

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 Lamp

Model: 7R20DIM/930

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ21120007b

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

Review by:



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Dec. 15, 2021

Approved by:



Manager: Jim Zhang

Dec. 15, 2021

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: 7R20DIM/930

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
90.7	629.6	6.94	0.8018
CCT (K)	CRI	Stabilization Time (Light & Power)	
2993	95.1	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	: Dec. 03, 2021
Date of Test	: Dec. 08, 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 Lamp
Model	: 7R20DIM/930
Electrical Ratings	: 120V, 60Hz, 7W
Product Description	: 3000K
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 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
Voltage frequency (Hz)	60
Test Current (A)	0.072
Power Factor	0.8018
Test Power (W)	6.94
THD A%	59.67
Luminous Efficacy (lm/W)	90.7
Total Luminous Flux (lm)	629.6
Color Rendering Index (CRI)	95.1
R9	72.9
Correlated Color Temperature (CCT)(K)	2993
Chromaticity Chroma x	0.4367
Chromaticity Chroma y	0.4030
Chromaticity Chroma u	0.2509
Chromaticity Chroma v	0.3473
Duv	-0.0004
Chromaticity Chroma u'	0.2509
Chromaticity Chroma v'	0.5209

Special Color Rendering Indices	
R1	97.9
R2	96.6
R3	93
R4	95.9
R5	96.6
R6	96.3
R7	94.8
R8	89.6
R9	72.9
R10	89.3
R11	95
R12	83.8
R13	97.4
R14	94.5

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 2.47 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)	0.073
Power Factor	0.7978
Power (W)	6.97
Luminous Efficacy (lm/W)	92.6
Total Luminous Flux (lm)	645.5
Beam Angle (°)	113.0 (0°-180°) / 113.3 (90°-270°)
Center Beam Candle Power (cd)	190
Maximum Beam Candle Power (cd)	190.2 (At: C=180.0, Gamma=2.0)
Spacing Criteria	1.28 (0°-180°) / 1.24 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	65.35%
Zonal Lumens in the 60 °-90 °Zone	26.10%
Zonal Lumens in the 90 °-120 °Zone	7.14%
Zonal Lumens in the 120 °-180 °Zone	1.41%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

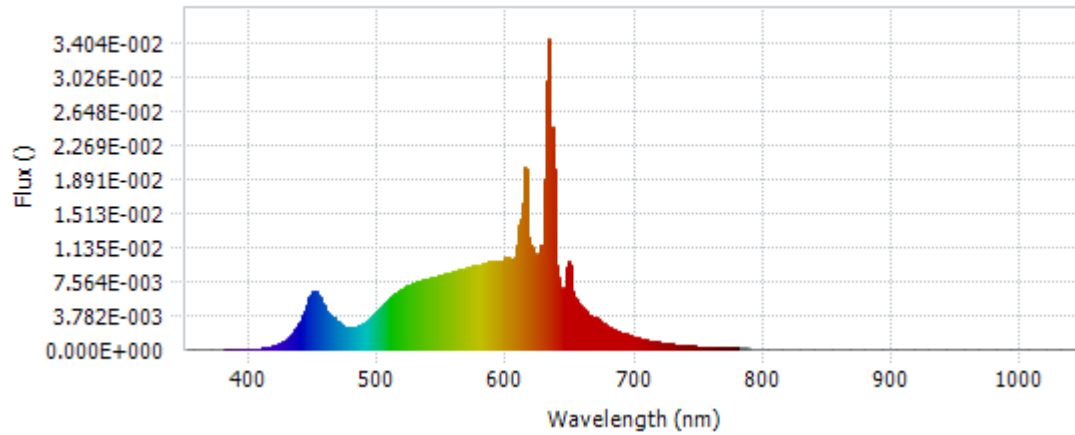
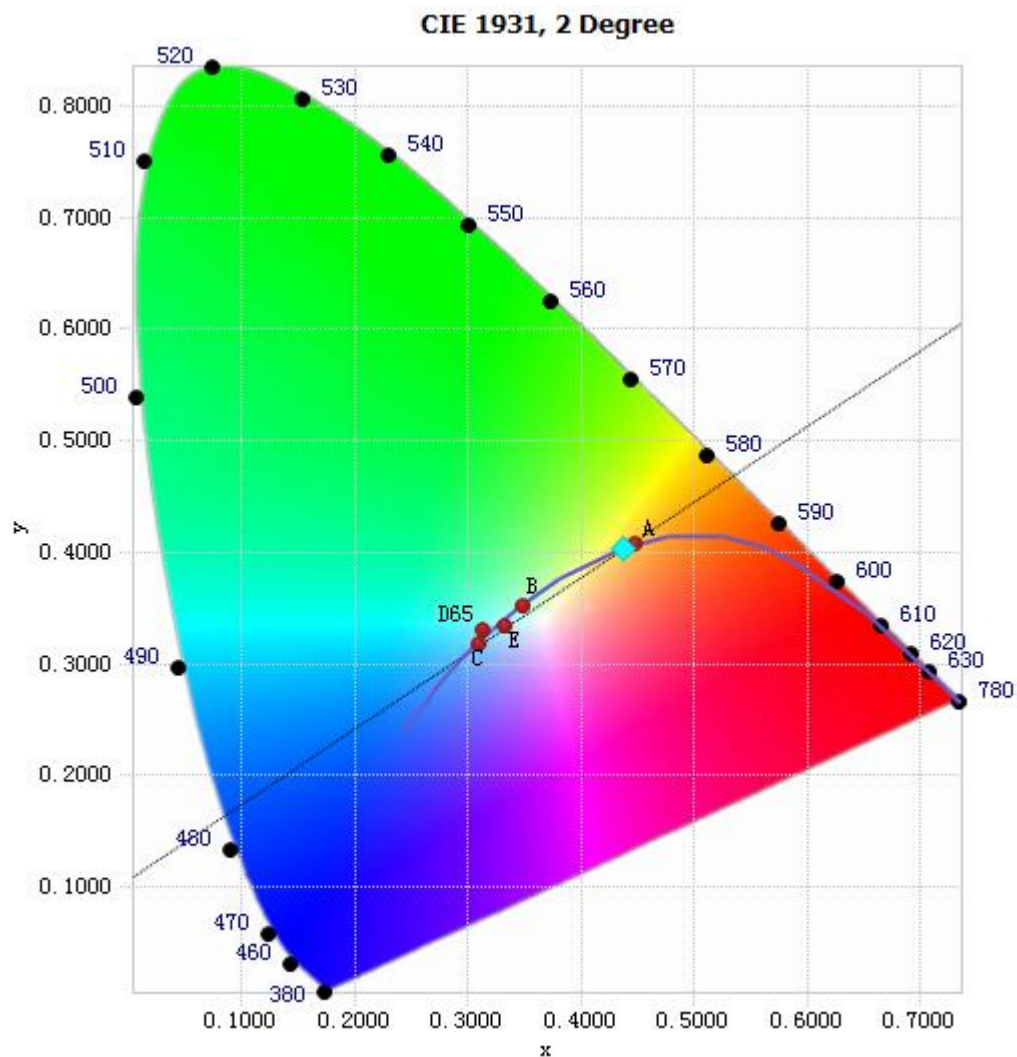


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.88E-05	485	2.62E-03	590	9.76E-03	695	1.56E-03
385	3.22E-05	490	3.06E-03	595	9.72E-03	700	1.32E-03
390	4.39E-05	495	3.65E-03	600	1.02E-02	705	1.14E-03
395	3.45E-05	500	4.37E-03	605	1.01E-02	710	9.63E-04
400	3.60E-05	505	5.14E-03	610	1.45E-02	715	8.30E-04
405	5.41E-05	510	5.82E-03	615	2.01E-02	720	7.24E-04
410	1.23E-04	515	6.42E-03	620	1.14E-02	725	6.19E-04
415	2.73E-04	520	6.85E-03	625	1.07E-02	730	5.23E-04
420	4.65E-04	525	7.19E-03	630	1.88E-02	735	4.43E-04
425	8.00E-04	530	7.47E-03	635	2.21E-02	740	3.75E-04
430	1.33E-03	535	7.68E-03	640	7.99E-03	745	3.28E-04
435	2.12E-03	540	7.87E-03	645	6.84E-03	750	2.80E-04
440	3.44E-03	545	8.07E-03	650	7.58E-03	755	2.38E-04
445	5.34E-03	550	8.23E-03	655	5.24E-03	760	2.07E-04
450	6.38E-03	555	8.46E-03	660	4.41E-03	765	1.73E-04
455	5.42E-03	560	8.62E-03	665	3.69E-03	770	1.51E-04
460	4.17E-03	565	8.83E-03	670	3.44E-03	775	1.29E-04
465	3.45E-03	570	9.08E-03	675	2.87E-03	780	1.08E-04
470	2.78E-03	575	9.24E-03	680	2.42E-03		
475	2.41E-03	580	9.42E-03	685	2.09E-03		
480	2.42E-03	585	9.68E-03	690	1.80E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4367, 0.4030)

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

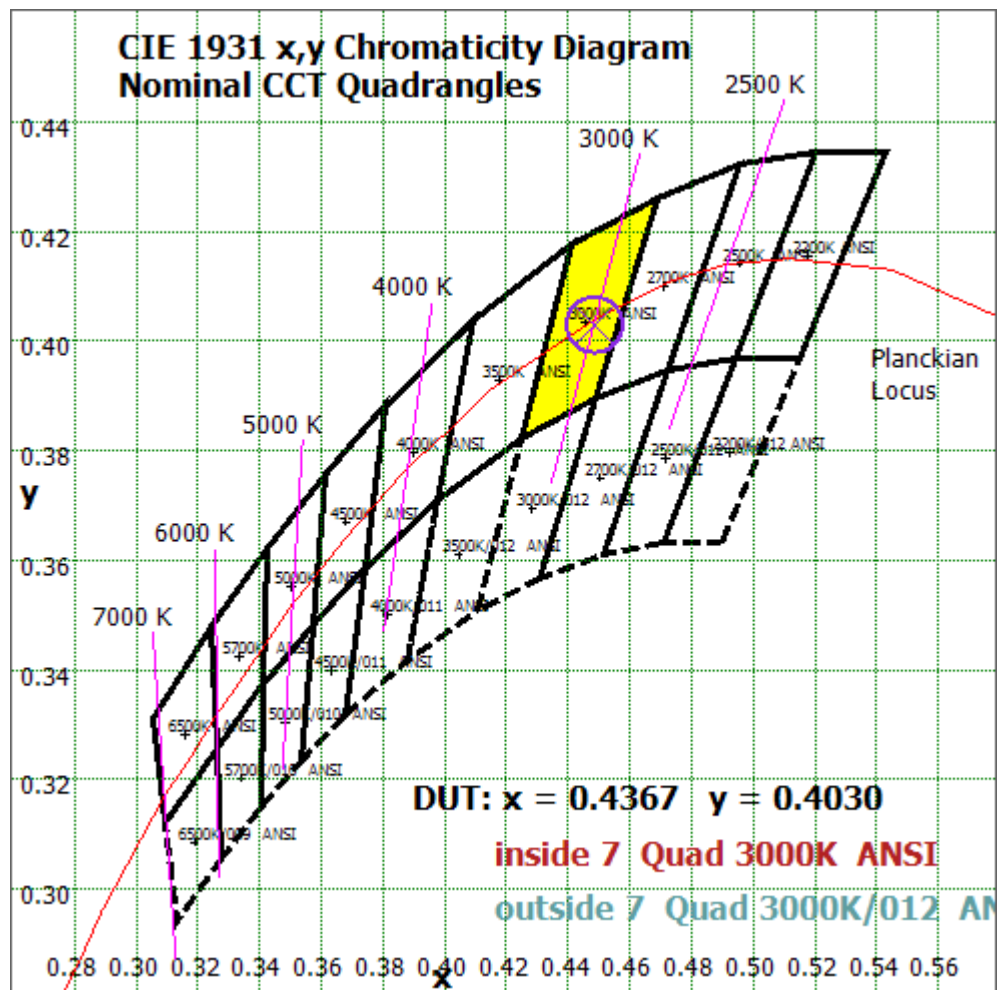


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

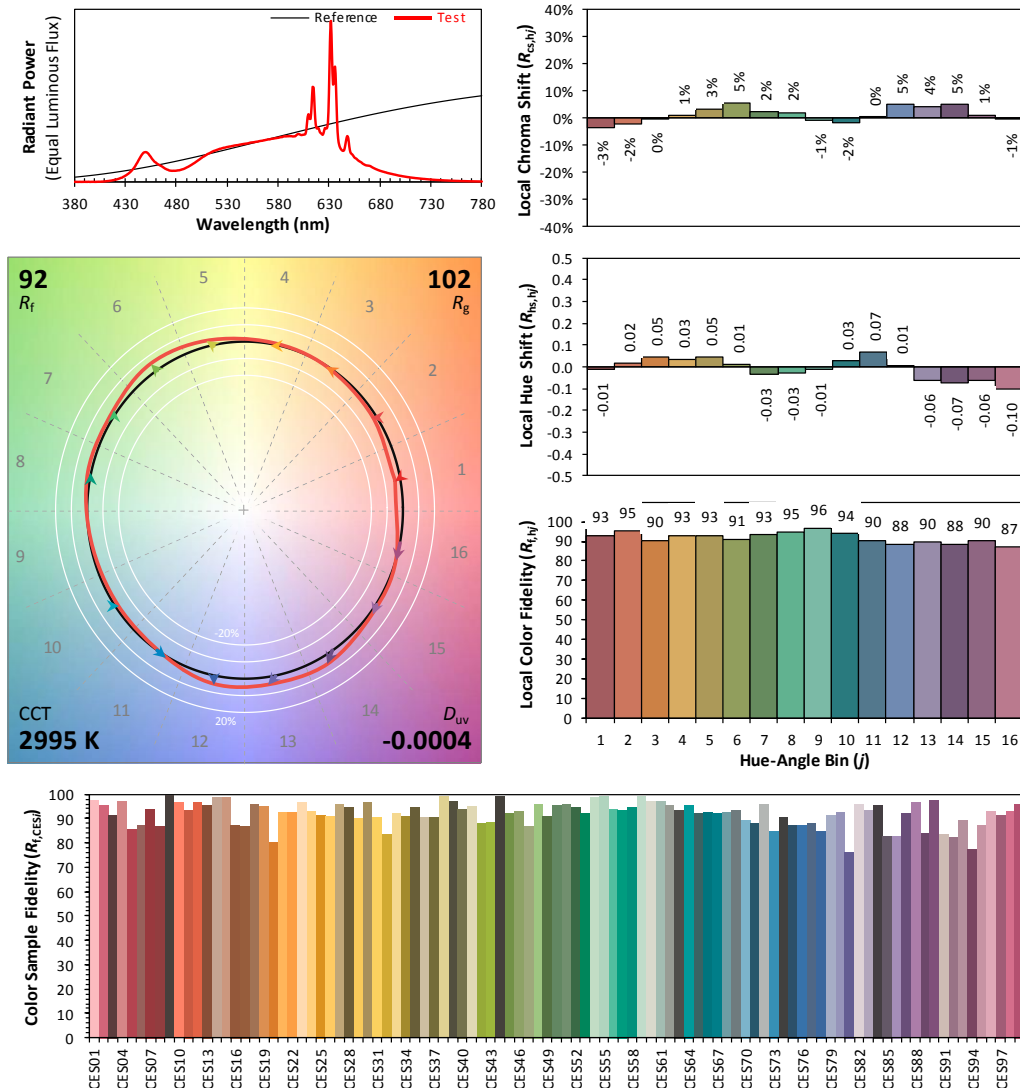
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: GREEN CREATIVE LTD

Date: 2021/12/08

Model: 7R20DIM/930



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

x 0.4367
 y 0.4030
 u' 0.2509
 v' 0.5209

CIE 13.3-1995
(CRI)
 R_a 95
 R_g 73

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	17.927	2.78%
10- 20	51.092	7.91%
20- 30	76.759	11.89%
30- 40	91.988	14.25%
40- 50	95.508	14.80%
50- 60	88.598	13.72%
60- 70	74.247	11.50%
70- 80	56.2	8.71%
80- 90	38.063	5.90%
90-100	23.491	3.64%
100-110	14.051	2.18%
110-120	8.529	1.32%
120-130	4.907	0.76%
130-140	2.549	0.39%
140-150	1.123	0.17%
150-160	0.381	0.06%
160-170	0.091	0.01%
170-180	0.019	0.00%
Total	645.5	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	421.872	65.35%
60- 90	168.51	26.10%
0-90	590.382	91.46%
90- 180	55.141	8.54%
0- 180	645.5	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

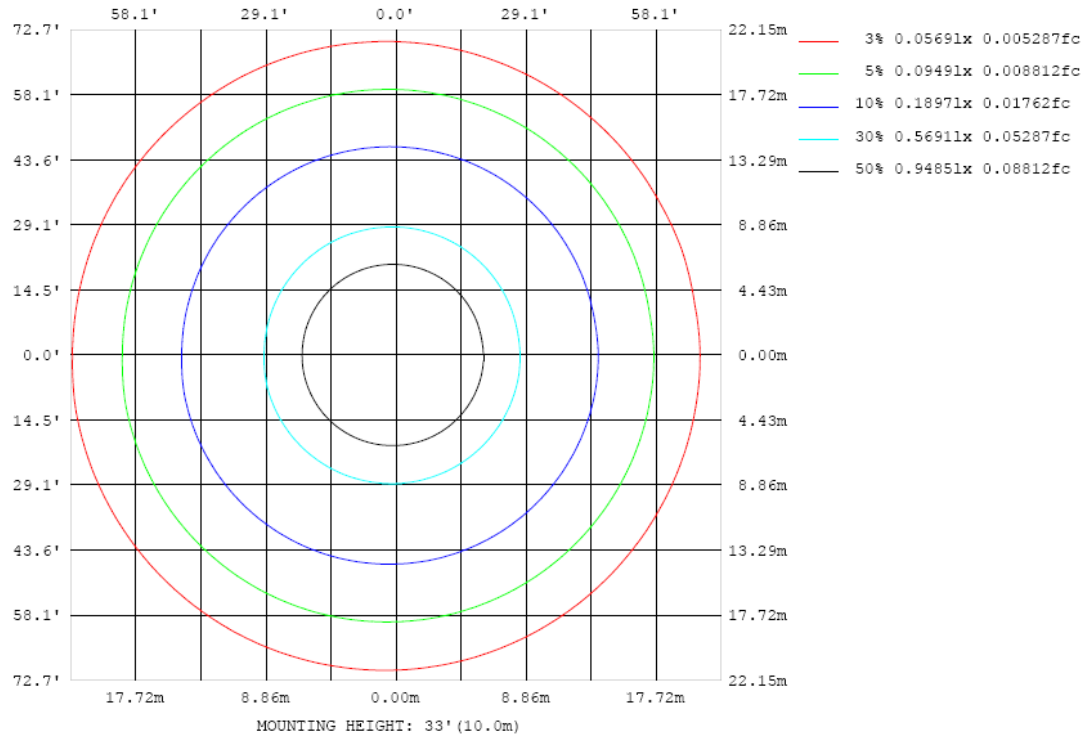


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

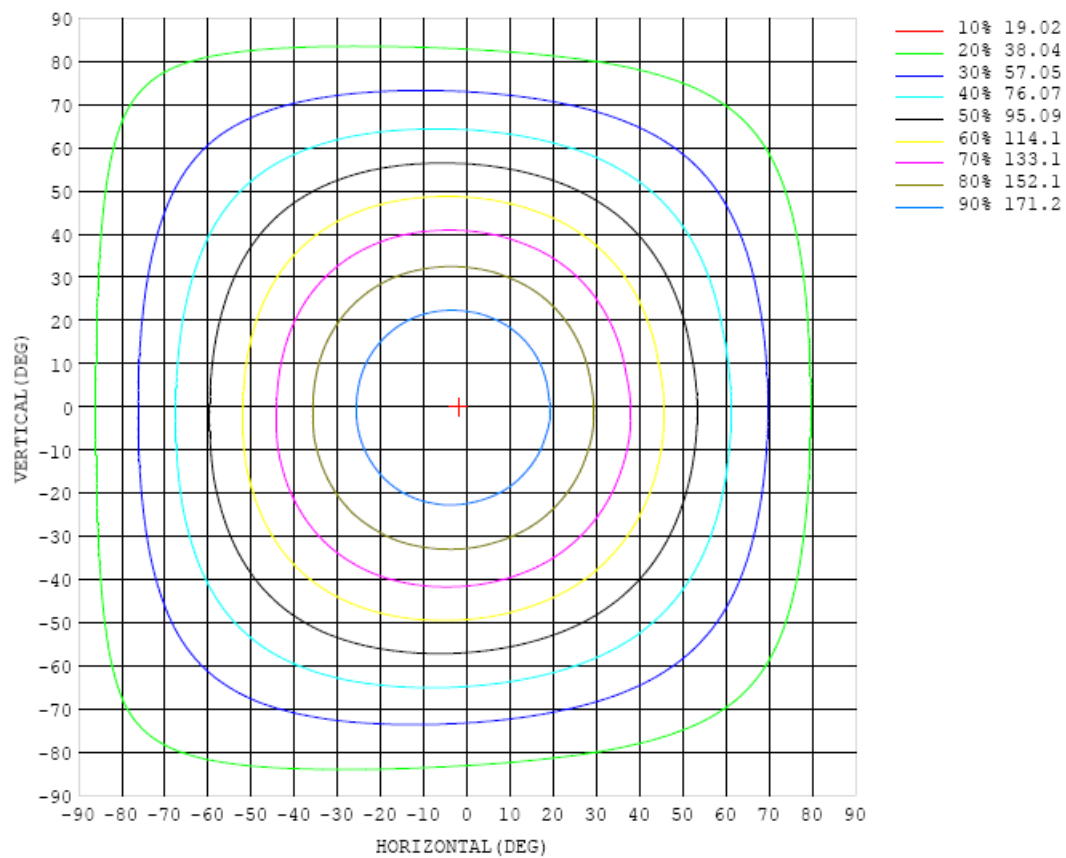


Chart 6: Isocandela Plot

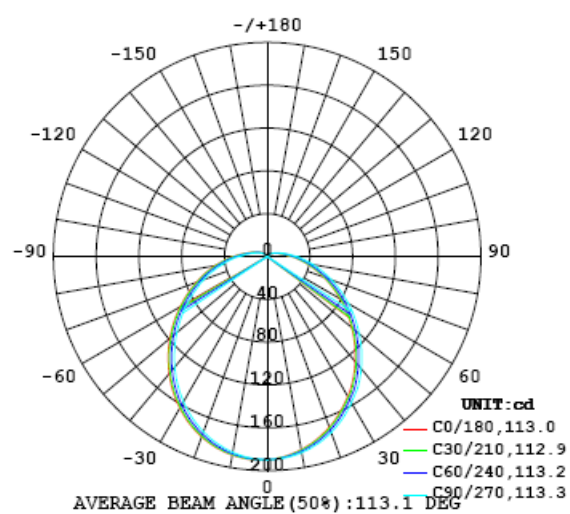


Chart 7: Polar Candela Distribution

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	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
5	187	187	187	188	188	188	188	188	189	189	189	190	189	189	190	190	190	190	190
10	183	183	184	184	184	184	185	185	186	186	186	187	187	188	188	188	188	188	188
15	177	178	178	178	179	179	180	180	180	181	182	183	183	184	184	184	185	185	185
20	170	170	170	171	171	172	173	173	174	175	176	177	178	178	179	179	179	179	179
25	161	161	161	162	162	163	164	165	166	167	168	169	170	171	171	172	172	172	172
30	151	152	152	152	153	153	154	155	156	158	159	160	161	162	163	163	164	164	164
35	140	141	141	142	142	143	144	146	147	148	150	151	152	152	153	154	154	154	154
40	128	129	129	130	130	131	133	134	135	137	138	140	141	142	143	144	144	144	143
45	116	116	117	117	118	119	120	122	123	125	126	128	129	130	131	132	132	132	131
50	103	104	104	105	105	107	108	109	111	112	114	115	117	118	119	120	120	120	119
55	91.1	91.3	91.7	92.2	93.0	94.2	95.5	96.9	98.4	99.9	101	103	104	106	106	107	108	108	106
60	79.0	79.2	79.5	80.0	80.8	82.0	83.3	84.6	86.2	87.7	89.1	90.6	92.1	93.1	94.0	94.7	95.2	95.3	94.1
65	67.4	67.5	67.8	68.3	69.1	70.2	71.4	72.7	74.2	75.7	77.1	78.5	79.9	80.9	81.8	82.5	82.9	83.1	81.9
70	56.5	56.5	56.8	57.3	58.0	59.0	60.2	61.4	62.8	64.1	65.5	66.8	68.2	69.1	70.0	70.6	71.0	71.3	70.1
75	46.4	46.4	46.7	47.2	47.8	48.7	49.8	50.9	52.1	53.4	54.7	55.9	57.1	58.0	58.9	59.3	59.8	60.1	59.7
80	37.5	37.4	37.7	38.1	38.7	39.5	40.4	41.4	42.5	43.6	44.7	45.9	46.9	47.7	48.5	49.0	49.3	49.6	49.2
85	29.7	29.7	29.9	30.3	30.8	31.4	32.2	33.0	33.9	34.9	35.9	36.9	37.8	38.5	39.1	39.6	39.9	40.1	39.8
90	23.2	23.2	23.4	23.6	24.0	24.6	25.2	25.9	26.7	27.5	28.3	29.1	29.8	30.5	31.0	31.4	31.6	31.8	31.6
95	18.1	18.1	18.2	18.4	18.8	19.2	19.7	20.2	20.8	21.4	22.0	22.6	23.2	23.7	24.2	24.5	24.7	24.8	24.7
100	14.2	14.2	14.3	14.5	14.7	15.0	15.4	15.8	16.2	16.7	17.1	17.6	18.1	18.4	18.8	19.0	19.2	19.3	19.1
105	11.3	11.3	11.4	11.5	11.7	11.9	12.1	12.4	12.7	13.1	13.4	13.8	14.2	14.4	14.7	14.9	15.0	15.1	15.0
110	9.21	9.20	9.26	9.35	9.47	9.64	9.84	10.1	10.3	10.5	10.8	11.0	11.2	11.5	11.6	11.8	11.9	11.9	11.9
115	7.43	7.43	7.48	7.56	7.66	7.80	7.97	8.15	8.35	8.54	8.75	8.94	9.12	9.28	9.43	9.53	9.60	9.66	9.65
120	5.92	5.93	5.98	6.05	6.13	6.25	6.39	6.54	6.70	6.87	7.03	7.19	7.34	7.48	7.60	7.69	7.75	7.79	7.78
125	4.66	4.67	4.72	4.77	4.84	4.94	5.05	5.18	5.31	5.45	5.59	5.72	5.85	5.96	6.06	6.13	6.19	6.22	6.19
130	3.61	3.62	3.66	3.71	3.77	3.85	3.94	4.04	4.15	4.26	4.37	4.49	4.59	4.69	4.77	4.83	4.87	4.91	4.88
135	2.74	2.75	2.79	2.83	2.88	2.95	3.02	3.10	3.18	3.27	3.36	3.46	3.54	3.62	3.69	3.74	3.78	3.81	3.78
140	2.02	2.04	2.07	2.11	2.15	2.20	2.26	2.32	2.38	2.45	2.53	2.61	2.68	2.74	2.80	2.84	2.87	2.90	2.87
145	1.44	1.46	1.49	1.52	1.55	1.59	1.63	1.67	1.72	1.78	1.84	1.90	1.96	2.02	2.06	2.09	2.11	2.14	2.12
150	0.94	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.23	1.28	1.33	1.38	1.42	1.45	1.47	1.49	1.51	1.51
155	0.57	0.62	0.67	0.68	0.70	0.72	0.74	0.75	0.77	0.80	0.84	0.88	0.92	0.95	0.97	0.98	1.00	1.02	1.02
160	0.37	0.37	0.40	0.42	0.43	0.44	0.45	0.45	0.46	0.48	0.51	0.54	0.57	0.58	0.60	0.61	0.62	0.64	0.64
165	0.25	0.25	0.25	0.25	0.27	0.27	0.27	0.27	0.28	0.29	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38	0.39
170	0.20	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.22	0.23	0.24	0.24	0.25	0.25
175	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
180	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

Table 6: Luminous Intensity Data

Table--2		UNIT: cd																	
γ	C (DEG) (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	
0	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	
5	190	190	190	190	190	189	189	189	189	188	188	188	188	188	188	188	188	188	
10	188	188	188	188	187	187	187	186	186	185	185	185	184	184	184	184	184	183	
15	185	184	184	184	183	183	182	181	181	180	180	179	179	178	178	178	178	177	
20	179	179	179	178	177	177	176	175	174	174	173	172	172	171	171	171	170	170	
25	172	172	171	171	170	169	168	167	166	165	164	164	163	162	161	161	161	161	
30	163	163	162	162	161	160	159	158	157	156	155	154	153	152	151	151	151	150	
35	153	153	153	152	151	150	149	147	146	145	144	143	142	141	140	140	140	139	
40	143	142	142	141	140	139	137	136	135	134	132	131	130	129	128	128	128	127	
45	131	130	130	129	128	127	125	124	123	121	120	119	118	117	116	115	115		
50	119	118	118	117	116	114	113	112	111	109	108	107	106	105	104	103	102		
55	106	106	105	104	103	102	101	99.4	98.1	96.8	95.5	94.4	93.2	92.2	91.4	90.7	90.1		
60	93.8	93.5	92.7	91.8	90.8	89.8	88.5	87.2	85.9	84.6	83.4	82.3	81.1	80.1	79.2	78.6	78.1		
65	81.7	81.3	80.6	79.7	78.7	77.8	76.5	75.2	74.0	72.7	71.5	70.5	69.3	69.4	67.8	68.0	67.0		
70	69.9	69.4	68.9	68.2	67.4	66.5	65.6	64.5	63.4	62.2	61.1	60.1	59.0	58.2	57.4	56.8	56.4		
75	59.5	59.1	58.5	57.8	56.9	55.9	54.9	53.7	52.7	51.6	50.6	49.6	48.7	47.9	47.2	46.7	46.4		
80	49.0	48.7	48.2	47.5	46.7	45.8	44.9	43.9	42.9	42.0	41.1	40.2	39.4	38.7	38.1	37.6	37.4		
85	39.6	39.3	38.9	38.3	37.6	36.9	36.0	35.1	34.3	33.5	32.7	32.0	31.3	30.7	30.2	29.9	29.6		
90	31.4	31.1	30.8	30.3	29.7	29.1	28.3	27.6	26.9	26.3	25.6	25.1	24.5	24.1	23.7	23.3	23.1		
95	24.5	24.3	24.0	23.6	23.1	22.6	22.1	21.5	21.0	20.5	20.0	19.5	19.1	18.8	18.5	18.2	18.0		
100	19.0	18.9	18.7	18.3	18.0	17.6	17.2	16.8	16.4	16.0	15.6	15.3	15.0	14.7	14.5	14.3	14.2		
105	14.9	14.8	14.6	14.4	14.1	13.8	13.5	13.2	12.9	12.7	12.4	12.2	12.0	11.8	11.6	11.5	11.4		
110	11.9	11.8	11.7	11.5	11.3	11.1	10.9	10.6	10.4	10.2	10.0	9.86	9.69	9.55	9.41	9.30	9.23		
115	9.59	9.54	9.44	9.30	9.15	8.98	8.80	8.61	8.44	8.27	8.10	7.95	7.81	7.69	7.58	7.49	7.44		
120	7.74	7.68	7.60	7.48	7.35	7.22	7.05	6.88	6.71	6.58	6.44	6.32	6.20	6.10	6.02	5.95	5.91		
125	6.14	6.10	6.04	5.94	5.83	5.71	5.57	5.43	5.31	5.19	5.08	4.98	4.88	4.80	4.73	4.67	4.64		
130	4.84	4.80	4.75	4.67	4.57	4.47	4.35	4.23	4.13	4.03	3.94	3.86	3.77	3.71	3.65	3.60	3.58		
135	3.75	3.72	3.67	3.60	3.52	3.43	3.33	3.23	3.15	3.06	2.99	2.92	2.86	2.80	2.76	2.72	2.71		
140	2.84	2.82	2.78	2.72	2.65	2.58	2.49	2.40	2.33	2.26	2.20	2.15	2.10	2.06	2.02	1.99	1.99		
145	2.09	2.07	2.04	1.99	1.93	1.87	1.80	1.72	1.66	1.60	1.56	1.50	1.43	1.32	1.26	1.32	1.38		
150	1.47	1.46	1.44	1.40	1.35	1.30	1.24	1.18	1.12	1.08	1.04	0.97	0.92	0.93	0.94	0.93	0.86		
155	0.99	0.98	0.97	0.94	0.90	0.86	0.81	0.76	0.72	0.68	0.63	0.53	0.50	0.54	0.57	0.57	0.58		
160	0.62	0.62	0.61	0.59	0.56	0.53	0.49	0.45	0.42	0.39	0.36	0.32	0.31	0.32	0.32	0.33	0.36		
165	0.37	0.36	0.36	0.36	0.34	0.32	0.30	0.28	0.26	0.24	0.23	0.21	0.19	0.19	0.20	0.21	0.24		
170	0.25	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.20	0.20	0.19	0.19	0.18	0.18	0.18	0.20	0.20		
175	0.21	0.21	0.21	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20		
180	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20		

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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