



## LM-79-08 Test Report

for

### Signify North America Corporation

200 Franklin Square Drive, Somerset, NJ 08873, USA

### LED Tube

**Model: 9290019926**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ18110028b

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

Review by:

*April Zou*

Engineer: April Zou  
Nov. 29, 2018

Approved by:



*Jim Zhang*

Manager: Jim Zhang  
Nov. 29, 2018

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: **9290019926**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
157.5	3675.0	23.33	0.9935
CCT (K)	CRI	Stabilization Time (Light & Power)	
3964	82.7	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** : Nov. 19, 2018

**Date of Test** : Nov. 28, 2018

**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)

<b>Name</b>	: LED Tube
<b>Model</b>	: 9290019926
<b>Electrical Ratings</b>	: 120-277V, 60Hz
<b>Product Description</b>	: 25T5HO/COR/46-840/MF35/G 25/1
<b>Manufacturer</b>	: Signify North America Corporation
<b>Address</b>	: 200 Franklin Square Drive, Somerset, NJ 08873,USA

## TEST RESULTS

Test ambient temperature was 25.0°C.

Base orientation was Horizontal. Test was conducted without a dimmer in the circuit.

The stabilization time of the sample was 60minutes, and the total operating time including stabilization was 65minutes.

### Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.196	0.085
Power Factor	0.9935	0.9660
Test Power (W)	23.33	22.85
THD A%	10.74	14.76
Luminous Efficacy (lm/W)	157.5	162.0
Total Luminous Flux (lm)	3675.0	3701.0
Color Rendering Index (CRI)	82.7	
R9	6.5	
Correlated Color Temperature (CCT)(K)	3964	
Chromaticity Chroma x	0.3817	
Chromaticity Chroma y	0.3769	
Chromaticity Chroma u	0.2259	
Chromaticity Chroma v	0.3346	
Duv	0.0003	
Chromaticity Chroma u'	0.2259	
Chromaticity Chroma v'	0.5019	

Special Color Rendering Indices	
R1	81
R2	89.7
R3	95.2
R4	80.8
R5	81
R6	85.4
R7	85.2
R8	63.2
R9	6.5
R10	75.2
R11	79.4
R12	62.2
R13	83.3
R14	97.7
Rf	82
Rg	95

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 25.0°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)	0.197
Power Factor	0.9928
Power (W)	23.49
Luminous Efficacy (lm/W)	153.8
Total Luminous Flux (lm)	3612.4
Beam Angle ( ° )	110.9 ( 0°-180° ) / 177.3(90°-270°)
Center Beam Candle Power (cd)	719
Maximum Beam Candle Power (cd)	719.8 (At: C=100.0, Gamma=1.5)
Spacing Criteria	1.26 ( 0°-180° ) /1.39 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	49.56%
Zonal Lumens in the 60 °-90 °Zone	27.31%
Zonal Lumens in the 90 °-120 °Zone	14.40%
Zonal Lumens in the 120 °-180 °Zone	8.73%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

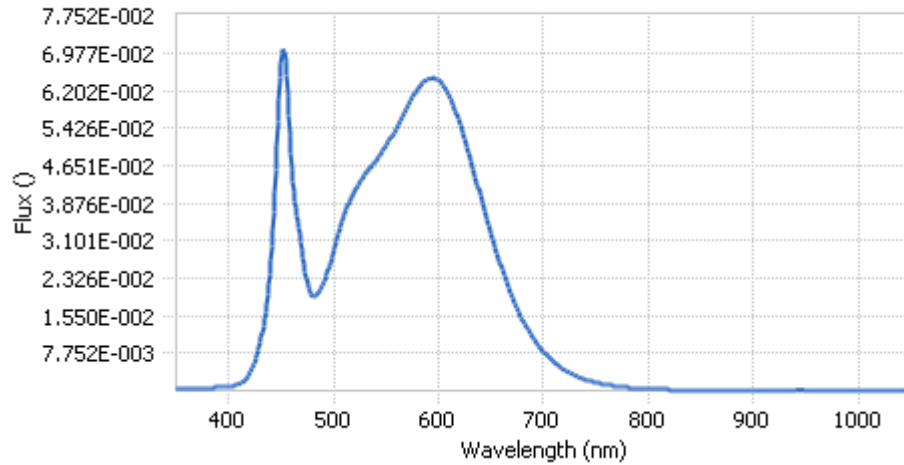


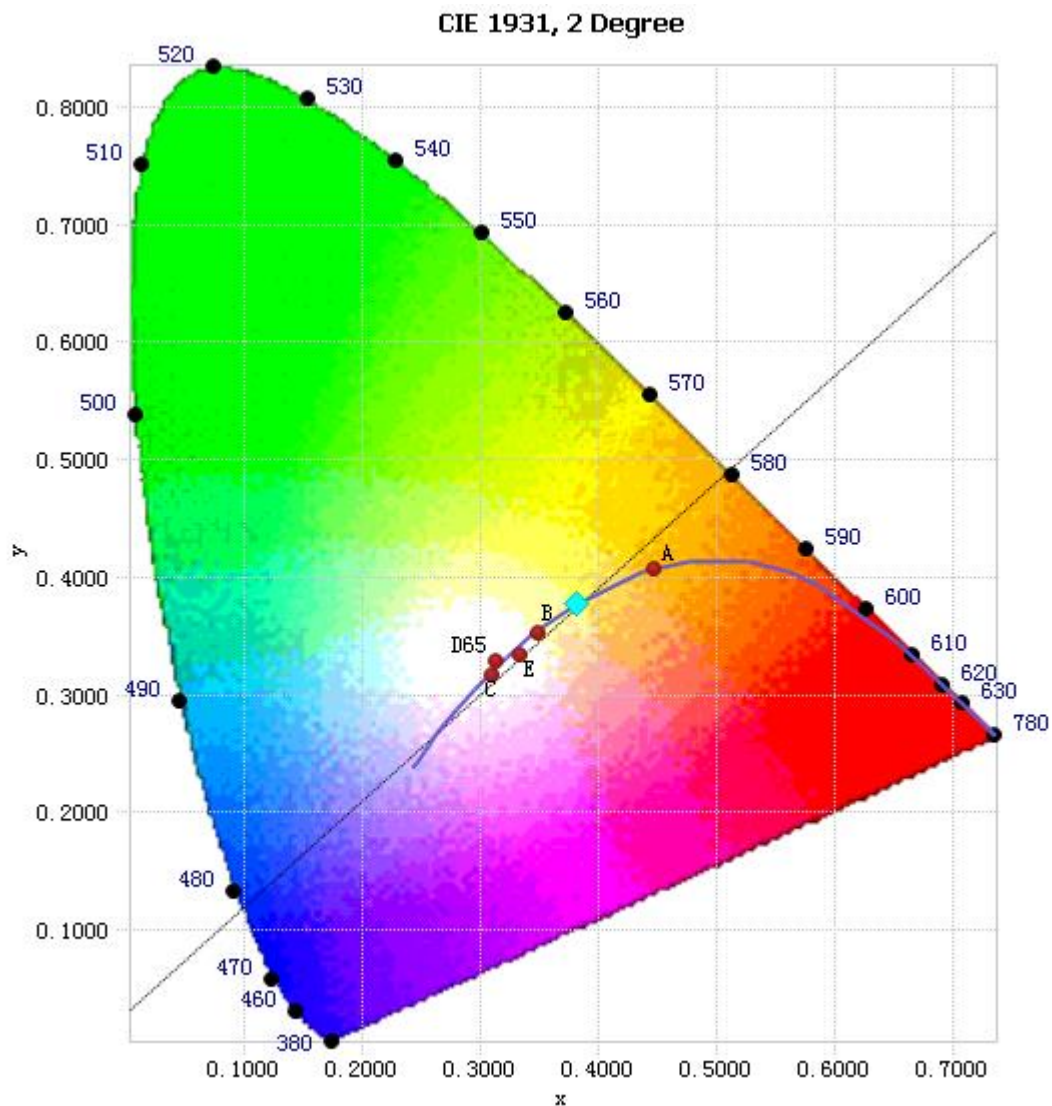
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	6.25E-04	485	2.02E-02	590	6.43E-02	695	9.44E-03
385	6.20E-04	490	2.18E-02	595	6.46E-02	700	8.07E-03
390	6.76E-04	495	2.51E-02	600	6.41E-02	705	6.92E-03
395	7.58E-04	500	2.92E-02	605	6.28E-02	710	5.91E-03
400	8.66E-04	505	3.30E-02	610	6.09E-02	715	5.06E-03
405	1.05E-03	510	3.63E-02	615	5.84E-02	720	4.35E-03
410	1.45E-03	515	3.91E-02	620	5.52E-02	725	3.72E-03
415	2.21E-03	520	4.14E-02	625	5.18E-02	730	3.19E-03
420	3.58E-03	525	4.31E-02	630	4.79E-02	735	2.71E-03
425	6.00E-03	530	4.48E-02	635	4.41E-02	740	2.32E-03
430	1.00E-02	535	4.61E-02	640	4.01E-02	745	1.99E-03
435	1.63E-02	540	4.75E-02	645	3.61E-02	750	1.69E-03
440	2.68E-02	545	4.90E-02	650	3.24E-02	755	1.46E-03
445	4.56E-02	550	5.06E-02	655	2.88E-02	760	1.28E-03
450	6.77E-02	555	5.23E-02	660	2.54E-02	765	1.09E-03
455	6.51E-02	560	5.42E-02	665	2.23E-02	770	9.40E-04
460	4.57E-02	565	5.64E-02	670	1.95E-02	775	8.12E-04
465	3.63E-02	570	5.87E-02	675	1.69E-02	780	7.01E-04
470	2.90E-02	575	6.04E-02	680	1.47E-02		
475	2.21E-02	580	6.24E-02	685	1.27E-02		
480	1.96E-02	585	6.37E-02	690	1.09E-02		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y):(0.3817, 0.3769)

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

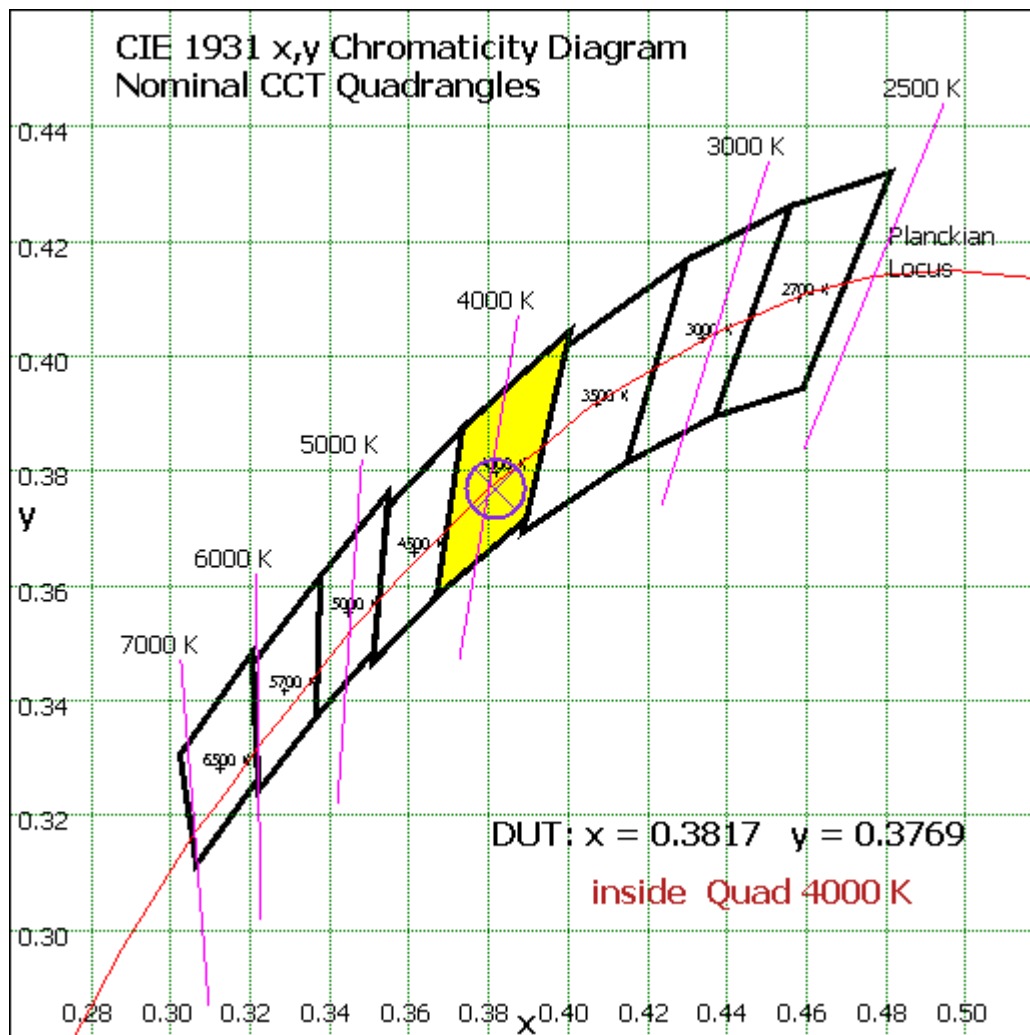


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	68.198	1.89%
10- 20	197.174	5.46%
20- 30	305.005	8.44%
30- 40	381.053	10.55%
40- 50	419.344	11.61%
50- 60	419.449	11.61%
60- 70	386.502	10.70%
70- 80	331.026	9.16%
80- 90	268.964	7.45%
90-100	215.849	5.98%
100-110	170.388	4.72%
110-120	134.057	3.71%
120-130	105.739	2.93%
130-140	81.542	2.26%
140-150	60.145	1.66%
150-160	40.513	1.12%
160-170	21.476	0.59%
170-180	5.967	0.17%
Total	3612.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1790.223	49.56%
60- 90	986.492	27.31%
0-90	2776.715	76.87%
90- 180	835.676	23.13%
0- 180	3612.4	100%

Table 5: Zonal Lumen

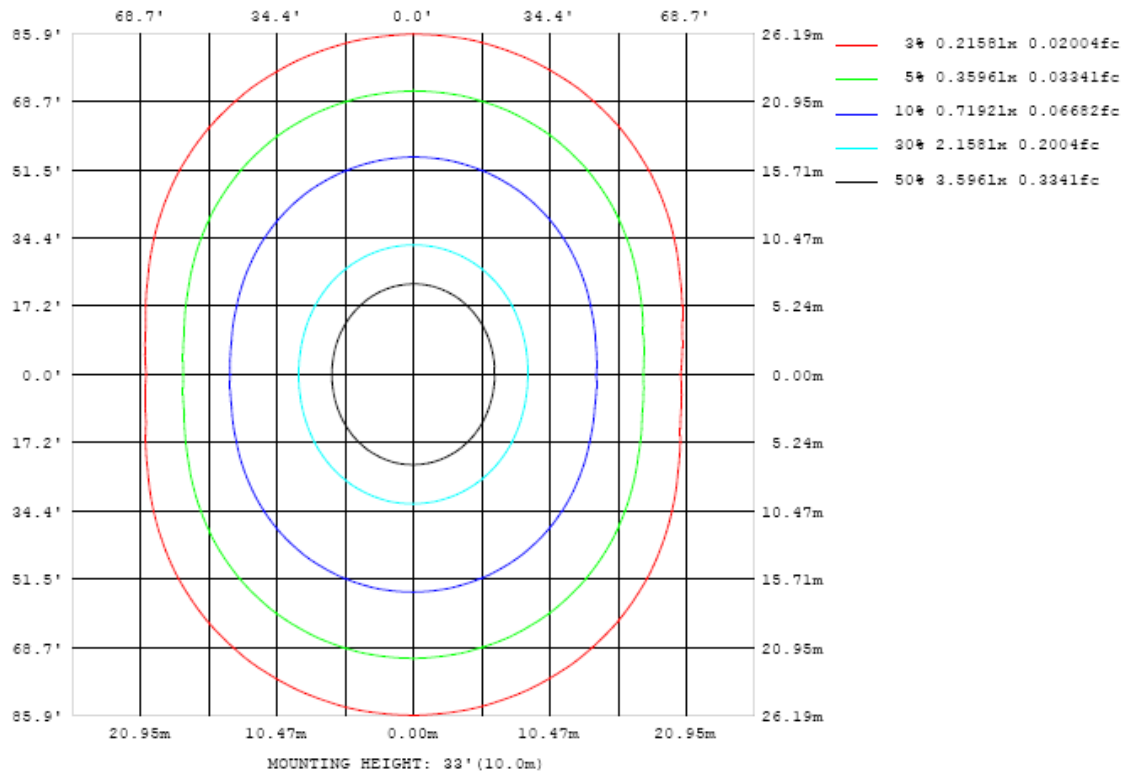


Chart 4: Beam Angle

## Luminous Intensity Distribution Plots- Goniophotometer Method

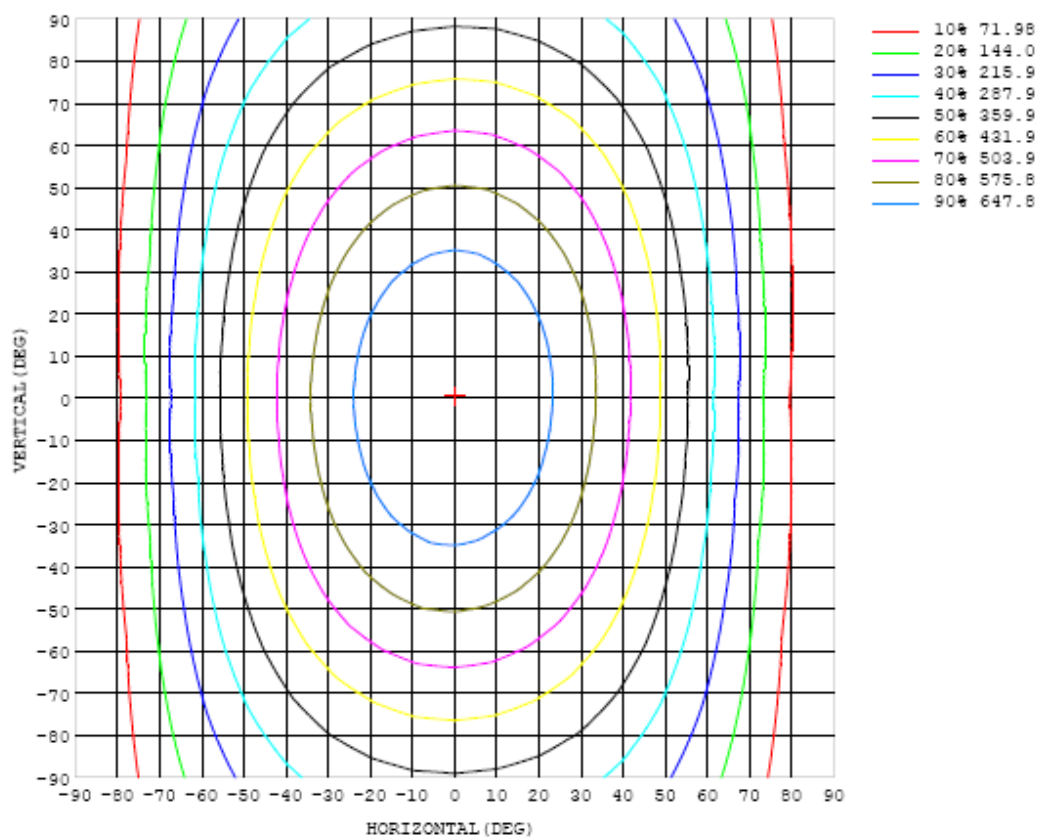


Chart 5: Illuminance Plot (Footcandles)

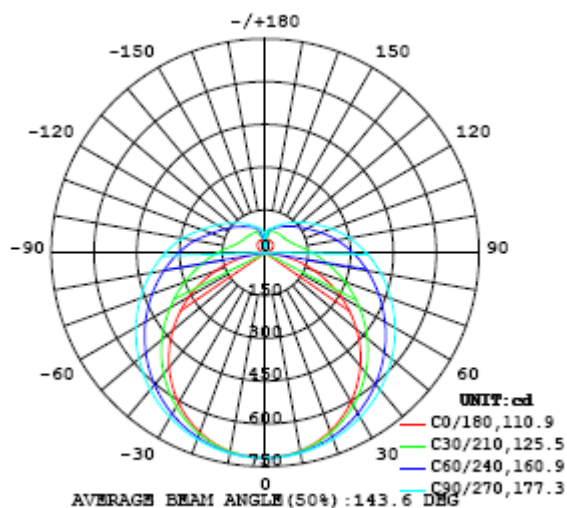


Chart 6: Polar Candela Distribution

## 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	719	719	719	719	719	719	719	719	719	719	719	719	719	719	719	719	719	719	719
5	715	715	716	715	717	716	717	717	718	718	718	717	718	717	717	716	717	716	717
10	705	705	706	706	708	709	711	712	712	713	714	712	712	711	710	708	708	707	707
15	689	689	690	692	696	697	701	702	704	705	706	704	702	700	698	695	693	692	692
20	666	666	668	672	676	681	687	689	694	695	695	693	690	685	681	676	673	670	669
25	637	638	641	647	655	662	670	675	679	681	682	678	673	667	660	652	646	642	641
30	603	604	609	618	629	639	650	657	663	665	666	661	654	645	634	624	615	609	608
35	563	565	573	585	599	614	627	637	644	647	647	641	632	619	605	591	579	571	569
40	519	522	532	548	567	585	602	614	622	626	625	618	607	591	574	555	539	528	524
45	471	475	489	509	532	554	574	589	598	603	602	593	579	561	539	516	495	480	476
50	419	424	442	467	496	522	545	563	574	579	577	567	551	528	502	474	448	429	423
55	363	370	393	424	458	489	515	535	548	553	550	539	521	495	465	431	399	375	367
60	305	315	343	381	421	456	485	507	520	526	523	510	490	461	426	388	349	318	307
65	244	258	293	338	383	422	454	477	492	497	495	481	459	428	389	344	299	260	246
70	183	200	245	297	347	390	423	448	463	469	466	451	427	394	352	303	250	202	183
75	122	145	199	258	313	358	393	418	434	440	436	421	397	362	317	264	204	147	121
80	67.2	96.5	159	223	280	328	364	389	405	411	408	392	367	331	285	228	164	98.4	64.4
85	21.7	58.5	126	192	251	298	335	361	377	383	379	363	338	302	255	198	131	61.8	20.3
90	0.77	35.2	100	166	224	271	307	333	349	355	350	335	310	274	228	171	106	39.6	0.69
95	2.34	24.8	81.5	143	199	246	281	307	322	327	323	309	284	249	204	149	87.3	29.2	2.34
100	6.13	23.6	69.2	124	177	221	256	280	295	300	297	282	258	225	181	130	74.6	28.3	6.08
105	11.2	26.0	63.6	110	157	198	231	254	269	274	270	256	233	201	161	115	68.9	30.2	11.3
110	17.0	30.7	60.8	101	141	177	207	229	243	247	244	231	209	180	145	106	66.4	34.9	16.9
115	23.2	35.9	60.0	93.9	129	161	187	206	218	223	219	207	189	164	133	98.7	65.5	39.5	22.7
120	28.8	41.1	61.2	89.0	119	147	170	187	198	202	199	189	173	150	123	93.5	66.5	43.3	28.2
125	33.4	46.4	63.4	85.5	111	135	156	171	180	183	181	172	158	138	115	90.0	68.1	48.6	32.9
130	37.4	52.3	66.0	84.0	105	125	143	156	164	167	165	157	144	128	108	88.0	69.5	53.4	37.1
135	40.4	56.6	68.7	83.0	99.9	117	131	142	149	152	150	143	133	119	103	86.5	71.1	58.4	40.5
140	42.6	61.1	70.5	82.6	95.8	109	121	130	136	138	137	131	122	111	98.6	85.1	71.3	62.2	43.2
145	44.1	67.1	72.1	82.6	92.9	103	113	120	124	126	125	121	114	105	94.8	84.1	71.7	65.9	45.1
150	45.3	69.1	74.9	80.9	90.4	97.9	105	110	114	116	115	111	106	99.2	91.4	81.2	73.7	69.7	46.3
155	46.0	67.9	76.2	80.7	86.0	93.5	98.6	102	105	106	106	103	99.4	94.6	87.2	77.5	75.7	64.3	46.9
160	46.8	61.8	79.2	81.3	84.4	87.8	91.4	95.3	97.5	98.3	98.0	96.1	92.7	87.9	80.0	73.9	68.7	58.2	47.1
165	47.2	52.5	65.0	81.1	83.2	85.5	86.9	88.3	89.3	89.5	89.4	88.5	86.9	75.8	67.8	62.4	56.2	48.9	46.5
170	47.3	45.5	51.4	64.0	77.3	79.6	82.2	84.4	85.0	85.3	85.4	82.3	66.5	58.7	58.2	54.0	51.8	40.7	45.8
175	60.3	58.7	54.6	53.5	59.2	61.0	65.0	68.5	77.3	78.6	61.4	41.2	48.9	55.8	54.8	58.7	54.7	54.4	61.6
180	21.2	21.2	21.1	21.0	20.8	20.5	20.2	19.9	19.6	19.3	19.4	19.5	19.6	19.7	19.7	19.8	19.9	19.9	19.9

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	719	719	719	719	719	719	719	719	719	719	719	719	719	719	719	719	719		
5	717	717	717	717	717	717	718	718	718	719	717	717	716	717	716	716	716		
10	707	708	709	710	710	712	713	714	714	714	712	711	710	709	707	706	706		
15	692	693	695	698	700	703	704	706	707	706	703	702	699	696	693	691	690		
20	670	673	676	681	684	690	693	695	697	696	693	689	684	679	674	670	667		
25	643	646	652	659	666	673	678	682	683	682	677	672	665	658	650	643	639		
30	610	615	624	634	643	653	660	665	667	665	660	653	643	632	621	612	606		
35	571	579	591	605	617	630	639	646	648	646	639	630	617	604	589	576	567		
40	528	539	554	572	589	604	616	624	627	625	616	605	589	572	553	537	525		
45	481	495	515	537	558	576	590	600	604	601	592	577	559	537	514	493	478		
50	430	448	473	500	525	547	563	574	579	576	565	549	527	501	473	447	428		
55	375	399	430	462	491	516	534	547	552	549	537	519	494	464	431	399	375		
60	319	348	386	424	457	485	505	519	524	521	508	489	461	426	388	350	320		
65	261	298	342	386	423	454	475	489	495	492	479	457	427	389	345	300	263		
70	203	249	300	349	389	422	445	460	466	463	449	426	394	353	304	252	207		
75	148	203	261	314	356	391	415	430	437	433	419	396	362	318	266	207	153		
80	99.2	163	226	281	325	361	385	401	407	404	389	366	331	286	230	167	104		
85	61.2	130	194	250	296	332	356	372	378	375	361	336	302	256	199	134	65.1		
90	38.3	104	168	223	269	304	328	344	350	347	332	309	274	228	172	107	40.9		
95	27.2	83.6	145	199	243	277	302	317	323	320	306	282	248	203	149	86.8	27.9		
100	25.3	71.4	123	174	217	250	274	289	295	291	278	255	221	178	127	72.2	25.5		
105	28.8	65.2	110	154	191	223	245	260	265	262	249	226	195	157	112	65.3	28.7		
110	33.1	62.6	101	140	173	200	219	232	237	234	222	202	175	142	102	62.0	33.0		
115	37.2	62.8	94.9	128	158	182	199	210	215	212	201	184	159	129	94.1	62.2	37.9		
120	42.9	63.9	90.5	119	145	166	182	192	196	193	183	167	147	119	89.4	63.8	43.2		
125	48.5	65.6	87.5	112	134	153	166	175	178	176	167	154	135	111	87.0	65.5	48.8		
130	53.7	67.3	85.7	105	124	140	152	159	162	161	153	141	125	105	85.7	67.2	53.9		
135	56.3	68.4	84.4	101	116	130	140	146	149	147	141	130	117	101	84.6	69.5	57.9		
140	58.3	71.0	81.5	96.7	109	120	129	134	136	135	129	121	110	97.0	83.7	72.2	61.5		
145	62.7	73.4	81.5	93.5	103	112	118	123	125	123	119	112	104	93.6	83.1	74.7	66.2		
150	66.4	75.5	80.8	88.2	98.2	105	110	113	115	114	110	105	98.6	90.4	83.5	76.1	71.0		
155	65.7	74.6	80.4	86.3	87.5	98.6	102	105	106	105	103	98.8	94.0	89.1	83.8	75.9	71.8		
160	53.2	65.7	73.4	79.1	86.2	86.8	95.4	96.7	97.7	97.6	96.2	94.1	91.3	87.9	83.4	79.2	63.9		
165	46.7	54.3	61.0	65.1	72.3	82.0	87.0	90.9	91.9	92.0	91.3	90.3	88.7	85.9	82.2	79.0	55.6		
170	45.8	45.5	53.5	57.2	56.7	55.3	63.8	81.2	79.1	87.3	86.7	85.4	82.9	81.9	76.7	60.1	48.3		
175	61.6	61.2	59.8	62.7	58.9	59.9	51.1	41.4	51.1	81.5	74.5	68.1	64.5	63.0	63.9	58.5	58.5		
180	19.9	19.9	19.8	19.7	19.7	19.6	19.5	19.4	19.3	19.6	19.9	20.2	20.5	20.8	21.0	21.1	21.2		

Table 7: Luminous Intensity Data

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 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	2M	HZTE015-01	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  $4\pi$ . 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  $10^\circ$  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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