680	1.05E-02		
475	1.10E-02	580	4.00E-02	685	9.07E-03		
480	1.05E-02	585	4.14E-02	690	7.83E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4043, 0.3878)

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

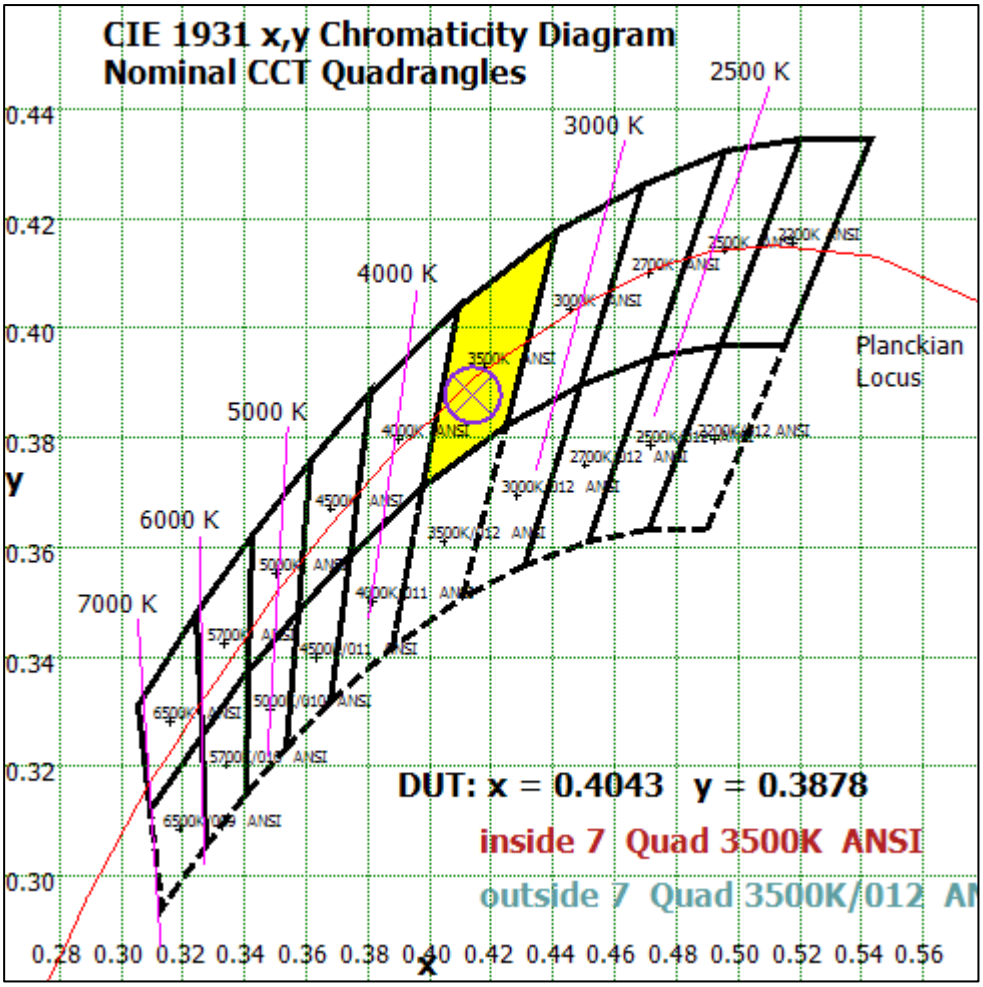


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

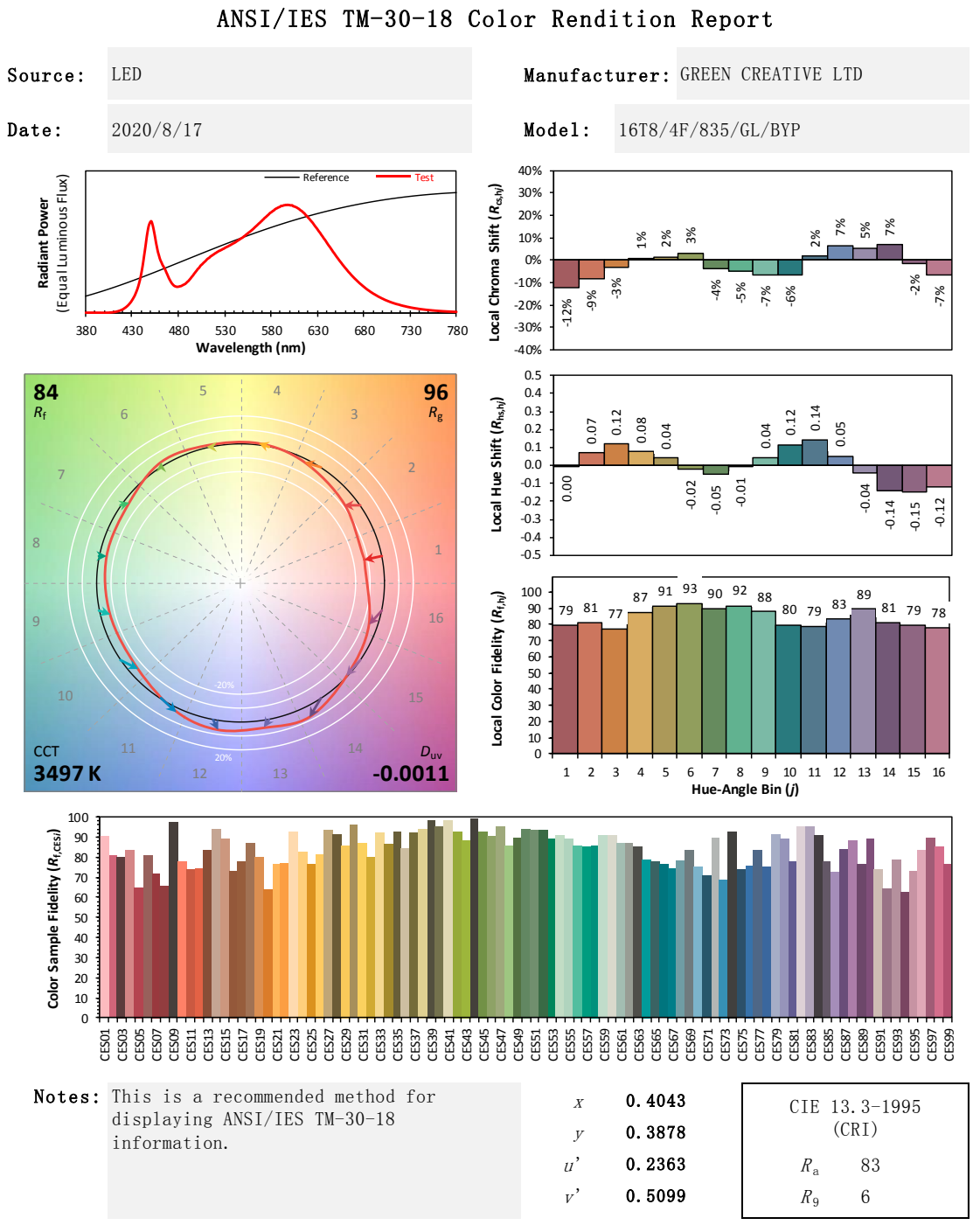


Chart 4: Full Report Created with the IES TM-30 Calculator

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

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	31.515	1.40%
10- 20	91.896	4.07%
20- 30	144.571	6.41%
30- 40	185.32	8.21%
40- 50	211.253	9.36%
50- 60	221.265	9.81%
60- 70	216.476	9.60%
70- 80	200.362	8.88%
80- 90	179.453	7.95%
90-100	160.49	7.11%
100-110	142.081	6.30%
110-120	123.847	5.49%
120-130	105.919	4.69%
130-140	88.018	3.90%
140-150	69.245	3.07%
150-160	49.067	2.17%
160-170	27.206	1.21%
170-180	8.012	0.36%
Total	2256.0	100%

γ(°)	Lumens	% Total
0- 60	885.82	39.27%
60- 90	596.291	26.43%
0-90	1482.111	65.70%
90- 180	773.885	34.30%
0- 180	2256.0	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

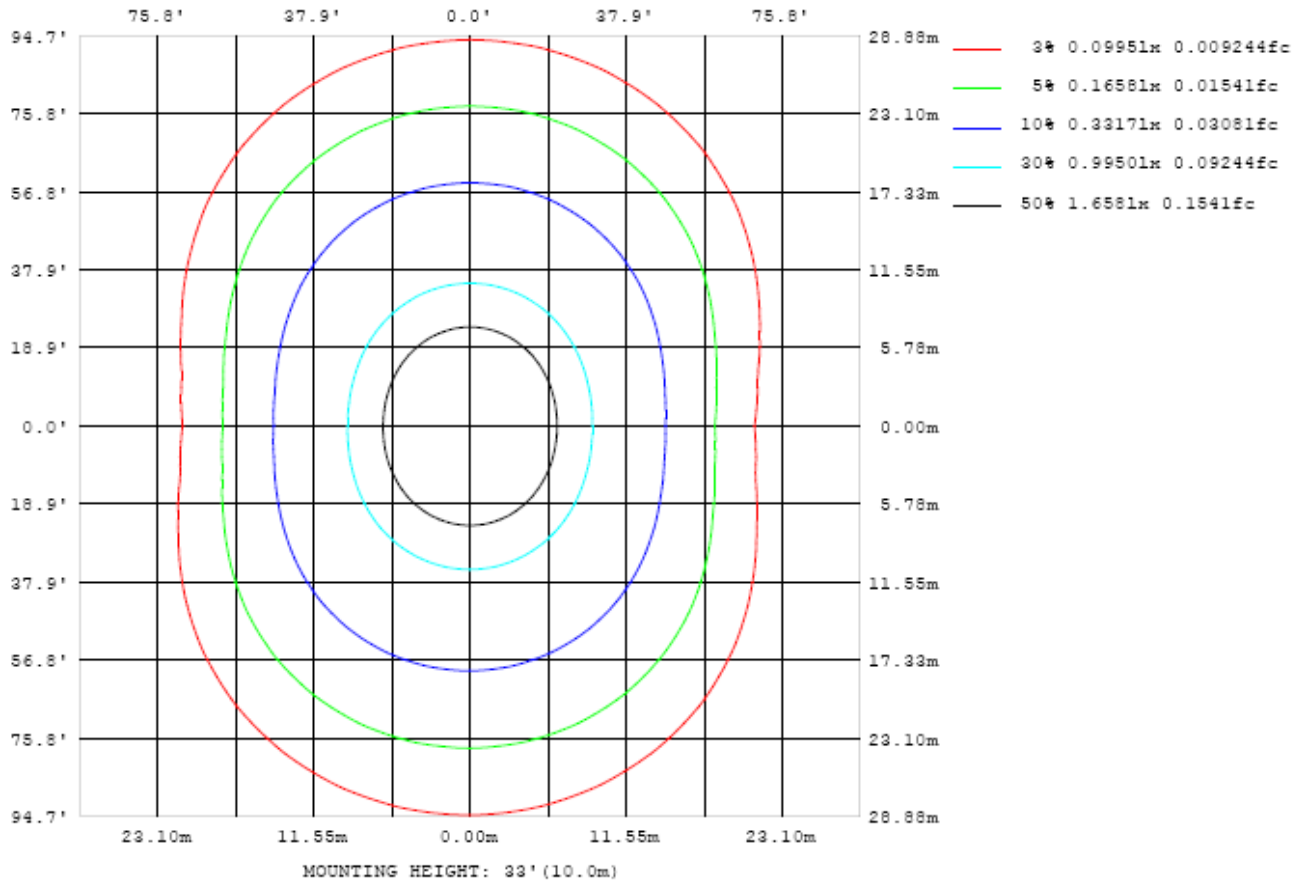


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

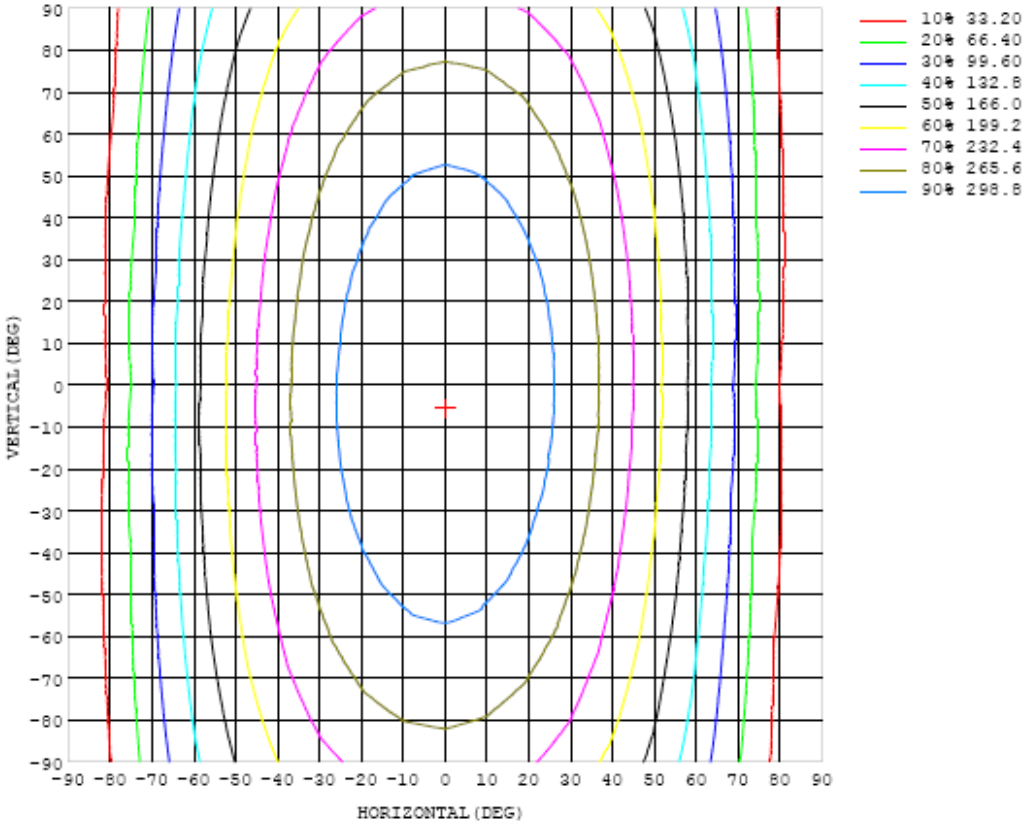


Chart 6: Isocandela Plot

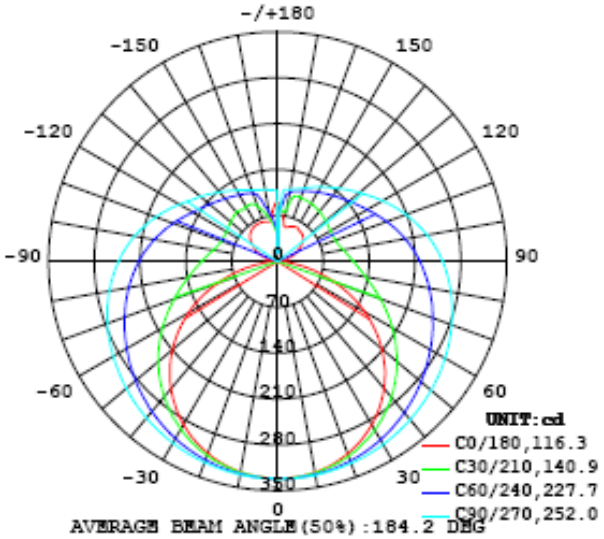


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

γ (DEG) \ C (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332
5	330	331	331	331	331	331	332	332	332	332	331	332	331	331	331	331	330	330	330
10	327	327	327	328	329	329	330	330	331	331	331	331	330	329	329	328	327	327	327
15	321	321	322	323	325	327	328	329	329	329	329	329	327	326	325	323	322	321	320
20	312	313	314	317	319	322	324	326	327	328	327	326	324	322	319	317	314	313	312
25	301	302	304	307	312	315	320	323	325	325	325	323	320	317	312	308	305	302	301
30	288	289	292	297	303	309	314	319	322	322	322	319	314	310	304	298	293	289	288
35	272	273	278	285	292	301	308	314	318	319	318	314	309	303	294	286	279	274	272
40	253	255	261	270	282	292	301	309	313	315	314	310	303	294	284	273	263	257	253
45	232	234	243	254	269	282	294	303	309	311	309	304	296	285	272	258	246	237	233
50	208	212	223	238	255	272	286	297	304	306	304	298	289	276	260	242	227	215	210
55	182	187	201	220	242	262	278	290	298	301	299	292	281	266	247	226	206	191	185
60	153	160	178	202	228	251	269	283	292	295	293	286	273	256	234	210	185	166	157
65	123	131	154	184	214	240	261	276	285	289	287	279	265	246	221	193	163	139	128
70	92.1	103	132	167	201	230	252	269	279	283	280	272	257	236	209	176	142	111	97.5
75	61.4	74.9	110	151	188	219	244	261	272	276	274	265	249	227	197	161	122	85.0	66.6
80	32.4	50.3	91.9	137	177	210	235	253	265	269	266	257	240	217	186	148	104	61.6	37.2
85	9.65	31.6	77.8	125	167	200	226	245	256	261	258	249	232	208	176	137	90.3	43.2	14.0
90	0.97	22.5	68.1	116	157	191	217	236	247	252	249	240	223	199	167	127	80.6	33.0	1.01
95	3.18	20.6	63.2	108	149	182	208	227	238	242	240	231	214	190	158	119	74.3	29.6	3.45
100	8.62	24.1	60.4	102	140	173	198	216	227	232	229	220	204	181	150	112	70.4	31.3	9.29
105	15.3	30.4	60.6	97.1	133	164	188	205	216	221	218	209	194	171	142	107	69.1	36.2	17.0
110	23.1	38.1	63.0	94.4	127	155	177	194	205	209	207	198	183	162	135	103	70.6	43.1	25.7
115	30.9	46.2	66.7	93.2	121	146	168	183	193	197	195	187	173	153	129	101	73.6	51.1	34.3
120	38.2	54.5	71.4	93.4	117	139	158	173	181	185	183	176	163	145	124	101	77.5	59.1	41.7
125	45.0	60.9	76.3	94.4	115	134	150	162	170	174	172	165	154	139	121	101	81.6	66.2	48.4
130	50.6	67.7	80.8	96.2	113	129	143	154	160	163	161	156	146	134	118	102	85.9	71.5	55.0
135	54.6	74.4	85.7	98.0	112	125	137	146	152	154	153	148	140	129	116	103	90.0	77.1	59.2
140	56.5	81.0	90.0	99.3	111	122	131	139	143	145	144	140	134	125	115	104	93.5	80.8	62.2
145	57.5	86.6	93.1	101	110	119	126	132	136	138	137	134	128	122	113	105	95.2	85.4	63.9
150	59.8	91.2	95.9	102	109	116	122	127	130	131	130	128	124	118	112	105	93.2	89.7	64.7
155	58.3	85.1	98.9	103	109	114	118	122	124	125	124	123	119	116	111	103	93.1	89.6	64.8
160	56.3	73.7	101	103	108	111	114	117	118	119	119	118	116	113	103	90.2	85.4	82.6	64.0
165	54.4	63.5	81.1	103	105	108	111	113	115	115	115	114	112	98.3	88.0	78.9	75.8	72.9	62.7
170	57.3	59.3	64.6	82.0	100	104	106	111	111	111	111	105	87.9	77.5	78.6	77.2	74.2	67.2	64.3
175	76.5	74.7	75.1	76.0	82.8	82.5	86.5	92.6	105	109	83.3	67.2	69.5	77.0	76.5	80.3	78.7	81.1	79.6
180	13.1	13.1	13.1	13.1	13.0	13.0	13.0	12.9	12.9	12.9	12.9	12.9	12.9	13.0	13.0	13.0	13.0	13.0	13.0

Table 6: Luminous Intensity Data

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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	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332		
5	330	330	330	331	331	331	331	331	331	331	331	331	331	331	331	330	331		
10	327	326	327	328	329	329	330	330	330	330	330	329	329	329	328	327	327		
15	321	321	322	324	325	326	328	328	329	328	328	327	326	324	323	322	321		
20	312	313	315	318	319	322	324	326	326	326	325	323	321	319	316	314	313		
25	301	303	306	310	314	318	321	323	324	323	321	318	315	311	307	304	302		
30	288	291	296	301	307	312	316	319	320	319	317	313	308	303	297	292	289		
35	273	277	284	291	299	306	312	315	316	315	312	307	300	292	285	278	273		
40	256	261	269	280	289	299	306	310	312	310	306	300	291	281	271	262	255		
45	235	243	255	268	281	291	300	305	307	305	300	293	282	269	256	244	235		
50	213	223	238	255	270	283	293	299	302	300	294	284	272	256	240	224	213		
55	189	202	221	241	260	275	286	294	296	294	287	276	261	243	223	203	188		
60	163	180	203	227	249	267	279	287	290	288	280	268	251	230	205	181	162		
65	136	158	186	214	238	258	272	281	284	281	273	259	240	216	188	159	135		
70	108	136	168	200	227	249	264	273	277	274	265	250	230	203	171	138	107		
75	80.3	114	153	187	217	240	256	266	269	266	257	242	220	191	156	117	80.5		
80	55.1	95.5	138	176	207	231	247	258	261	258	249	233	210	180	142	99.4	56.6		
85	35.5	80.6	126	165	197	222	238	249	252	249	240	223	200	169	130	85.5	38.7		
90	24.8	70.2	116	155	187	212	229	239	243	239	230	214	190	159	120	75.5	29.2		
95	21.3	63.4	108	146	177	202	219	229	233	230	220	204	180	150	112	68.6	25.6		
100	23.5	59.1	100	137	168	191	208	218	222	219	209	193	170	140	104	64.0	27.3		
105	29.3	58.6	94.4	128	157	181	197	207	210	207	198	182	160	132	97.9	62.8	32.7		
110	37.3	60.9	91.2	121	148	170	185	195	198	195	186	171	151	124	94.0	64.0	40.3		
115	45.8	65.0	90.2	116	140	160	174	183	186	183	175	161	142	118	92.1	66.8	48.4		
120	53.4	69.8	90.6	112	133	150	163	171	174	172	164	152	134	114	91.7	70.9	55.3		
125	61.9	74.8	91.9	110	127	142	154	160	163	161	155	144	129	111	92.3	75.9	63.0		
130	68.2	80.0	93.7	108	123	136	146	152	154	152	147	137	124	109	94.1	81.1	69.4		
135	74.5	82.1	95.8	107	119	130	139	144	146	144	139	131	120	108	96.2	84.6	74.9		
140	80.6	86.0	97.9	107	117	125	132	137	138	137	133	126	117	108	98.5	87.8	81.5		
145	85.8	90.3	94.4	107	115	121	127	130	131	130	127	122	115	108	99.8	91.9	87.5		
150	89.9	94.5	96.7	106	112	117	122	124	125	125	122	118	113	107	100	94.8	92.2		
155	85.2	94.3	96.7	101	110	114	118	120	120	120	118	116	111	106	102	98.8	89.1		
160	71.8	85.8	89.2	92.6	103	111	114	116	116	116	115	113	109	106	104	103	81.5		
165	65.4	72.5	77.6	80.4	86.6	98.1	109	113	113	113	112	110	107	106	106	106	74.0		
170	61.2	58.8	64.9	75.1	66.9	76.3	76.0	110	111	111	111	109	108	100	107	108	66.6		
175	56.9	45.1	52.1	72.8	46.1	59.8	36.7	107	109	108	110	109	108	93.8	108	111	59.1		
180	13.0	13.0	13.0	13.0	13.0	12.9	12.9	12.9	12.9	12.9	12.9	13.0	13.0	13.0	13.1	13.1	13.1		

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, 2020	Aug. 04, 2021
Digital Power Meter	PF2010A	HZTE028-01	Aug. 05, 2020	Aug. 04, 2021
AC Power Supply	DPS1060	HZTE001-06	Aug. 05, 2020	Aug. 04, 2021
DC Power Supply	WY12010	HZTE004-03	Aug. 05, 2020	Aug. 04, 2021
Temperature recorder	JM624U	HZTE018-08	Aug. 05, 2020	Aug. 04, 2021
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 05, 2020	Aug. 04, 2021
Standard source	D908	HZTE012-01	Aug. 05, 2020	Aug. 04, 2021
Integrate Sphere system	3M	HZTE015-04	Aug. 05, 2020	Aug. 04, 2021
Digital Power Meter	WT210	HZTE008-01	Aug. 05, 2020	Aug. 04, 2021
AC Power Supply	PCR 500L	HZTE001-07	Aug. 05, 2020	Aug. 04, 2021
DC Power Supply	IT6154	HZTE004-04	Aug. 05, 2020	Aug. 04, 2021
Standard source	SCL-1400	HZTE012-02	Aug. 05, 2020	Aug. 04, 2021
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 05, 2020	Aug. 04, 2021
Temperature Meter	TES1310	HZTE017-01	Aug. 05, 2020	Aug. 04, 2021

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.

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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 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 2.3% with a coverage factor k=2.

Color Characteristics Measurements

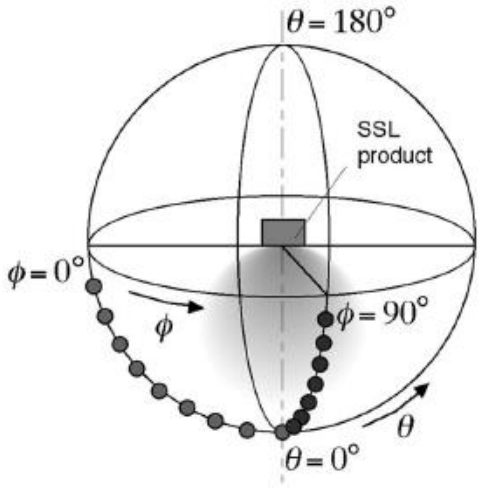
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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