LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

T5 TUBE

Model: 24T5HO/4F/835/DIR/R

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ17060008d

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

Review by: April Zou

Engineer: April Zou
Jun. 08, 2017

Approved by:

Manager: Jim Zhang
Jun. 08, 2017

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: **24T5HO/4F/835/DIR/R**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
119.2	3453.0	28.97	0.9962

CCT (K)	CRI	Stabilization Time (Light & Power)
3439	83.0	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	: Jun. 05, 2017
Date of Test	: Jun. 06, 2017
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 Photos

Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: T5 TUBE
Model	: 24T5HO/4F/835/DIR/R
Electrical Ratings	: 120V, 60Hz, 24W
Product Description	: Mini Bi-Pin G5 base, 3500K, CRI80 LED Tubes supplied by a high frequency fluorescent lamp ballast: B254PUNVHB-D
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 25.4℃.

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 70 minutes.

Sphere-Spectroradiometer Method

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.493
Power Factor	0.9962
Test Power (W)/2	28.97
THD A%	6.41
Luminous Efficacy (lm/W)	119.2
Total Luminous Flux (lm)	3453.0
Color Rendering Index (CRI)	83.0
R9	7.9
Correlated Color Temperature (CCT)(K)	3439
Chromaticity Chroma x	0.4081
Chromaticity Chroma y	0.3910
Chromaticity Chroma u	0.2374
Chromaticity Chroma v	0.3412
Duv	0.0008
Chromaticity Chroma u ’	0.2374
Chromaticity Chroma v’	0.5118

Special Color Rendering Indices	
R1	81.7
R2	91.9
R3	95.6
R4	80
R5	81.8
R6	89.1
R7	83.2
R8	60.7
R9	7.9
R10	80.8
R11	78.8
R12	68
R13	84.4
R14	98.3

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℃.

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)	0.486
Power Factor	0.9954
Test Power (W)	29.02
Luminous Efficacy (lm/W)	121.0
Total Luminous Flux (lm)	3509.5
Beam Angle (°)	122.5
Center Beam Candle Power (cd)	924
Spacing Criteria	1.24 (0°-180°)/ 1.31 (90°-270°)
Zonal Lumens in the 0°-60°Zone	61.78%
Zonal Lumens in the 60°-90°Zone	26.61%
Zonal Lumens in the 90°-120°Zone	8.69%
Zonal Lumens in the 120°-180°Zone	2.92%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

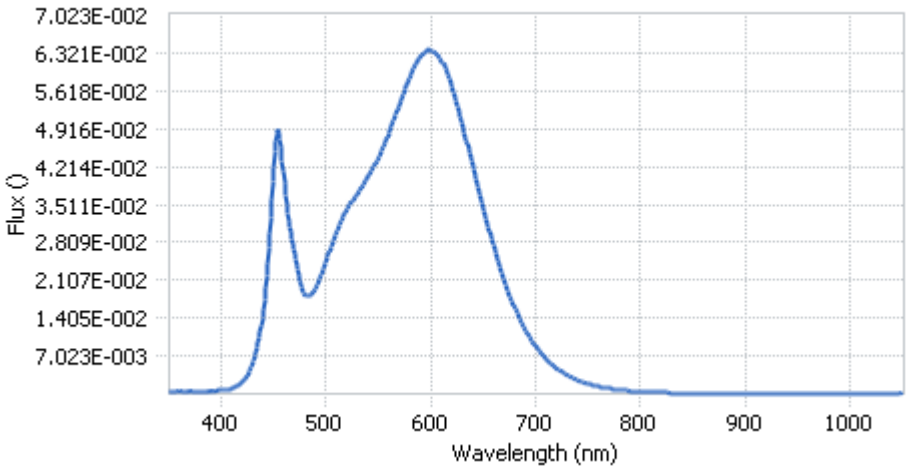
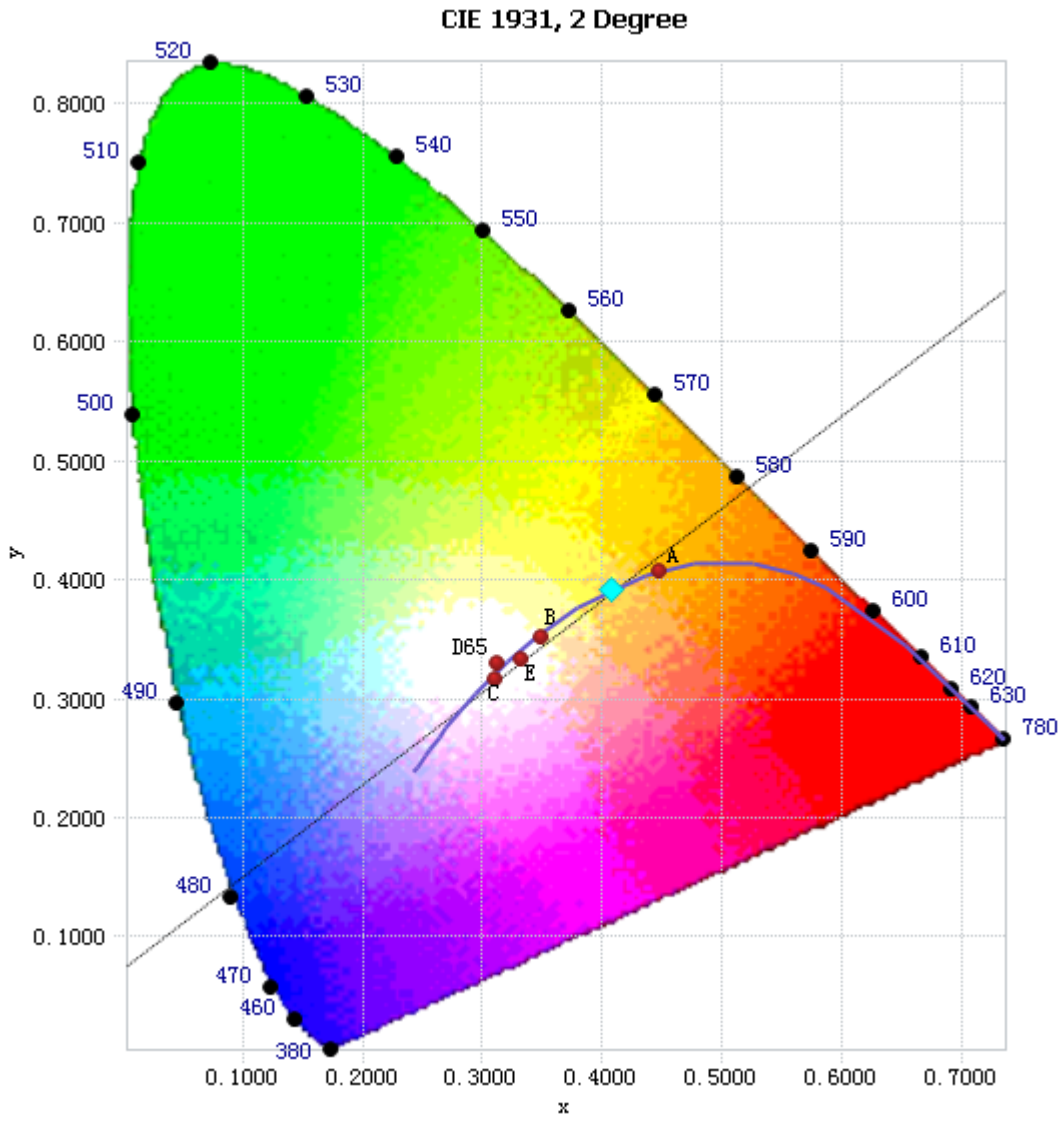


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	5.89E-04	485	1.88E-02	590	6.41E-02	695	1.05E-02
385	5.38E-04	490	2.02E-02	595	6.51E-02	700	9.10E-03
390	5.82E-04	495	2.25E-02	600	6.51E-02	705	7.79E-03
395	5.78E-04	500	2.53E-02	605	6.49E-02	710	6.69E-03
400	6.66E-04	505	2.83E-02	610	6.33E-02	715	5.76E-03
405	7.51E-04	510	3.09E-02	615	6.12E-02	720	4.90E-03
410	9.87E-04	515	3.33E-02	620	5.83E-02	725	4.22E-03
415	1.45E-03	520	3.51E-02	625	5.50E-02	730	3.59E-03
420	2.31E-03	525	3.66E-02	630	5.13E-02	735	3.08E-03
425	3.61E-03	530	3.82E-02	635	4.74E-02	740	2.63E-03
430	5.98E-03	535	3.96E-02	640	4.34E-02	745	2.24E-03
435	9.76E-03	540	4.14E-02	645	3.92E-02	750	1.94E-03
440	1.62E-02	545	4.31E-02	650	3.54E-02	755	1.65E-03
445	2.77E-02	550	4.50E-02	655	3.15E-02	760	1.42E-03
450	4.29E-02	555	4.72E-02	660	2.80E-02	765	1.23E-03
455	4.96E-02	560	4.97E-02	665	2.47E-02	770	1.06E-03
460	4.01E-02	565	5.24E-02	670	2.17E-02	775	8.95E-04
465	3.17E-02	570	5.51E-02	675	1.89E-02	780	7.82E-04
470	2.66E-02	575	5.78E-02	680	1.65E-02		
475	2.15E-02	580	6.02E-02	685	1.43E-02		
480	1.89E-02	585	6.25E-02	690	1.23E-02		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4081, 0.3910)

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

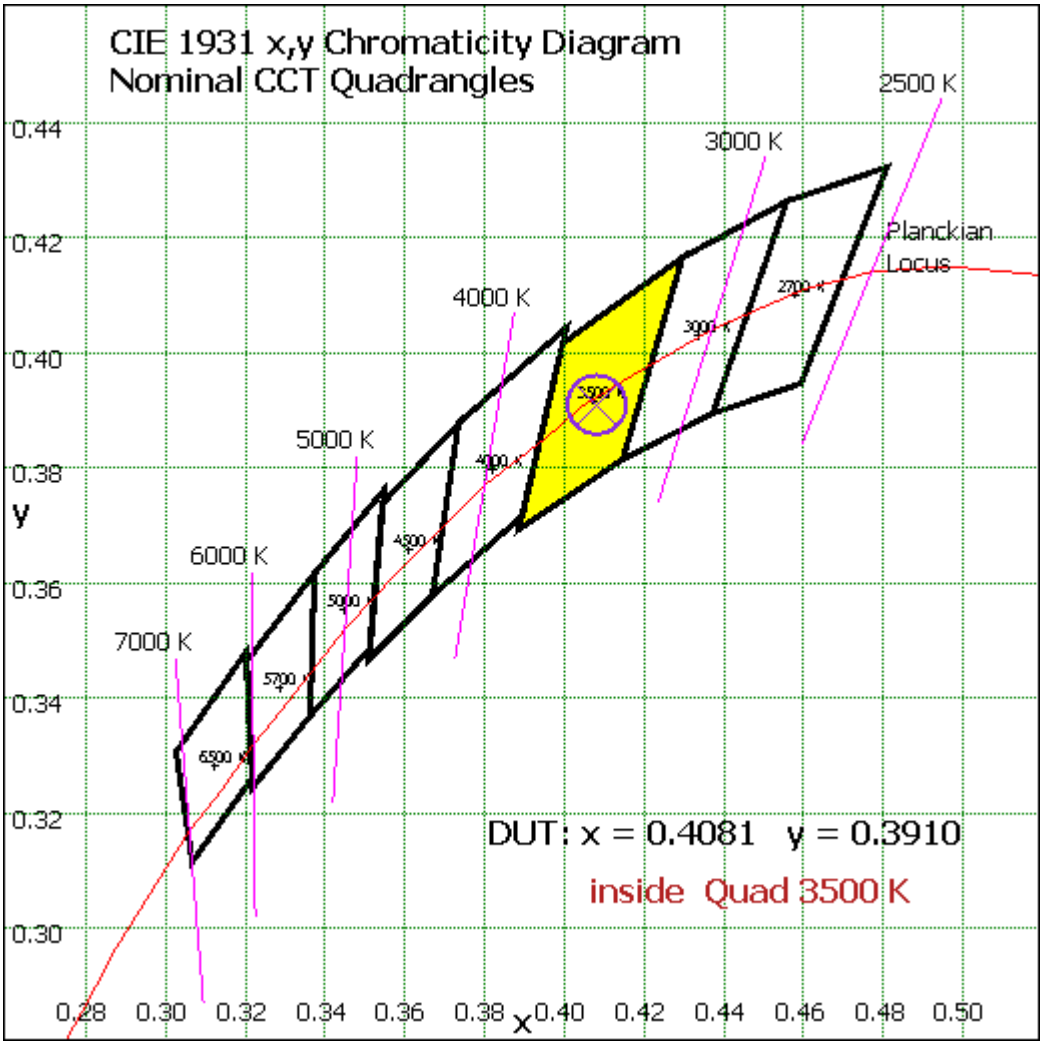


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	87.503	2.49%
10- 20	251.491	7.17%
20- 30	384.085	10.94%
30- 40	469.678	13.38%
40- 50	499.969	14.25%
50- 60	475.567	13.55%
60- 70	406.437	11.58%
70- 80	311.232	8.87%
80- 90	216.086	6.16%
90-100	145.462	4.14%
100-110	96.629	2.75%
110-120	63.036	1.80%
120-130	41.597	1.19%
130-140	27.193	0.77%
140-150	17.225	0.49%
150-160	10.135	0.29%
160-170	4.899	0.14%
170-180	1.322	0.04%
Total	3509.5	100%

γ(°)	Lumens	% Total
0- 60	2168.293	61.78%
60- 90	933.755	26.61%
0-90	3102.048	88.39%
90- 180	407.498	11.61%
0- 180	3509.5	100%

Table 5: Zonal Lumen Data

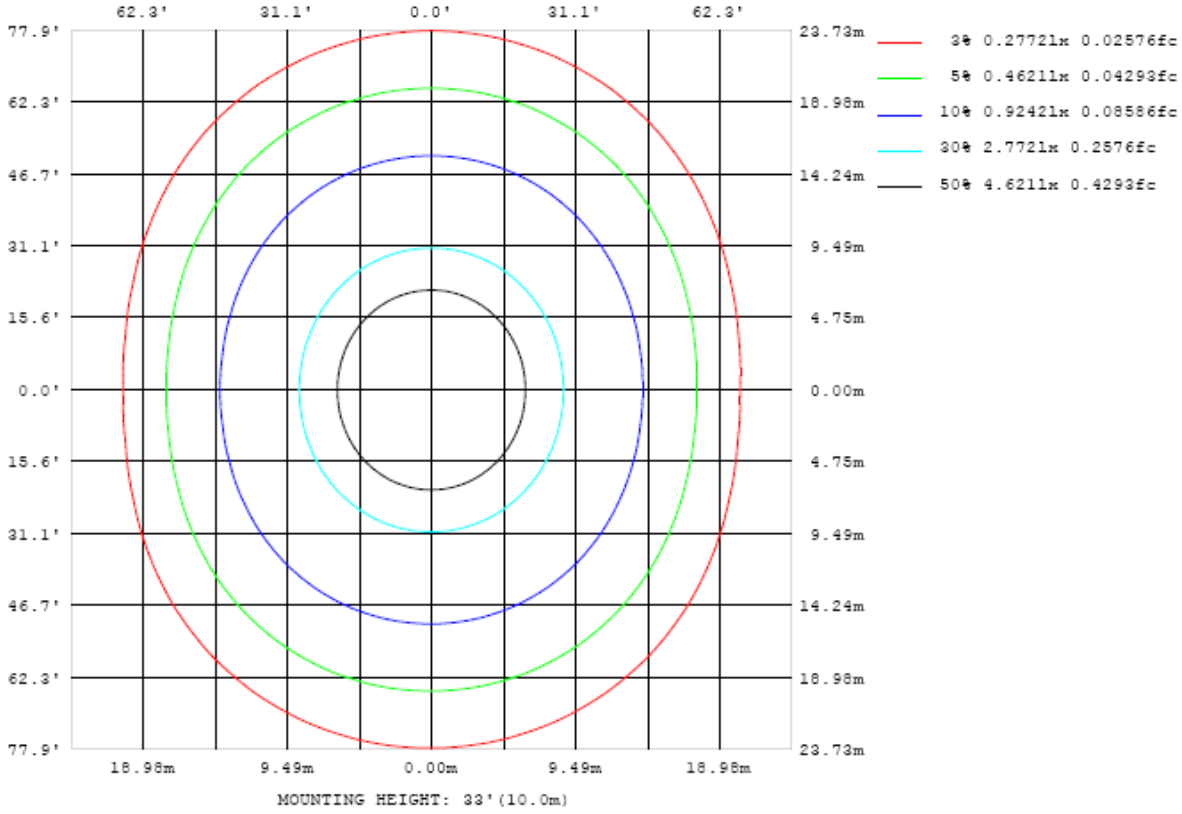


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

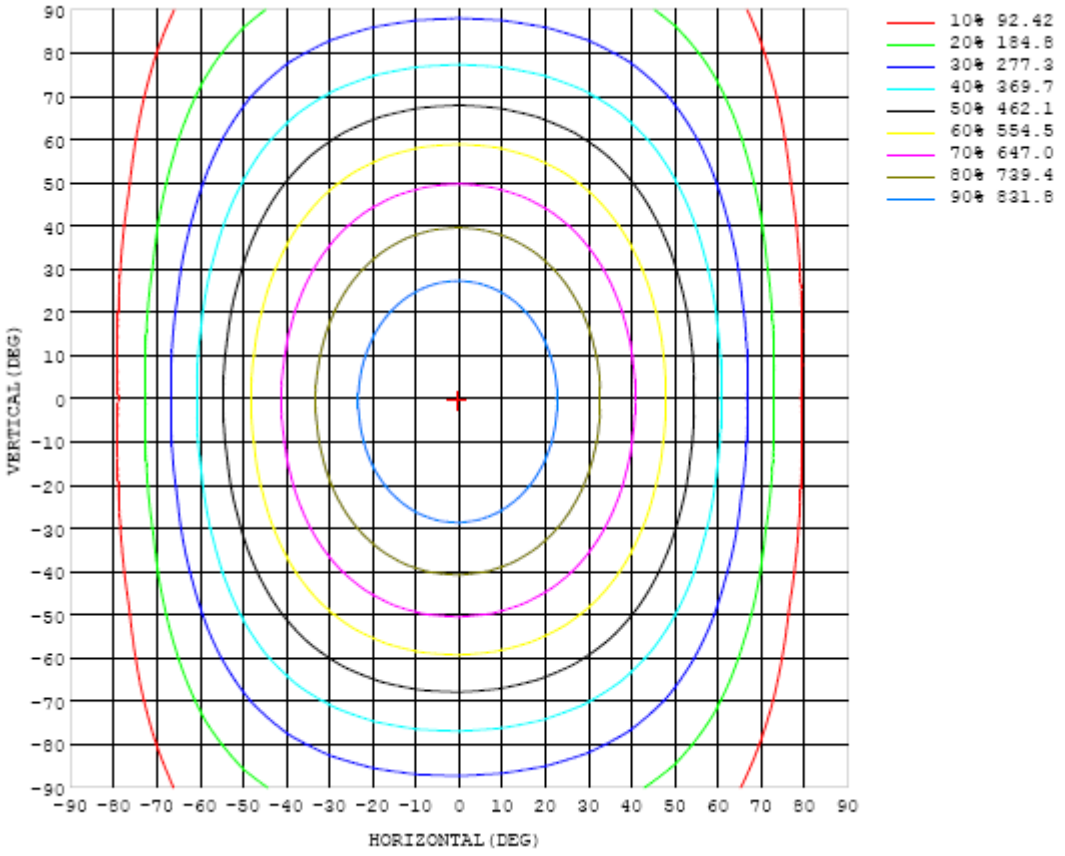


Chart 5: Isocandela Plot

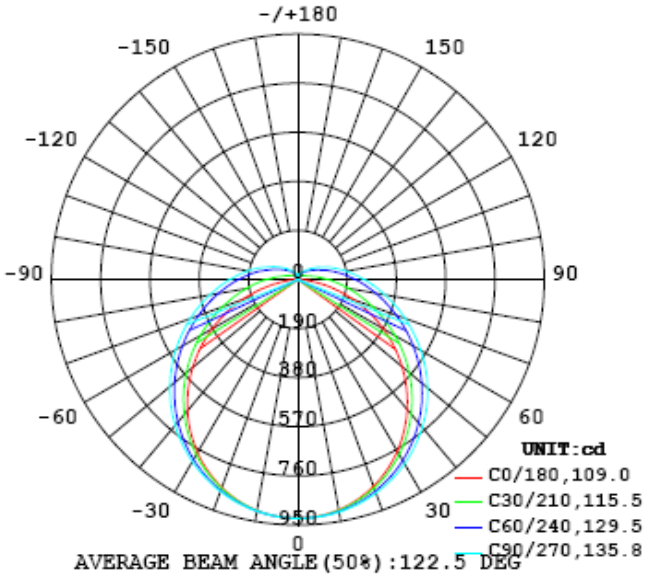


Chart 6: Polar Candela Distribution

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	924	924	924	924	924	924	924	924	924	924	924	924	924	924	924	924	924	924	924
5	919	919	919	920	920	921	921	921	922	922	922	922	922	922	921	921	921	921	921
10	905	905	906	907	909	910	911	912	913	914	914	913	913	912	911	910	909	908	908
15	882	883	885	887	889	892	895	897	899	899	900	899	897	895	893	891	889	887	887
20	852	853	855	859	863	868	872	876	878	879	879	878	875	871	868	864	860	858	857
25	813	814	818	823	830	837	843	848	852	854	854	851	847	841	835	829	824	820	819
30	767	769	774	781	790	800	808	816	821	823	822	819	813	805	797	788	780	775	773
35	714	717	723	733	745	757	769	778	784	787	786	782	774	763	752	740	730	723	721
40	656	659	667	680	694	710	724	735	743	746	745	739	729	717	702	687	674	665	662
45	592	596	606	622	640	659	675	688	697	701	699	693	681	666	647	629	612	601	598
50	524	529	541	560	582	604	623	638	648	652	650	643	629	611	590	567	547	533	529
55	453	458	474	497	522	547	569	585	596	600	598	590	575	555	530	503	479	462	457
60	379	386	405	432	462	490	513	531	542	547	545	536	520	497	469	439	409	388	382
65	304	312	336	368	402	433	458	477	488	493	491	481	464	440	409	374	340	313	305
70	227	238	268	307	344	377	404	423	435	440	438	428	410	384	351	312	272	238	227
75	152	167	205	249	290	325	352	372	384	389	386	376	358	332	297	255	209	167	151
80	82.3	104	149	198	241	277	304	324	336	341	338	328	310	283	247	203	153	104	79.4
85	26.5	54.1	103	153	197	233	261	280	292	296	294	284	266	239	203	159	107	55.5	24.2
90	0.46	23.9	69.8	117	160	195	222	241	252	256	254	244	226	200	165	122	74.4	26.1	0.42
95	0.70	10.8	45.6	88.5	129	162	188	206	217	221	218	209	192	167	134	93.3	49.8	12.8	0.78
100	1.34	7.34	31.5	67.0	102	133	157	175	185	189	187	178	161	138	107	71.2	34.7	9.18	1.38
105	2.12	6.56	23.7	51.2	81.1	109	131	148	157	161	159	150	135	113	84.9	55.0	26.8	8.06	2.26
110	3.12	7.06	19.5	40.7	65.3	88.2	108	123	132	136	134	125	111	91.4	69.1	44.3	22.4	8.37	3.26
115	4.19	7.92	17.3	33.8	53.6	73.1	89.3	102	110	113	111	104	91.8	77.1	57.0	37.0	19.9	9.03	4.31
120	5.25	8.93	16.2	29.1	44.9	61.0	75.6	85.4	92.1	94.7	93.1	87.0	77.0	63.7	47.9	31.9	18.5	9.89	5.36
125	6.25	10.00	15.9	25.7	38.4	51.4	63.0	72.1	77.7	79.7	78.2	73.5	65.1	53.8	41.0	28.3	17.7	10.8	6.31
130	7.27	11.1	15.9	23.5	33.4	43.8	53.3	60.8	65.6	67.4	66.3	61.9	54.9	45.8	35.6	25.6	17.2	11.6	7.13
135	8.15	12.2	16.0	21.9	29.5	37.8	45.3	51.3	55.2	56.8	55.9	52.3	46.6	39.4	31.3	23.5	16.9	12.2	7.98
140	8.91	13.1	16.2	20.8	26.6	32.8	38.7	43.5	46.6	47.8	47.1	44.3	39.8	34.2	28.0	21.9	17.0	13.0	8.64
145	9.53	14.2	16.4	19.9	24.2	28.8	33.2	36.9	39.3	40.3	39.7	37.6	34.2	29.9	25.2	20.7	16.9	13.9	9.06
150	10.0	15.1	16.6	19.2	22.2	25.6	28.8	31.4	33.2	33.9	33.6	32.0	29.6	26.4	23.0	19.8	16.8	14.8	9.37
155	10.3	14.9	16.7	18.6	20.8	23.0	25.2	27.0	28.3	28.8	28.6	27.5	25.7	23.6	21.3	18.2	15.9	14.8	9.59
160	10.3	13.6	17.2	18.1	19.6	21.1	22.4	23.5	24.3	24.7	24.6	23.9	22.8	21.5	18.6	16.3	14.5	13.7	9.75
165	10.2	12.1	15.0	17.7	18.5	19.5	20.3	21.0	21.5	21.7	21.7	21.4	20.6	17.1	15.2	13.5	12.8	12.0	9.73
170	10.7	11.0	12.2	15.1	17.3	17.6	18.2	18.8	19.0	19.1	19.2	18.1	14.6	12.7	13.1	13.1	12.7	11.0	10.1
175	13.4	13.2	13.0	13.2	13.9	14.1	15.0	16.3	18.1	18.1	14.1	10.5	11.3	12.9	13.1	13.3	13.0	12.8	12.7
180	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04

Table 6: Luminous Intensity Data

Table--2 UNIT: cd

γ (DEG) \ C (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	924	924	924	924	924	924	924	924	924	924	924	924	924	924	924	924	924		
5	920	920	920	920	920	920	920	920	920	920	920	920	919	919	919	919	919		
10	908	908	908	909	909	910	910	910	910	910	909	909	908	907	906	905	905		
15	887	887	888	890	891	893	894	894	894	894	893	891	889	887	885	884	883		
20	857	858	860	863	866	869	871	873	873	872	870	867	863	860	856	854	852		
25	819	821	825	830	835	840	843	845	846	844	842	837	832	826	821	817	814		
30	774	777	783	790	798	804	810	813	814	812	808	802	794	786	779	772	769		
35	722	727	735	745	755	764	771	776	777	775	770	762	752	741	730	722	717		
40	664	670	681	695	708	720	729	734	736	733	727	717	705	691	677	666	659		
45	600	610	624	640	657	671	683	690	692	689	681	669	654	637	620	606	597		
50	533	544	562	583	603	621	634	642	644	641	632	618	601	580	560	542	530		
55	462	477	499	524	547	568	583	592	594	591	581	566	546	522	497	476	460		
60	388	408	435	464	491	514	530	540	543	540	529	513	490	463	434	408	389		
65	314	338	371	405	436	460	478	489	492	488	477	460	435	405	372	340	316		
70	239	271	310	349	382	408	427	438	441	437	426	408	382	349	312	274	243		
75	168	208	253	295	331	358	377	388	392	388	377	358	331	297	256	212	173		
80	104	153	202	247	283	311	331	342	345	342	330	311	284	248	205	157	110		
85	54.5	107	159	203	240	268	287	298	302	298	287	268	241	205	162	111	59.1		
90	25.2	72.8	123	167	202	229	248	259	263	259	248	230	203	168	125	76.0	27.8		
95	12.3	49.2	94.0	135	170	195	213	224	227	224	213	196	171	137	96.3	51.6	13.2		
100	8.39	34.0	70.6	109	141	166	183	193	196	193	183	166	142	110	72.8	35.2	8.80		
105	7.78	25.9	54.6	86.0	114	137	154	164	167	164	155	138	115	86.8	55.4	26.2	7.84		
110	8.23	22.1	43.8	69.6	93.5	113	127	136	139	136	127	113	93.7	69.8	44.2	21.7	8.17		
115	8.68	19.9	37.1	57.2	77.8	94.5	107	115	117	115	107	94.5	77.6	57.7	36.8	19.4	8.41		
120	9.67	18.6	32.3	48.7	64.8	79.9	90.7	97.3	99.5	97.2	90.0	79.4	64.9	48.5	31.6	18.2	9.28		
125	10.3	17.9	28.8	41.9	55.2	66.9	76.1	81.9	84.3	82.4	76.4	66.8	55.0	41.3	28.1	17.5	9.64		
130	10.7	17.0	26.1	36.5	47.3	57.2	64.9	69.8	71.4	69.8	64.6	56.7	46.9	36.0	25.7	16.7	10.0		
135	11.2	16.7	24.2	32.4	41.1	49.0	55.2	59.1	60.4	59.0	54.6	48.4	40.6	32.0	23.8	16.3	9.90		
140	11.6	16.5	22.6	29.2	35.9	42.0	46.8	50.0	51.0	49.9	46.3	41.4	35.3	28.7	21.9	16.4	9.72		
145	11.7	16.7	21.2	26.4	31.6	36.2	39.9	42.3	43.1	42.1	39.4	35.7	31.0	25.7	20.5	15.8	9.92		
150	11.8	16.2	19.7	23.8	27.8	31.3	34.0	35.9	36.4	35.7	33.7	30.9	27.2	23.3	19.7	15.5	10.5		
155	11.0	15.0	18.1	21.4	24.3	26.9	29.1	30.5	30.8	30.2	28.8	26.6	24.0	21.4	18.6	15.0	10.3		
160	9.88	13.2	15.4	18.1	21.7	22.9	24.6	25.6	25.9	25.6	24.8	23.6	22.2	20.1	18.1	14.3	9.89		
165	9.46	10.5	13.0	13.9	16.2	18.9	21.4	22.1	22.4	22.3	21.9	21.3	20.1	18.9	16.6	13.7	9.58		
170	9.91	10.2	11.3	12.7	13.6	12.9	14.6	17.4	19.0	18.9	18.7	18.2	17.0	16.0	14.3	11.2	10.4		
175	12.6	12.7	12.9	13.4	12.8	12.8	12.0	9.61	10.2	15.0	14.8	14.3	13.6	13.6	13.6	12.9	13.2		
180	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Jul. 26, 2016	Jul. 25, 2017
Digital Power Meter	PF2010A	HZTE028-01	Jul. 26, 2016	Jul. 25, 2017
AC Power Supply	DPS1060	HZTE001-06	Dec. 25, 2016	Dec. 24, 2017
DC Power Supply	WY12010	HZTE004-03	Dec. 25, 2016	Dec. 24, 2017
Temperature Meter	TES1310	HZTE017-01	Aug. 08, 2016	Aug. 07, 2017
Standard source	D908	HZTE012-01	Jul. 28, 2016	Jul. 27, 2017
Integrate Sphere system	2M	HZTE015-01	Jul. 26, 2016	Jul. 25, 2017
Digital Power Meter	WT210	HZTE008-01	Jul. 26, 2016	Jul. 25, 2017
AC Power Supply	PCR 500L	HZTE001-07	Dec. 25, 2016	Dec. 24, 2017
DC Power Supply	IT6154	HZTE004-04	Jul. 27, 2016	Jul. 26, 2017
Temperature and humidity recorder	JR900	HZTE018-01	Dec. 25, 2016	Dec. 24, 2017
Standard source	SCL-1400	HZTE012-02	Jul. 28, 2016	Jul. 27, 2017

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 FA19 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 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 FA19 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

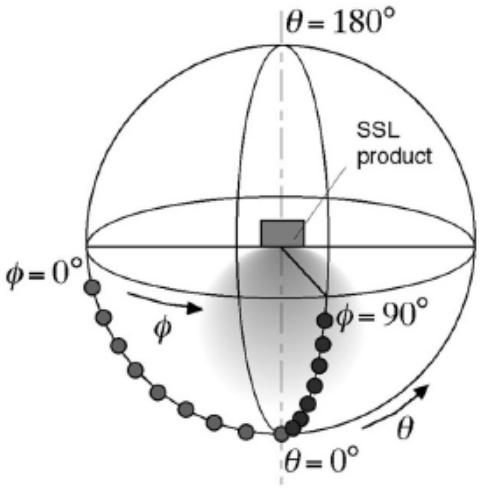
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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

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