

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: 17PLL/840/BYP/R

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

Tel: +86571 86376106

www.ledtestlab.com

Report No.: HZ22070009f

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

Review by:



Engineer: April Zou
Jul. 15, 2022

Approved by:



Manager: Jim Zhang
Jul. 15, 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: 17PLL/840/BYP/R

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
138.3	2195.6	15.87	0.9757
CCT (K)	CRI	Stabilization Time (Light & Power)	
3969	81.8	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. 08, 2022

Date of Test : Jul. 12, 2022

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: 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

LM-79-08 TEST REPORT.....	1
TEST SUMMARY	2
SAMPLE PHOTO	4
TEST RESULTS	5
Sphere-Spectroradiometer Method.....	5
Goniophotometer Method	6
Spectral Power Distribution - Sphere Spectroradiometer Method	7
Chromaticity Diagram - Sphere Spectroradiometer Method.....	8
Nominal CCT Quadrangles – Sphere Spectroradiometer Method	9
Color Rendition Report – Sphere Spectroradiometer Method	10
Zonal Lumen Tabulation- Goniophotometer Method	11
Illuminance Plots- Goniophotometer Method	12
Luminous Intensity Distribution Plots- Goniophotometer Method.....	13
Luminous Intensity Data- Goniophotometer Method	14
EQUIPMENT LIST	16
TEST METHODS	16
Seasoning of SSL Product.....	16
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements.....	16
Goniophotometer Method	17
Photometric and Electrical Measurements	17
Color Characteristics Measurements.....	17

SAMPLE PHOTO



Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 17PLL/840/BYP/R
Electrical Ratings	: 120-277V, 50/60Hz
Product Description	: 4000K
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 26.0 °C.

Base orientation was base up. 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	0.063
Power Factor	0.9757	0.9076
Test Power (W)	15.87	15.73
THD A%	19.47	20.22
Luminous Efficacy (lm/W)	138.3	139.8
Total Luminous Flux (lm)	2195.6	2199.6
Color Rendering Index (CRI)	81.8	
R9	1.8	
Correlated Color Temperature (CCT)(K)	3969	
Chromaticity Chroma x	0.3830	
Chromaticity Chroma y	0.3824	
Chromaticity Chroma u	0.2246	
Chromaticity Chroma v	0.3363	
Duv	0.0019	
Chromaticity Chroma u'	0.2246	
Chromaticity Chroma v'	0.5044	

Special Color Rendering Indices	
R1	79.6
R2	88.7
R3	95.3
R4	79.9
R5	79.6
R6	84.3
R7	85.3
R8	61.8
R9	1.8
R10	73.3
R11	78.5
R12	59
R13	81.9
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 24.8 °C.

The photometric distance is 2.47 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)	0.138
Power Factor	0.9766
Power (W)	16.19
Luminous Efficacy (lm/W)	134.6
Total Luminous Flux (lm)	2179.7
Beam Angle (°)	108.7 (0°-180°) / 143.5 (90°-270°)
Center Beam Candle Power (cd)	488
Maximum Beam Candle Power (cd)	490.4 (At: C=290.0, Gamma=6.5)
Spacing Criteria	1.22 (0°-180°) / 1.47 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	55.46%
Zonal Lumens in the 60 °-90 °Zone	24.46%
Zonal Lumens in the 90 °-120 °Zone	10.62%
Zonal Lumens in the 120 °-180 °Zone	9.46%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

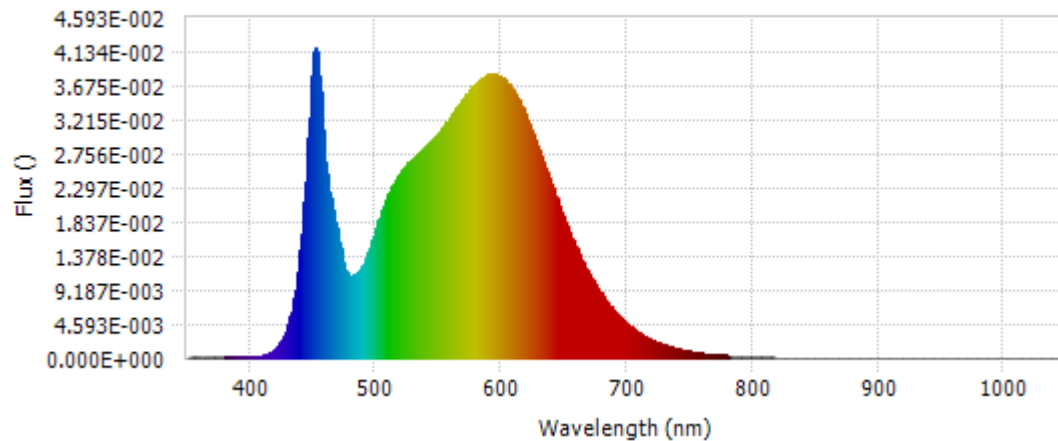
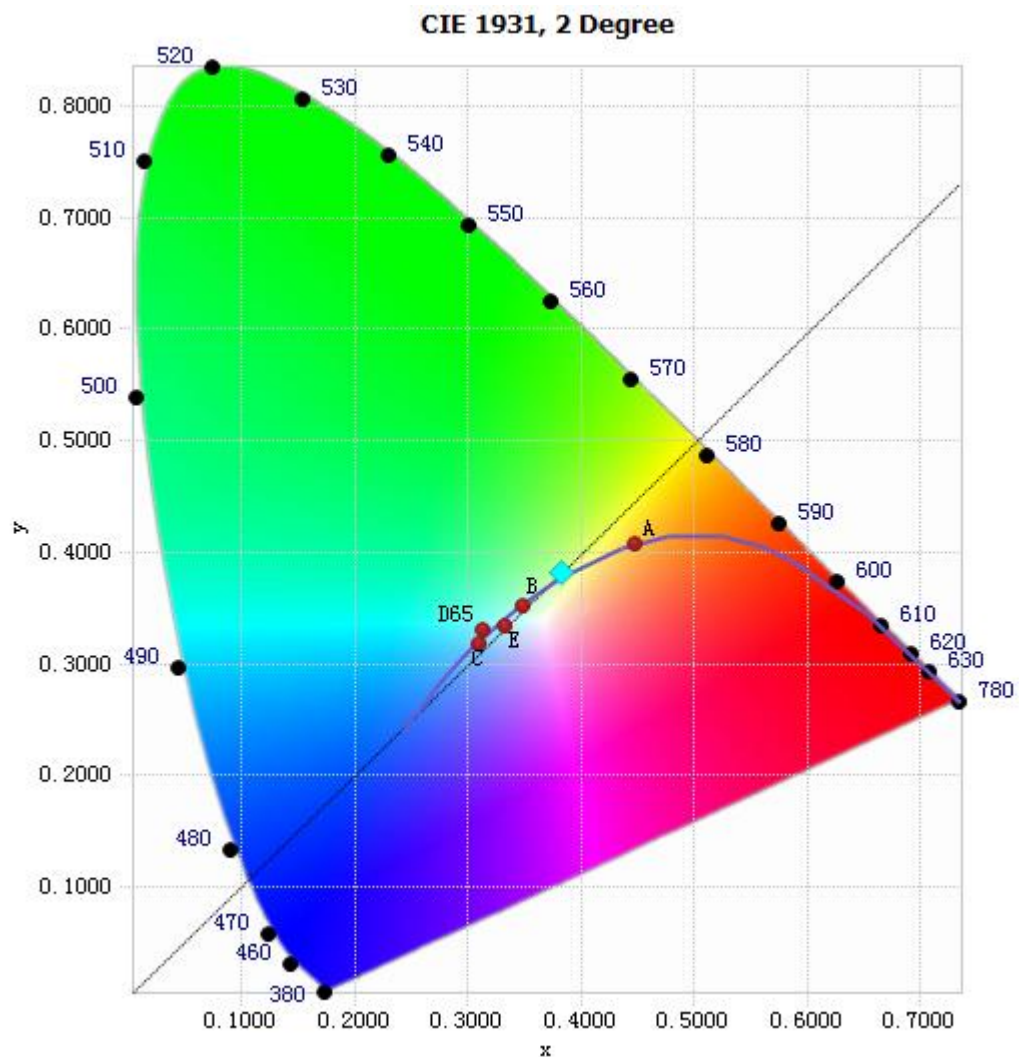


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.03E-04	485	1.15E-02	590	3.84E-02	695	5.44E-03
385	1.97E-04	490	1.28E-02	595	3.84E-02	700	4.67E-03
390	2.07E-04	495	1.49E-02	600	3.79E-02	705	3.99E-03
395	1.73E-04	500	1.76E-02	605	3.71E-02	710	3.42E-03
400	1.98E-04	505	2.00E-02	610	3.60E-02	715	2.92E-03
405	2.19E-04	510	2.21E-02	615	3.44E-02	720	2.52E-03
410	3.47E-04	515	2.39E-02	620	3.25E-02	725	2.13E-03
415	6.82E-04	520	2.52E-02	625	3.04E-02	730	1.81E-03
420	1.33E-03	525	2.61E-02	630	2.80E-02	735	1.54E-03
425	2.46E-03	530	2.70E-02	635	2.58E-02	740	1.31E-03
430	4.47E-03	535	2.77E-02	640	2.34E-02	745	1.13E-03
435	8.09E-03	540	2.86E-02	645	2.11E-02	750	9.60E-04
440	1.47E-02	545	2.94E-02	650	1.88E-02	755	8.25E-04
445	2.67E-02	550	3.06E-02	655	1.67E-02	760	7.04E-04
450	4.03E-02	555	3.15E-02	660	1.47E-02	765	5.95E-04
455	3.82E-02	560	3.27E-02	665	1.30E-02	770	5.14E-04
460	2.65E-02	565	3.40E-02	670	1.13E-02	775	4.35E-04
465	2.10E-02	570	3.52E-02	675	9.87E-03	780	3.75E-04
470	1.66E-02	575	3.62E-02	680	8.54E-03		
475	1.24E-02	580	3.71E-02	685	7.36E-03		
480	1.11E-02	585	3.78E-02	690	6.39E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3830, 0.3824)

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

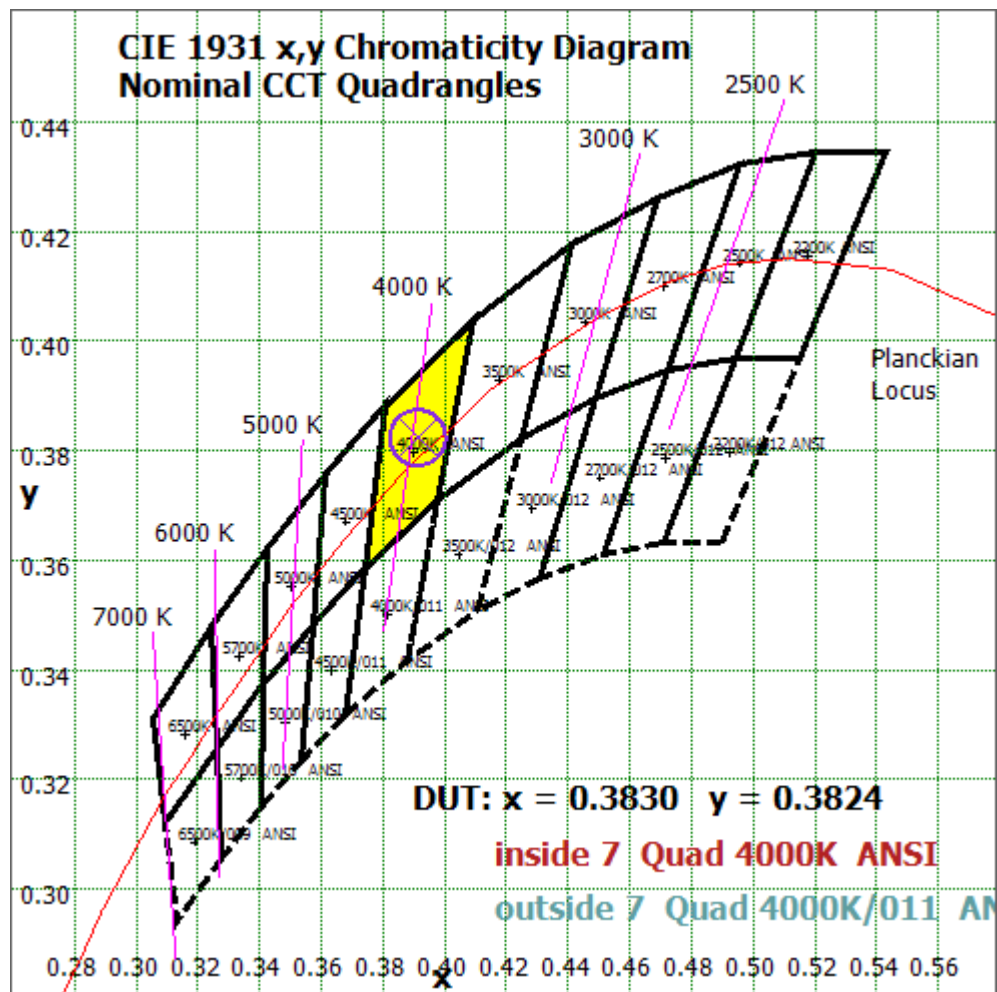


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

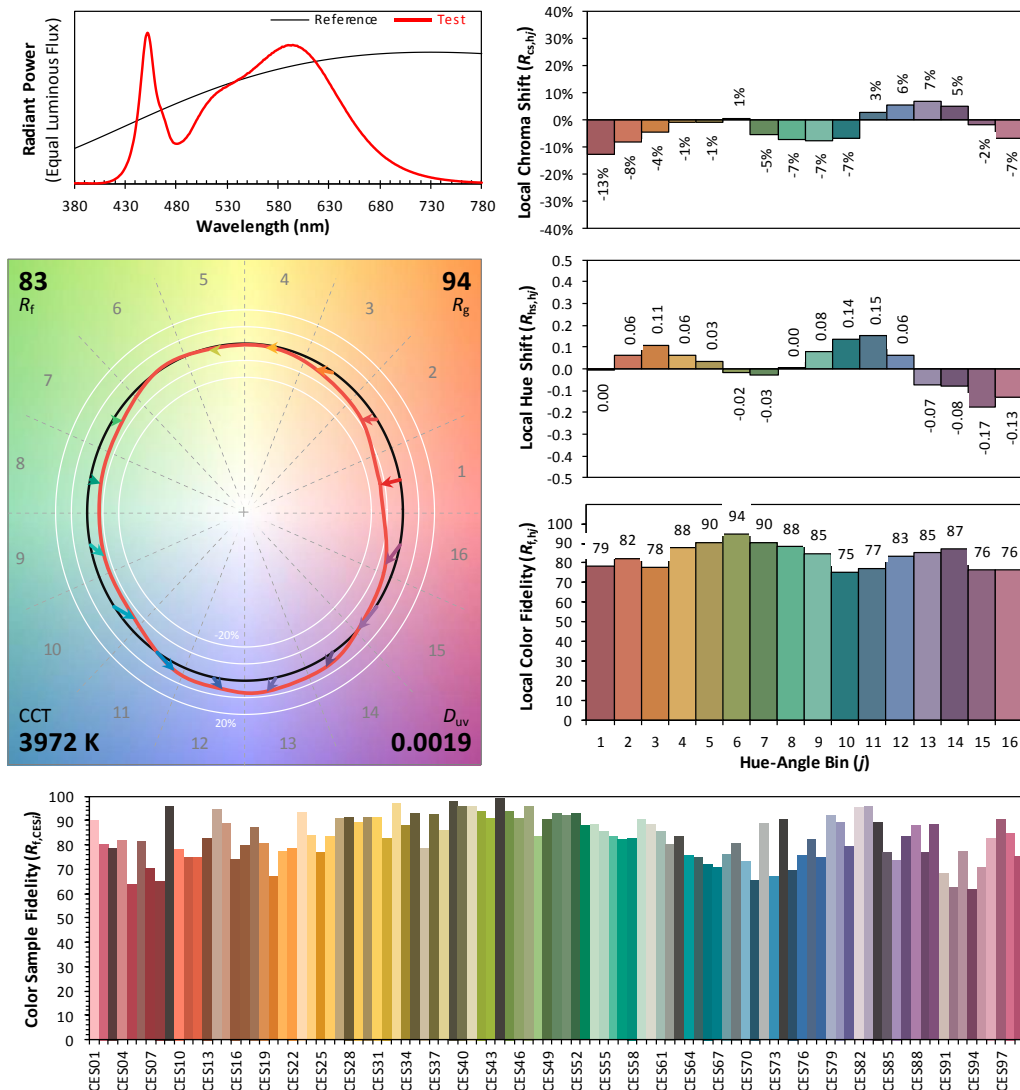
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: GREEN CREATIVE LTD

Date: 2022/07/12

Model: 17PLL/840/BYP/R



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

x 0.3830
 y 0.3824
 u' 0.2246
 v' 0.5044

CIE 13.3-1995
(CRI)
 R_a 82
 R_9 2

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.

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	46.324	2.13%
10- 20	134.159	6.15%
20- 30	208.288	9.56%
30- 40	261.27	11.99%
40- 50	284.315	13.04%
50- 60	274.523	12.59%
60- 70	236.248	10.84%
70- 80	179.143	8.22%
80- 90	117.705	5.40%
90-100	85.452	3.92%
100-110	76.295	3.50%
110-120	69.756	3.20%
120-130	63.221	2.90%
130-140	54.604	2.51%
140-150	42.24	1.94%
150-160	27.595	1.27%
160-170	14.941	0.69%
170-180	3.66	0.17%
Total	2179.7	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1208.88	55.46%
60- 90	533.096	24.46%
0-90	1741.98	79.92%
90- 180	437.764	20.08%
0- 180	2179.7	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

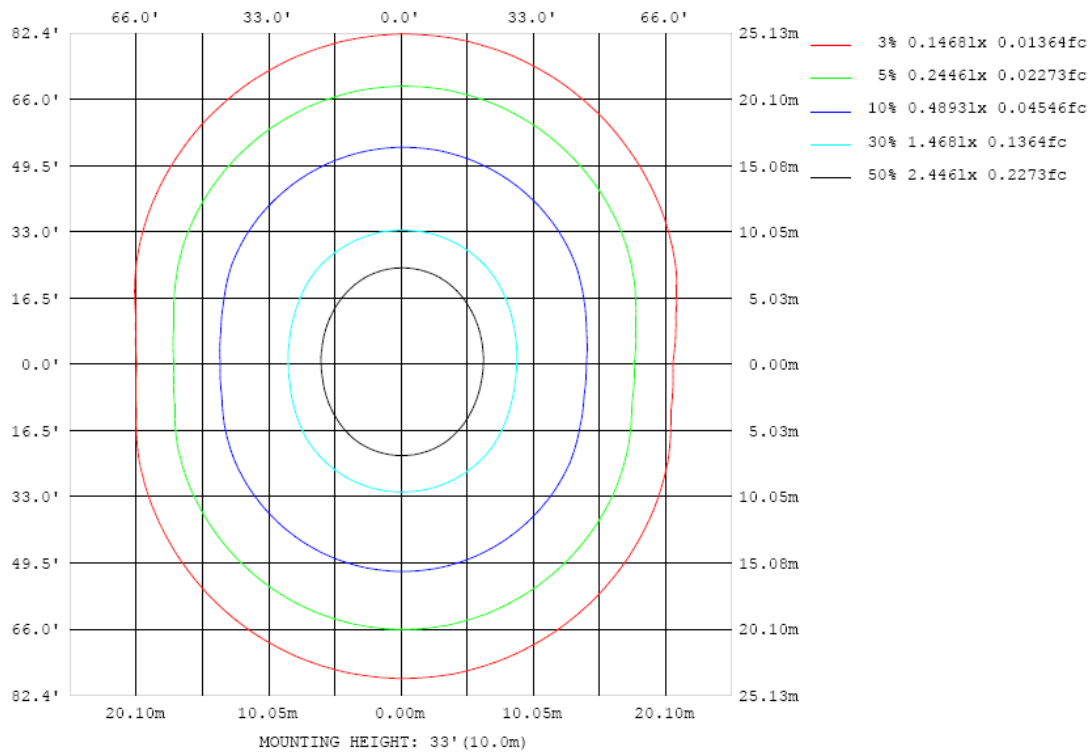


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

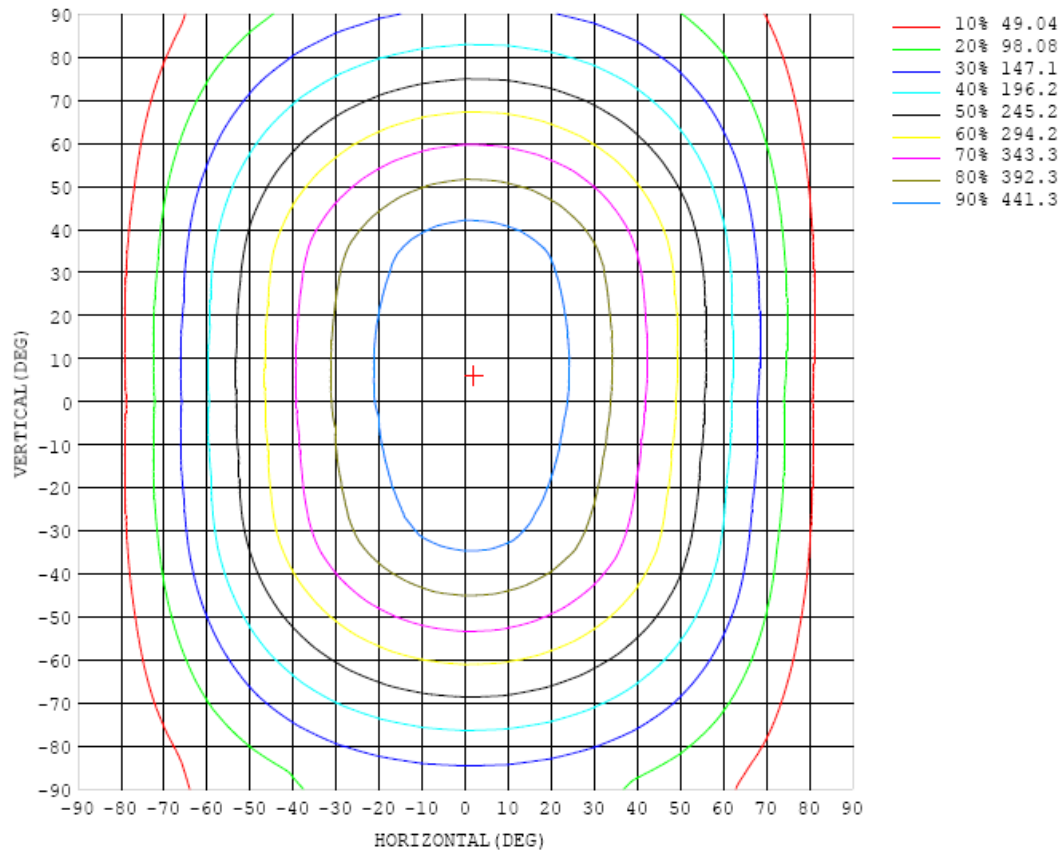


Chart 6: Isocandela Plot

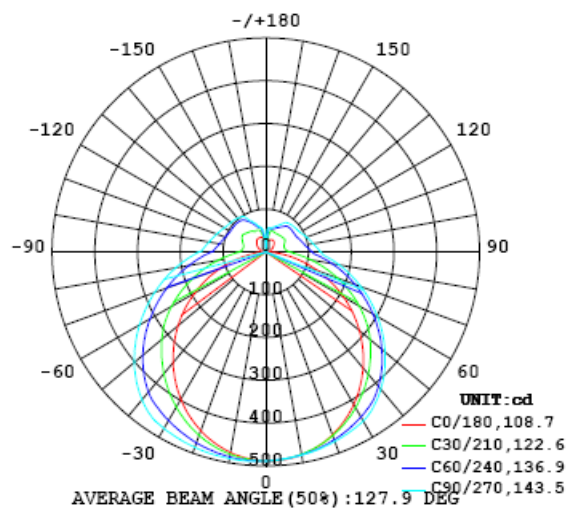


Chart 7: Polar Candela Distribution

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	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488
5	488	487	486	486	486	486	485	486	485	486	485	485	484	484	484	484	484	484	484
10	481	481	480	479	480	482	481	482	482	482	481	481	479	478	477	475	474	474	476
15	471	469	470	470	472	474	476	476	477	477	476	475	472	469	467	464	462	462	462
20	455	454	455	457	460	465	467	470	471	471	470	467	463	458	454	449	445	443	445
25	435	435	436	440	445	452	457	461	464	464	462	459	452	445	438	431	426	422	423
30	411	411	414	420	428	438	445	451	455	456	454	449	441	430	420	412	402	397	398
35	384	384	389	398	409	421	431	437	440	441	438	433	425	414	400	387	377	369	369
40	354	354	361	372	388	402	410	414	418	418	416	411	403	393	380	362	348	339	337
45	321	322	331	347	364	376	384	389	392	393	391	385	376	366	354	337	318	306	304
50	286	287	299	319	334	346	354	360	364	364	361	356	347	336	324	308	288	271	268
55	249	251	267	287	302	313	322	329	333	333	330	324	315	304	290	275	256	237	231
60	210	214	233	252	267	279	289	296	300	301	298	292	282	270	256	241	223	200	192
65	170	176	198	216	231	245	255	263	268	269	266	259	249	236	221	204	187	164	154
70	130	138	161	178	195	210	221	230	235	237	233	227	216	202	186	168	149	129	114
75	90.7	102	123	142	160	176	189	198	204	205	202	195	184	170	153	133	113	93.0	76.2
80	53.6	66.2	86.1	107	127	144	157	167	173	174	171	164	153	138	121	101	78.9	58.2	40.8
85	21.3	33.1	55.3	76.9	96.8	114	128	138	144	145	142	135	124	110	92.2	72.1	50.9	28.9	12.9
90	3.00	12.1	33.2	55.4	75.3	93.4	108	119	126	128	126	120	109	94.7	77.4	57.9	36.1	14.9	1.11
95	1.98	8.69	27.4	48.3	67.8	85.5	99.9	111	118	120	118	112	101	87.4	70.6	52.2	31.8	13.1	3.33
100	4.94	12.3	26.4	45.2	63.7	79.6	93.1	103	110	112	111	105	94.9	82.1	66.5	49.2	31.0	17.5	6.46
105	8.15	15.9	28.7	44.2	61.0	75.8	88.6	98.3	104	107	105	99.8	90.6	78.2	64.2	48.3	34.2	22.3	10.1
110	11.8	18.4	33.0	45.2	59.3	72.7	84.5	93.5	99.3	102	99.8	94.8	86.3	75.0	62.7	50.3	38.6	24.5	13.9
115	15.5	22.1	36.3	48.4	59.7	70.8	81.2	89.3	94.6	96.6	95.0	90.4	82.8	73.3	63.9	53.3	42.5	26.5	17.5
120	18.2	25.1	37.0	51.9	61.7	70.8	79.5	86.2	90.6	92.5	91.1	87.4	81.3	73.8	65.7	56.3	43.9	28.9	21.2
125	21.2	26.0	38.5	53.7	64.1	71.8	79.2	84.9	88.6	90.3	89.3	86.2	81.1	74.7	67.8	58.9	44.1	32.5	24.6
130	24.5	29.3	39.3	52.1	65.8	73.0	79.4	84.2	87.5	88.9	88.1	85.5	81.2	75.6	69.3	58.3	43.9	34.7	27.9
135	27.6	32.7	40.5	51.6	64.0	73.4	79.2	83.5	86.4	87.8	87.0	84.7	81.0	75.9	68.6	56.5	45.5	37.0	30.6
140	30.2	37.1	41.4	50.5	60.1	70.4	78.3	82.5	85.0	86.2	85.6	83.6	80.2	73.7	64.9	54.6	46.4	41.0	33.3
145	31.8	39.3	43.2	50.0	58.3	65.3	72.9	78.7	82.5	84.0	83.4	80.3	75.0	68.5	61.5	53.5	47.1	43.3	35.5
150	32.2	40.4	44.8	49.4	55.9	62.2	66.9	71.4	74.5	76.0	75.4	72.8	68.8	64.2	59.2	54.3	48.6	45.7	36.4
155	31.2	40.8	47.1	50.0	53.9	58.6	62.9	65.3	67.3	68.4	68.2	66.7	64.2	61.6	57.3	52.6	49.7	46.4	36.6
160	29.5	40.9	50.5	51.4	53.0	55.2	58.7	61.6	62.9	63.5	63.4	62.8	61.0	58.7	54.2	51.6	51.0	47.7	36.6
165	28.3	35.7	49.0	53.7	53.5	54.5	56.1	57.4	58.3	58.8	58.7	58.2	56.8	54.0	53.2	52.4	49.5	42.2	35.0
170	26.2	28.1	32.0	38.4	48.6	55.8	55.7	55.6	55.7	56.0	56.0	55.4	52.2	46.8	43.9	41.1	36.5	33.5	32.1
175	25.5	26.0	26.6	27.0	27.4	29.1	35.1	42.9	49.8	53.3	42.0	31.4	29.9	29.8	29.9	30.0	30.1	30.4	30.9
180	36.2	36.0	34.7	32.1	27.6	16.8	11.5	12.2	2.97	4.93	10.6	8.27	9.48	21.0	25.2	30.5	33.4	36.6	36.0

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	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488		
5	485	486	486	487	489	489	489	490	490	490	490	490	490	490	489	488	488		
10	477	479	480	482	485	486	488	489	490	490	490	489	488	487	486	485	483		
15	464	467	470	474	478	481	485	487	489	489	489	486	485	481	478	476	473		
20	447	451	456	462	469	475	480	484	486	486	485	481	477	472	466	462	458		
25	427	432	439	448	458	466	473	479	482	481	479	474	467	460	451	444	439		
30	402	409	419	431	444	455	465	472	476	476	472	464	455	445	434	424	417		
35	374	383	396	412	428	443	456	464	468	468	464	454	442	427	413	400	391		
40	343	355	371	391	412	427	438	446	451	450	447	439	426	408	390	374	363		
45	310	324	345	369	389	403	415	424	428	428	425	416	404	388	365	345	331		
50	276	293	317	342	361	376	388	397	402	401	398	389	377	361	339	315	296		
55	240	260	289	311	330	345	358	367	372	372	368	359	346	330	310	283	261		
60	202	227	255	277	297	313	326	336	341	341	336	327	313	296	276	251	225		
65	165	194	219	242	262	280	294	303	309	309	303	293	279	261	241	217	187		
70	129	157	183	206	228	246	261	271	277	276	270	260	244	225	204	179	151		
75	93.5	121	147	172	195	214	229	240	245	244	238	227	210	190	167	142	115		
80	59.5	85.9	114	141	163	183	198	209	214	213	207	195	178	157	133	106	78.8		
85	28.2	55.9	84.2	111	134	153	168	179	184	183	177	164	148	127	101	73.2	44.4		
90	12.4	36.6	62.0	86.1	108	127	142	152	156	155	149	137	120	99.1	74.6	47.7	20.9		
95	11.6	32.5	56.2	79.1	99.9	117	131	139	143	142	135	123	107	86.8	63.8	39.3	15.7		
100	17.5	32.8	53.8	75.0	94.4	110	123	131	135	133	127	116	100	81.8	60.3	37.7	17.8		
105	22.2	37.1	53.8	72.6	90.4	105	117	125	128	127	121	110	96.1	78.5	58.9	39.4	24.2		
110	25.1	42.9	56.7	71.7	87.6	101	112	119	122	121	116	106	92.7	76.7	59.3	43.4	27.7		
115	28.2	47.6	60.6	73.2	86.0	98.1	108	114	117	116	111	102	90.2	76.2	61.7	48.5	29.6		
120	31.2	47.8	64.3	75.7	86.7	96.1	104	110	112	111	107	99.1	89.2	77.5	65.0	51.6	31.5		
125	33.3	47.1	67.2	78.0	87.7	95.9	103	107	109	108	104	98.2	89.5	79.3	68.2	51.7	33.5		
130	35.6	48.2	66.0	79.8	88.6	95.9	102	106	107	106	103	97.6	90.1	81.1	68.4	49.9	34.5		
135	37.0	48.4	63.0	80.3	89.0	95.5	101	104	105	104	102	96.9	90.3	81.5	63.9	49.5	37.5		
140	41.7	48.7	60.9	74.9	88.3	94.3	99.0	102	103	102	99.8	95.4	88.8	72.7	59.8	49.7	40.4		
145	43.9	49.0	59.1	71.1	82.5	91.3	96.4	99.1	100	99.3	96.8	90.9	77.6	68.5	58.4	47.4	43.3		
150	45.4	49.8	55.4	65.7	75.5	83.0	87.8	90.6	92.1	90.2	84.5	77.3	71.8	64.9	55.7	47.3	45.1		
155	43.9	50.4	54.9	61.1	66.8	74.1	76.7	79.1	80.0	79.1	75.5	70.1	66.9	60.3	52.1	49.1	44.6		
160	42.0	50.5	54.3	59.6	61.7	64.1	67.9	69.7	70.7	69.9	68.2	65.2	60.8	55.9	53.4	51.8	45.0		
165	36.7	44.6	52.1	56.6	59.1	59.7	59.8	61.4	61.5	61.0	60.1	58.4	57.2	55.8	54.1	52.2	44.5		
170	32.2	33.6	38.3	42.5	46.9	52.1	56.2	52.5	56.0	57.2	56.8	56.3	56.1	55.4	49.9	35.9	29.9		
175	30.9	31.1	31.2	31.2	31.3	31.6	32.3	34.9	42.5	50.9	51.3	46.4	37.9	29.9	25.8	25.8	25.8		
180	36.1	35.7	34.2	31.6	27.3	22.2	16.0	11.6	11.0	4.35	9.79	12.6	16.8	20.4	26.1	31.2	34.2		

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 3 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 30min, 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.

*** End of Report ***

This report is considered invalidated without the Special Seal for Inspection of the LTL. This report shall not be altered, increased or deleted. The results shown in this test report refer only to the sample(s) tested. Without written approval of LTL, this test report shall not be copied except in full and published as advertisement.