



LM-79-08 Test Report

for

GREEN CREATIVE LTD

756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

LED Tube

Model: 14.5T5HO/3F/835/BYP

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19020002z

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

Review by:

Engineer: April Zou
Feb. 22, 2019

Approved by:



Manager: Jim Zhang
Feb. 22, 2019

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: 14.5T5HO/3F/835/BYP

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
135.0	1919.0	14.22	0.9805
CCT (K)	CRI	Stabilization Time (Light & Power)	
3447	81.5	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 : Feb. 01, 2019

Date of Test : Feb. 20, 2019

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 Photo



Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 14.5T5HO/3F/835/BYP
Electrical Ratings	: 120-277V, 50/60Hz, 14.5W
Product Description	: 3500K
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

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 70 minutes.

Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.121	0.055
Power Factor	0.9805	0.9617
Test Power (W)	14.22	14.67
THD A%	18.23	18.33
Luminous Efficacy (lm/W)	135.0	130.9
Total Luminous Flux (lm)	1919.0	1920.0
Color Rendering Index (CRI)	81.5	
R9	0.9	
Correlated Color Temperature (CCT)(K)	3447	
Chromaticity Chroma x	0.4094	
Chromaticity Chroma y	0.3954	
Chromaticity Chroma u	0.2365	
Chromaticity Chroma v	0.3425	
Duv	0.0008	
Chromaticity Chroma u'	0.2365	
Chromaticity Chroma v'	0.5138	

Special Color Rendering Indices	
R1	79.4
R2	88.1
R3	95.6
R4	80.8
R5	79.6
R6	84.6
R7	84.2
R8	59.8
R9	0.9
R10	72.6
R11	80
R12	65.2
R13	81.3
R14	97.6
Rf	84
Rg	96

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 30m.

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)	0.122
Power Factor	0.9800
Test Power (W)	14.30
Luminous Efficacy (lm/W)	132.9
Total Luminous Flux (lm)	1900.3
Beam Angle (°)	118.0
Center Beam Candle Power (cd)	526
Spacing Criteria	1.22 (0 °-180 °)/ 1.31 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	63.19%
Zonal Lumens in the 60 °-90 °Zone	25.96%
Zonal Lumens in the 90 °-120 °Zone	8.28%
Zonal Lumens in the 120 °-180 °Zone	2.58%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

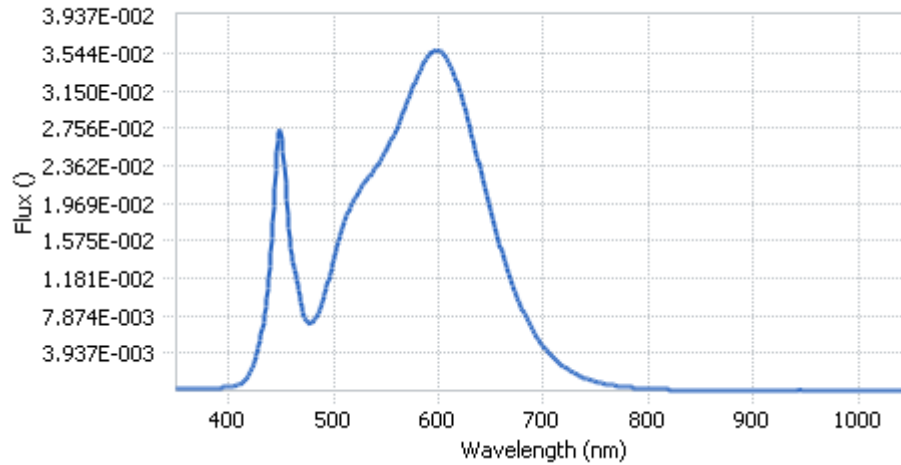
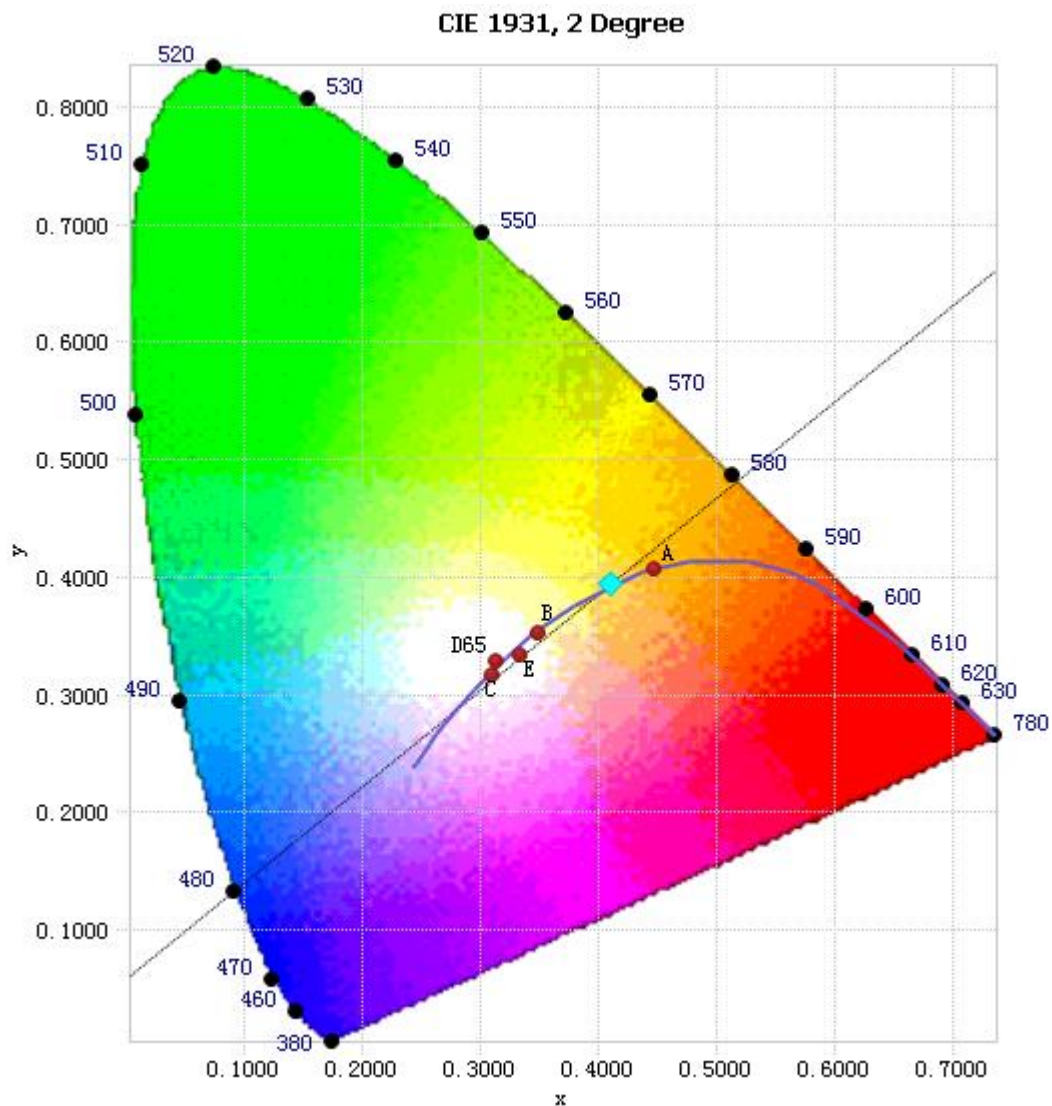


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.84E-04	485	7.99E-03	590	3.51E-02	695	5.40E-03
385	2.87E-04	490	9.45E-03	595	3.56E-02	700	4.64E-03
390	3.18E-04	495	1.16E-02	600	3.57E-02	705	3.97E-03
395	3.51E-04	500	1.38E-02	605	3.53E-02	710	3.39E-03
400	3.72E-04	505	1.59E-02	610	3.44E-02	715	2.89E-03
405	4.85E-04	510	1.77E-02	615	3.31E-02	720	2.49E-03
410	6.95E-04	515	1.91E-02	620	3.15E-02	725	2.14E-03
415	1.09E-03	520	2.02E-02	625	2.96E-02	730	1.82E-03
420	1.85E-03	525	2.10E-02	630	2.75E-02	735	1.54E-03
425	3.19E-03	530	2.19E-02	635	2.53E-02	740	1.33E-03
430	5.39E-03	535	2.26E-02	640	2.31E-02	745	1.12E-03
435	8.85E-03	540	2.35E-02	645	2.08E-02	750	9.61E-04
440	1.46E-02	545	2.43E-02	650	1.87E-02	755	8.26E-04
445	2.31E-02	550	2.52E-02	655	1.67E-02	760	7.16E-04
450	2.72E-02	555	2.63E-02	660	1.47E-02	765	6.14E-04
455	2.01E-02	560	2.75E-02	665	1.29E-02	770	5.21E-04
460	1.42E-02	565	2.89E-02	670	1.12E-02	775	4.53E-04
465	1.17E-02	570	3.03E-02	675	9.77E-03	780	3.92E-04
470	8.77E-03	575	3.16E-02	680	8.50E-03		
475	7.16E-03	580	3.30E-02	685	7.35E-03		
480	7.25E-03	585	3.43E-02	690	6.30E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4094, 0.3954)

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

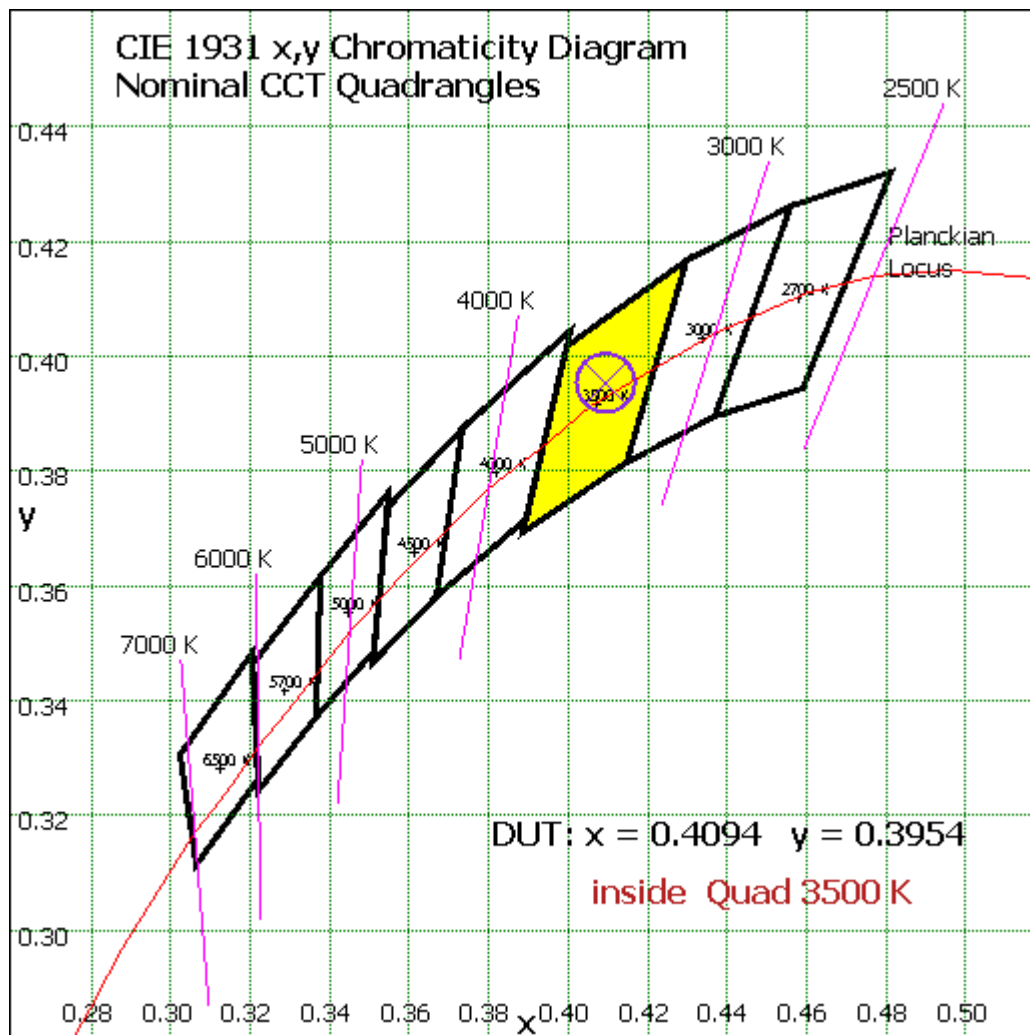


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Vector – Sphere Spectroradiometer Method

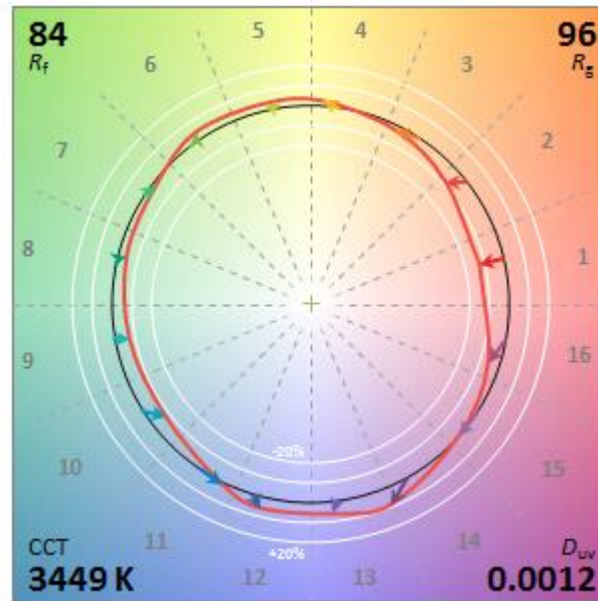


Chart 4: Color Vector Diagram of TM-30-18

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	49.614	2.61%
10- 20	142.145	7.48%
20- 30	215.716	11.35%
30- 40	261.238	13.75%
40- 50	274.623	14.45%
50- 60	257.456	13.55%
60- 70	216.781	11.41%
70- 80	163.84	8.62%
80- 90	112.618	5.93%
90-100	75.287	3.96%
100-110	49.903	2.63%
110-120	32.066	1.69%
120-130	20.541	1.08%
130-140	13.077	0.69%
140-150	8.029	0.42%
150-160	4.629	0.24%
160-170	2.205	0.12%
170-180	0.569	0.03%
Total	1900.3	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1200.792	63.19%
60- 90	493.239	25.96%
0-90	1694.031	89.14%
90- 180	206.306	10.86%
0- 180	1900.3	100%

Table 5: Zonal Lumen

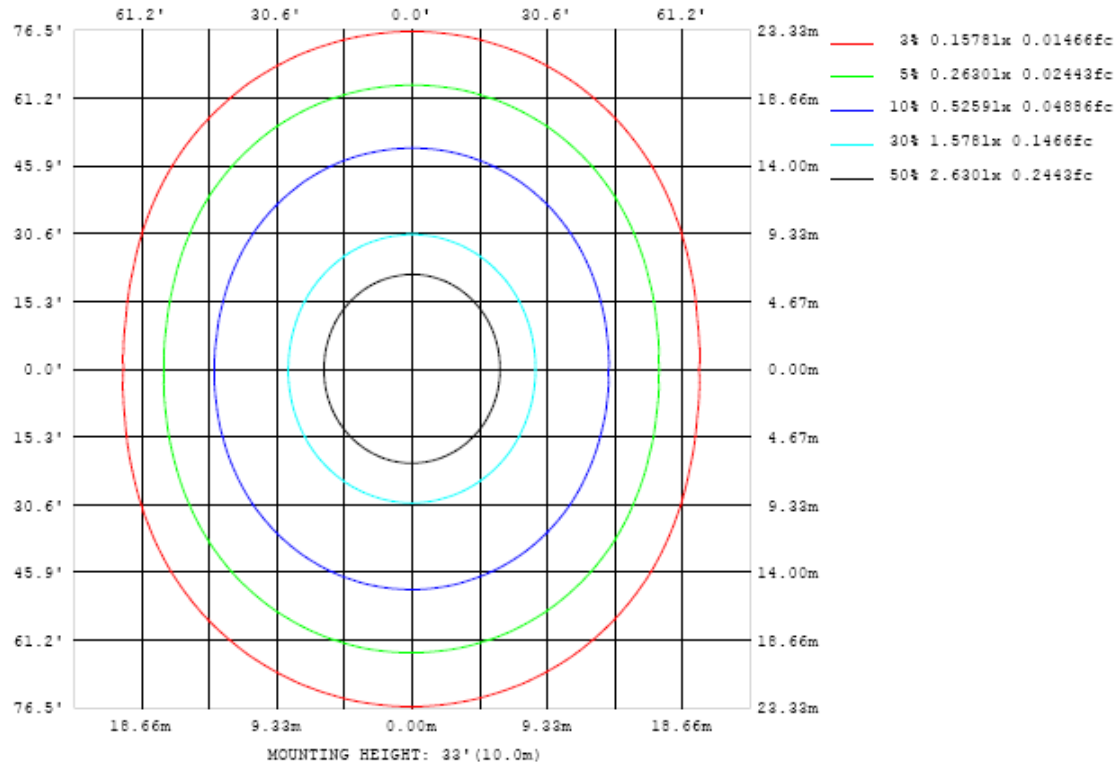


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

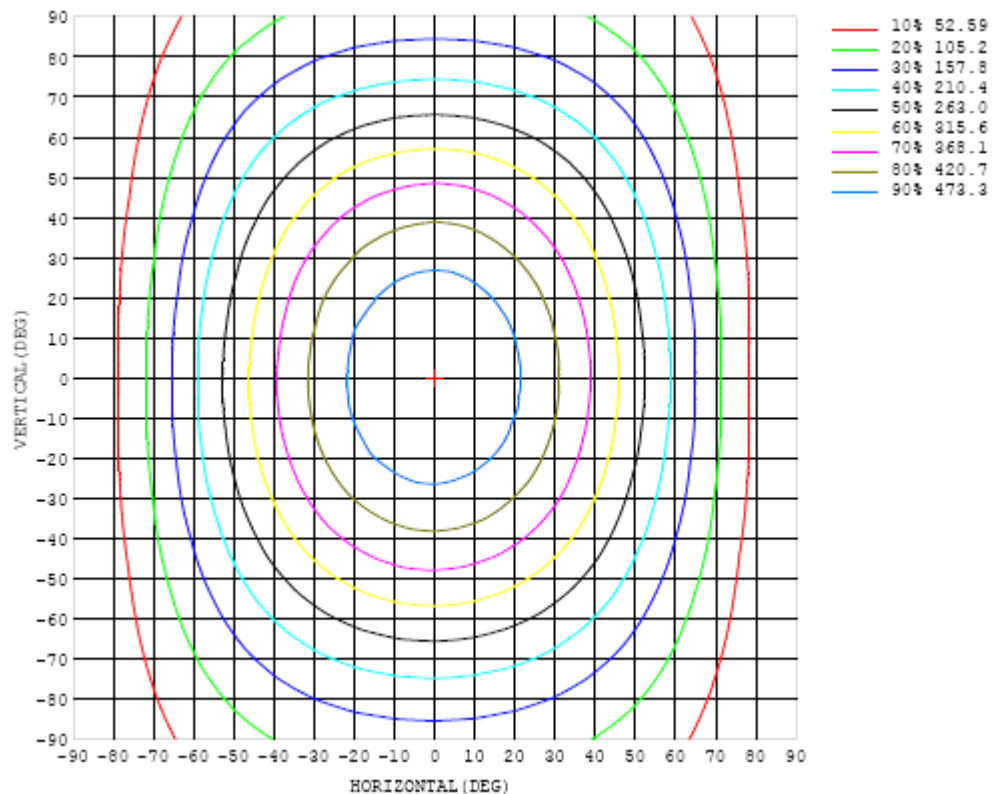


Chart 6: Isocandela Plot

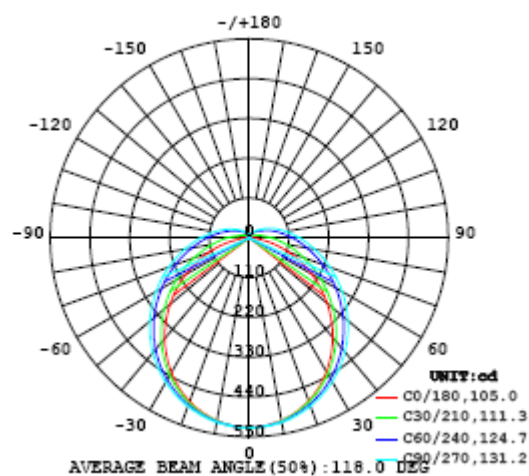


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1		UNIT: cd																	
C (DEG) y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	526	526	526	526	526	526	526	526	526	526	526	526	526	526	526	526	526	526	526
5	521	521	522	522	523	523	522	522	523	524	522	523	523	522	522	522	522	523	523
10	513	513	514	515	514	515	517	515	516	518	517	517	517	516	516	515	514	514	513
15	499	500	500	500	502	505	504	506	507	509	508	506	507	506	504	503	502	501	500
20	480	480	481	483	486	489	490	492	494	494	495	493	492	491	488	486	484	482	482
25	456	457	458	460	465	470	472	475	477	478	478	476	474	471	468	464	462	459	458
30	427	427	431	435	441	446	450	455	458	459	458	456	452	448	444	439	435	432	430
35	395	396	400	405	413	419	425	431	434	436	436	433	428	423	416	409	404	400	398
40	359	360	365	373	382	390	398	405	409	412	410	407	401	394	386	377	371	365	363
45	321	323	329	338	350	359	369	377	382	384	383	379	372	363	354	343	334	328	325
50	281	284	291	302	315	327	339	348	353	356	355	349	341	332	320	307	297	289	286
55	240	244	252	265	281	295	307	317	323	327	325	320	311	299	285	271	258	249	244
60	199	202	213	229	247	262	276	287	293	297	295	289	279	266	251	234	219	208	203
65	157	162	175	193	213	230	246	257	263	267	265	258	248	234	217	198	181	167	161
70	116	123	139	160	182	200	216	227	234	237	235	229	218	204	186	165	145	128	120
75	76.6	85.3	106	130	153	172	188	200	207	210	208	201	190	175	157	134	111	90.5	80.0
80	40.6	52.3	76.4	103	127	147	163	174	181	184	181	175	165	150	131	107	81.2	57.2	43.7
85	12.7	27.0	52.9	80.0	104	124	140	151	157	160	158	152	142	127	107	83.5	57.0	30.9	14.5
90	0.19	12.2	35.8	61.3	84.6	104	119	130	137	139	137	131	121	106	87.3	64.3	39.0	14.9	0.55
95	0.34	5.50	24.4	46.9	68.6	86.7	101	111	118	120	118	112	103	88.8	70.7	49.3	26.7	6.94	0.33
100	0.53	3.93	16.5	36.0	55.4	72.0	85.6	95.3	101	103	101	96.0	86.8	73.8	57.3	37.9	18.2	4.43	0.50
105	0.94	3.46	12.5	27.0	44.3	59.6	72.1	81.0	86.3	88.4	86.8	81.8	73.1	61.2	45.8	28.6	13.3	3.73	0.77
110	1.41	3.64	10.3	21.6	34.8	48.3	59.9	68.3	73.4	75.1	73.7	69.0	61.0	49.6	36.0	22.3	10.6	3.68	1.15
115	1.90	3.90	9.13	18.0	28.6	39.0	48.3	56.0	60.9	62.7	61.2	56.7	49.0	39.7	29.1	18.4	9.13	3.81	1.54
120	2.40	4.21	8.49	15.4	24.0	32.5	40.1	46.0	49.7	51.2	49.8	46.2	40.5	32.9	24.2	15.4	8.34	4.08	1.98
125	2.95	4.62	8.10	13.6	20.4	27.3	33.6	38.4	41.5	42.7	41.6	38.6	33.8	27.5	20.5	13.4	7.94	4.55	2.53
130	3.45	5.07	7.89	12.3	17.7	23.2	28.4	32.3	34.8	35.7	34.9	32.3	28.4	23.3	17.6	12.0	7.77	5.02	3.11
135	3.86	5.43	7.77	11.2	15.4	19.8	23.9	27.0	29.1	29.9	29.2	27.2	23.9	19.9	15.3	11.0	7.70	5.46	3.68
140	4.34	5.80	7.66	10.4	13.6	17.1	20.3	22.8	24.4	25.0	24.4	22.8	20.3	17.1	13.6	10.3	7.70	5.91	4.36
145	4.82	6.13	7.67	9.77	12.2	14.8	17.3	19.2	20.5	20.9	20.5	19.2	17.2	14.8	12.1	9.70	7.68	6.29	4.97
150	5.29	6.46	7.47	9.19	11.0	12.9	14.7	16.2	17.1	17.4	17.1	16.1	14.7	12.8	11.0	9.14	7.67	6.69	5.48
155	5.49	6.67	7.46	8.68	10.0	11.3	12.6	13.6	14.3	14.6	14.3	13.6	12.6	11.3	9.97	8.63	7.57	6.92	5.89
160	5.38	6.86	7.42	7.76	8.95	10.0	10.8	11.5	11.9	12.1	11.9	11.5	10.9	10.0	9.13	8.28	7.67	7.19	6.13
165	5.19	6.03	6.97	7.47	7.67	8.77	9.34	9.72	10.0	10.2	10.1	9.85	9.48	9.03	8.49	8.08	7.70	7.39	6.27
170	4.78	5.19	5.74	6.27	6.92	7.41	8.13	8.47	8.60	8.70	8.67	8.56	8.40	8.24	8.04	7.83	7.64	7.44	6.05
175	4.66	4.76	4.81	5.06	5.53	6.18	6.74	7.21	7.58	7.81	7.83	7.79	7.75	7.68	7.61	7.53	7.39	6.87	5.75
180	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57

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	526	526	526	526	526	526	526	526	526	526	526	526	526	526	526	526	526		
5	522	521	522	522	522	522	522	523	524	523	522	522	522	521	521	521	521		
10	514	515	514	515	516	517	516	517	517	517	516	515	515	514	513	514	512		
15	499	503	503	503	505	507	507	508	509	508	506	504	503	503	501	500	498		
20	482	482	487	487	489	492	493	494	496	495	494	491	488	486	484	480	480		
25	457	461	465	466	470	474	476	478	480	479	477	473	470	465	462	458	457		
30	431	433	439	444	448	454	458	459	461	460	457	452	447	442	436	431	428		
35	399	403	409	416	422	429	434	437	439	438	434	428	421	414	406	400	396		
40	365	369	378	386	394	403	409	412	414	413	408	402	393	384	374	366	361		
45	327	332	343	354	364	374	381	386	388	386	381	373	362	352	340	330	324		
50	288	295	307	320	332	343	352	357	359	356	351	342	331	318	304	292	284		
55	247	256	270	285	299	312	321	327	330	327	320	310	297	283	267	253	244		
60	206	217	233	250	266	279	289	295	298	296	289	279	264	248	231	215	203		
65	166	178	197	216	233	247	258	265	267	264	258	247	232	215	195	177	162		
70	125	141	162	184	202	217	228	234	236	234	227	216	202	183	162	140	123		
75	87.5	107	131	154	172	188	199	205	207	205	198	188	173	153	131	107	86.0		
80	54.0	77.3	103	127	146	161	172	178	180	178	172	162	146	127	104	78.1	54.0		
85	27.6	53.3	79.3	103	122	137	147	153	156	154	147	137	123	104	80.6	55.1	28.9		
90	11.8	35.4	60.5	83.0	101	116	126	132	134	132	126	116	102	84.0	62.2	37.6	13.8		
95	5.03	23.1	45.6	66.5	83.7	97.5	107	113	115	113	107	98.2	85.0	67.8	47.6	25.5	6.51		
100	3.20	15.3	33.7	52.8	68.7	81.7	90.6	95.7	97.8	96.2	91.2	82.6	70.3	54.7	36.0	17.2	4.55		
105	2.39	11.3	25.3	41.2	55.8	67.4	75.8	81.0	82.9	81.5	76.8	68.6	57.6	43.1	27.0	13.2	3.71		
110	2.60	9.10	19.9	32.6	44.8	55.2	62.7	67.5	69.4	68.1	63.8	56.6	46.1	34.3	21.9	10.8	3.63		
115	2.94	7.70	16.3	26.5	36.5	45.2	51.8	55.9	57.6	56.3	52.6	46.3	38.1	28.4	18.1	9.38	3.79		
120	3.28	6.60	13.6	22.0	30.3	37.7	43.3	46.8	48.1	47.2	44.0	38.9	31.7	23.6	15.3	8.49	3.99		
125	3.69	6.46	11.7	18.5	25.3	31.3	36.1	39.1	40.4	39.5	36.8	32.4	26.6	20.0	13.3	7.84	4.27		
130	3.86	6.52	10.0	15.5	21.2	26.3	30.2	32.7	33.7	33.1	30.8	27.2	22.5	17.1	11.8	7.49	4.49		
135	4.24	6.56	9.20	13.2	17.8	22.0	25.2	27.2	28.2	27.6	25.7	22.8	19.0	14.6	10.4	7.31	4.65		
140	4.43	6.64	8.88	11.5	14.8	18.3	21.0	22.7	23.4	23.0	21.5	19.1	16.0	12.6	9.56	7.20	4.75		
145	4.44	6.76	8.39	10.6	12.7	14.8	17.1	18.6	19.3	18.9	17.7	15.7	13.4	11.2	8.89	7.06	4.79		
150	4.27	6.78	7.98	9.66	11.3	12.9	14.1	14.9	15.3	15.1	14.3	13.2	11.7	10.0	8.32	6.97	4.71		
155	3.97	6.76	7.80	8.92	10.1	11.2	12.1	12.7	13.0	12.8	12.3	11.4	10.4	8.77	7.96	6.90	4.52		
160	4.26	5.45	7.17	8.25	9.10	9.80	10.4	10.8	10.9	10.8	10.5	10.0	8.70	8.03	7.19	6.07	4.53		
165	4.41	4.16	5.08	6.43	8.15	8.71	9.10	9.31	9.43	9.41	8.87	7.56	6.54	6.06	5.62	4.86	4.81		
170	4.34	3.89	3.90	4.06	4.27	4.99	6.53	7.99	8.16	6.39	4.95	5.12	4.89	4.81	4.68	4.63	4.65		
175	4.71	4.55	4.44	4.40	4.92	5.45	5.77	5.84	2.35	5.95	6.22	6.00	5.72	5.40	5.02	4.72	4.73		
180	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 14, 2018	Aug. 13, 2019
Digital Power Meter	PF2010A	HZTE028-01	Sep. 12, 2018	Sep. 11, 2019
AC Power Supply	DPS1060	HZTE001-06	Aug. 09, 2018	Aug. 08, 2019
DC Power Supply	WY12010	HZTE004-03	Aug. 09, 2018	Aug. 08, 2019
Temperature recorder	JM624U	HZTE018-08	Aug. 09, 2018	Aug. 08, 2019
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 09, 2018	Aug. 08, 2019
Standard source	D908	HZTE012-01	Aug. 14, 2018	Aug. 13, 2019
Integrate Sphere system	3M	HZTE015-04	Aug. 16, 2018	Aug. 15, 2019
Digital Power Meter	WT210	HZTE008-01	Aug. 02, 2018	Aug. 01, 2019
AC Power Supply	PCR 500L	HZTE001-07	Aug. 09, 2018	Aug. 08, 2019
DC Power Supply	IT6154	HZTE004-04	Aug. 09, 2018	Aug. 08, 2019
Standard source	SCL-1400	HZTE012-02	Aug. 16, 2018	Aug. 15, 2019
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 09, 2018	Aug. 08, 2019
Temperature Meter	TES1310	HZTE017-01	Aug. 09, 2018	Aug. 08, 2019

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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