

LM-79-08 TEST REPORT

for

Signify North America Corporation

200 Franklin Square Drive, Somerset, NJ 08873, USA

LED Tube

Model: 9290023253

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19080034f

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

Review by:



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Sep. 05, 2019

Approved by:



Manager: Jim Zhang
Sep. 05, 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: 9290023253

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
165.5	1698.3	10.26	0.9818
CCT (K)	CRI	Stabilization Time (Light & Power)	
5069	82.8	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	: Aug. 30, 2019
Date of Test	: Sep. 03, 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 ANSI/IES TM-30-18 IES Method for Evaluating Light Source Color Rendition

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SAMPLE PHOTO

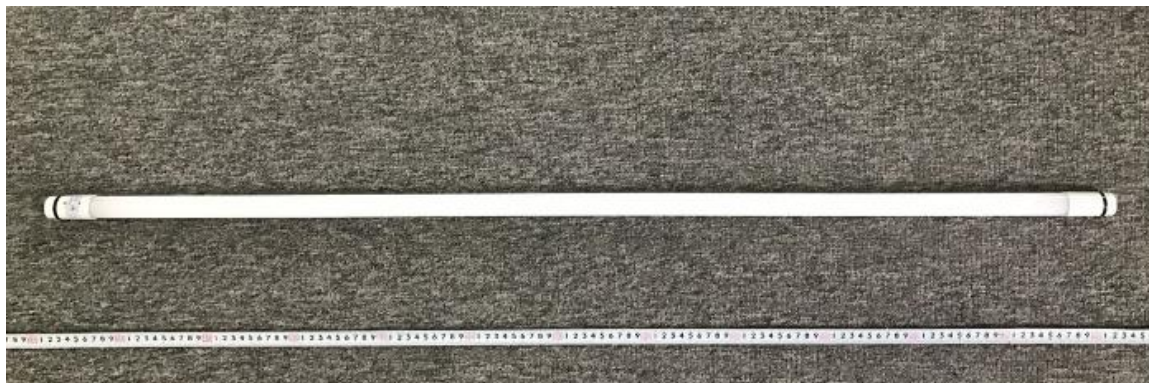


Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 9290023253
Electrical Ratings	: 120-277V, 50/60Hz, 10.5W
Product Description	: 10.5T8/MAS/48-850/MF16/P 10/1
Manufacturer	: Signify North America Corporation
Address	: 200 Franklin Square Drive, Somerset, NJ 08873, USA

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	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.087	0.041
Power Factor	0.9818	0.9227
Test Power (W)	10.26	10.56
THD A%	16.81	19.70
Luminous Efficacy (lm/W)	165.5	160.9
Total Luminous Flux (lm)	1698.3	1699.6
Color Rendering Index (CRI)	82.8	
R9	6.1	
Correlated Color Temperature (CCT)(K)	5069	
Chromaticity Chroma x	0.3434	
Chromaticity Chroma y	0.3535	
Chromaticity Chroma u	0.2095	
Chromaticity Chroma v	0.3235	
Duv	0.0016	
Chromaticity Chroma u'	0.2095	
Chromaticity Chroma v'	0.4853	

Special Color Rendering Indices	
R1	81.3
R2	88.7
R3	92.7
R4	82
R5	81.6
R6	83.2
R7	86.4
R8	66.4
R9	6.1
R10	72.3
R11	81.2
R12	58.1
R13	83.5
R14	96.3

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 °C.

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)	0.088
Power Factor	0.9754
Power (W)	10.29
Luminous Efficacy (lm/W)	162.8
Total Luminous Flux (lm)	1675.1
Beam Angle (°)	115.0 (0°-180°) / 168.9 (90°-270°)
Center Beam Candle Power (cd)	359
Maximum Beam Candle Power (cd)	358.8 (At: C=110.0, Gamma=0.5)
Spacing Criteria	1.28 (0°-180°) / 1.38 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	54.00%
Zonal Lumens in the 60 °-90 °Zone	28.96%
Zonal Lumens in the 90 °-120 °Zone	12.94%
Zonal Lumens in the 120 °-180 °Zone	4.11%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

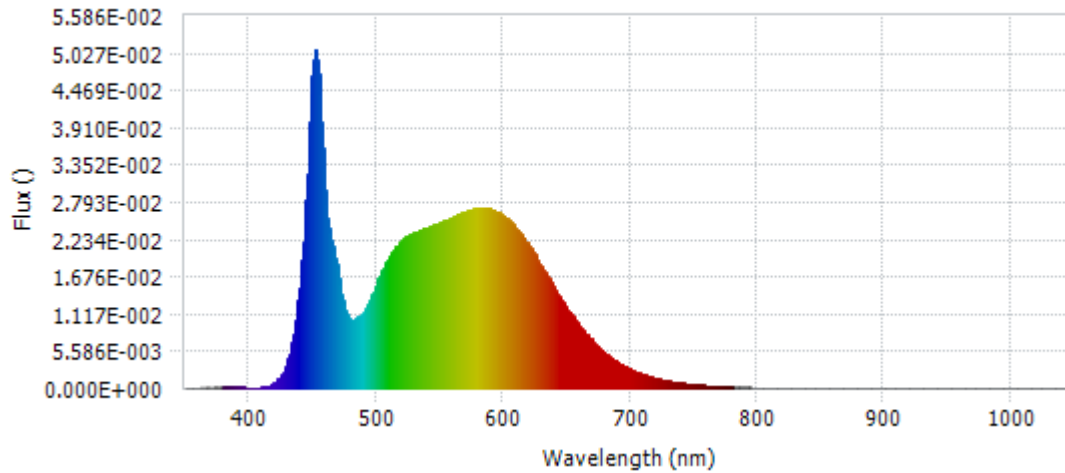
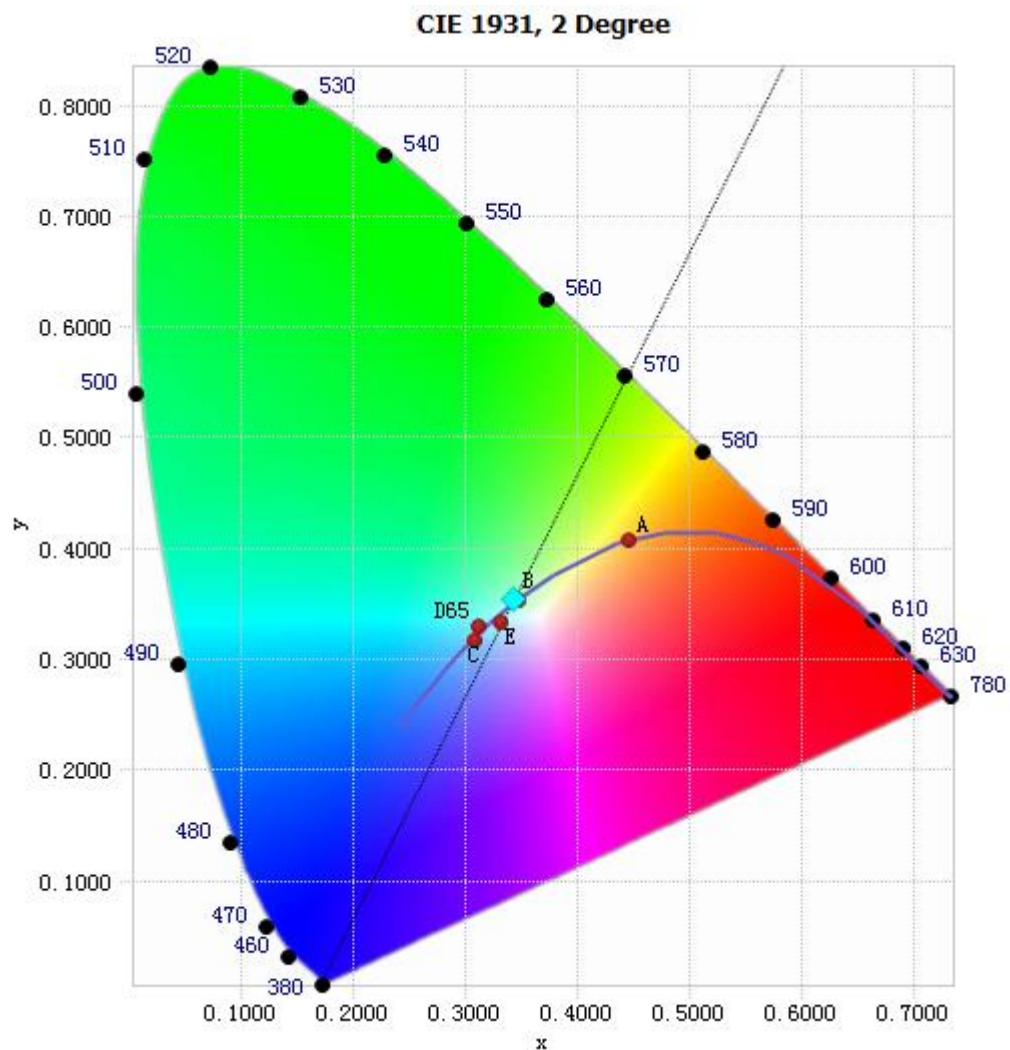


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.72E-04	485	1.05E-02	590	2.69E-02	695	3.38E-03
385	1.63E-04	490	1.14E-02	595	2.65E-02	700	2.88E-03
390	1.81E-04	495	1.31E-02	600	2.59E-02	705	2.46E-03
395	1.60E-04	500	1.54E-02	605	2.51E-02	710	2.09E-03
400	1.21E-04	505	1.77E-02	610	2.41E-02	715	1.79E-03
405	1.02E-04	510	1.95E-02	615	2.29E-02	720	1.53E-03
410	1.69E-04	515	2.10E-02	620	2.15E-02	725	1.30E-03
415	3.64E-04	520	2.21E-02	625	2.00E-02	730	1.11E-03
420	8.30E-04	525	2.28E-02	630	1.84E-02	735	9.47E-04
425	1.87E-03	530	2.33E-02	635	1.68E-02	740	8.07E-04
430	3.94E-03	535	2.37E-02	640	1.52E-02	745	6.82E-04
435	8.00E-03	540	2.41E-02	645	1.36E-02	750	5.83E-04
440	1.50E-02	545	2.45E-02	650	1.21E-02	755	5.02E-04
445	2.82E-02	550	2.48E-02	655	1.07E-02	760	4.32E-04
450	4.68E-02	555	2.52E-02	660	9.40E-03	765	3.67E-04
455	4.70E-02	560	2.56E-02	665	8.21E-03	770	3.16E-04
460	2.98E-02	565	2.61E-02	670	7.13E-03	775	2.68E-04
465	2.22E-02	570	2.65E-02	675	6.18E-03	780	2.31E-04
470	1.76E-02	575	2.68E-02	680	5.36E-03		
475	1.24E-02	580	2.70E-02	685	4.60E-03		
480	1.03E-02	585	2.71E-02	690	3.94E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3434, 0.3535)

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

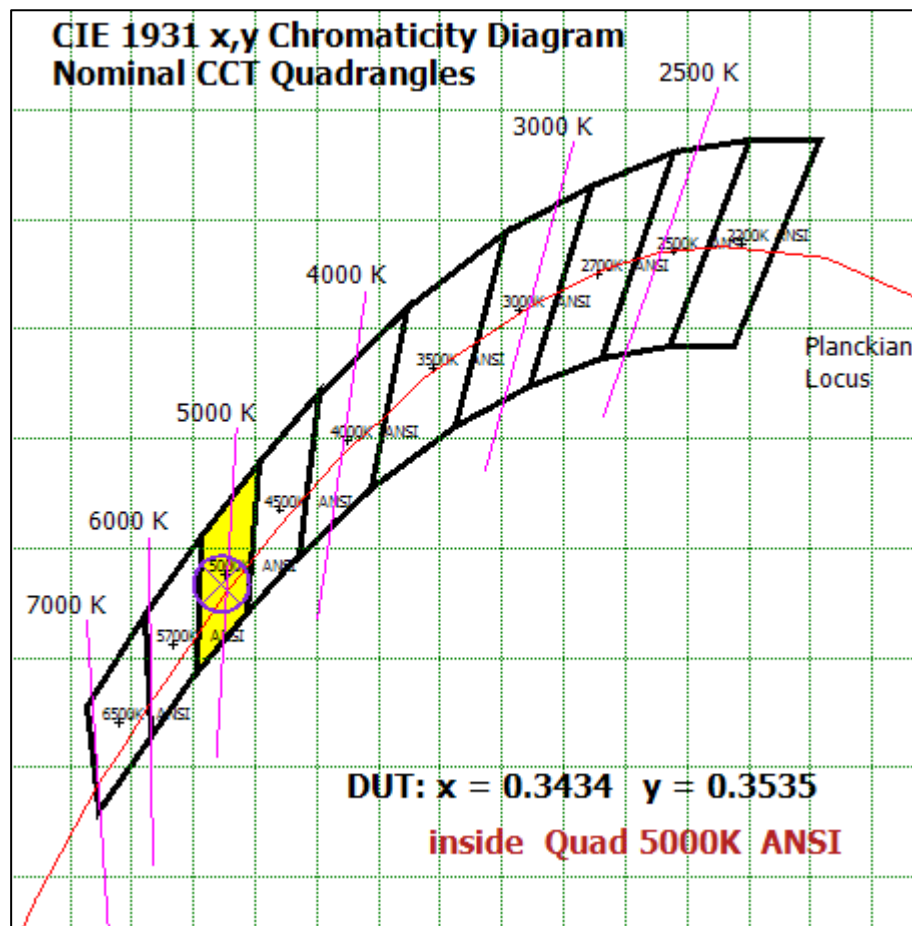
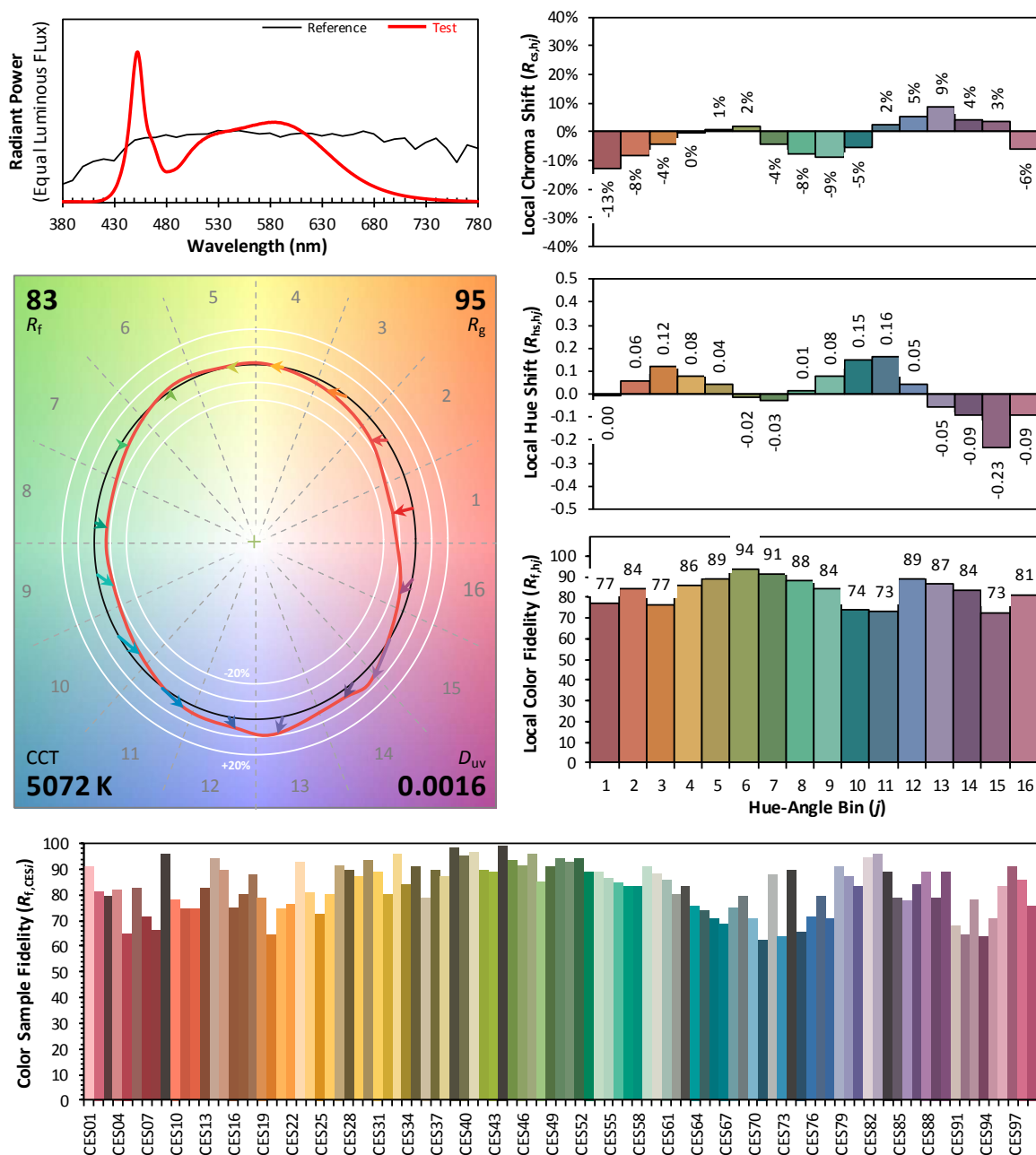


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method



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

 $x = 0.3434$

y 0.3534

 u' 0.2095

V' 0.4853

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	34.026	2.03%
10- 20	98.67	5.89%
20- 30	153.378	9.16%
30- 40	192.649	11.50%
40- 50	212.855	12.71%
50- 60	212.884	12.71%
60- 70	194.633	11.62%
70- 80	163.162	9.74%
80- 90	127.252	7.60%
90-100	96.444	5.76%
100-110	70.953	4.24%
110-120	49.375	2.95%
120-130	31.959	1.91%
130-140	19.29	1.15%
140-150	10.52	0.63%
150-160	4.92	0.29%
160-170	1.75	0.10%
170-180	0.345	0.02%
Total	1675.1	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	904.462	54.00%
60- 90	485.047	28.96%
0-90	1389.509	82.95%
90- 180	285.556	17.05%
0- 180	1675.1	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

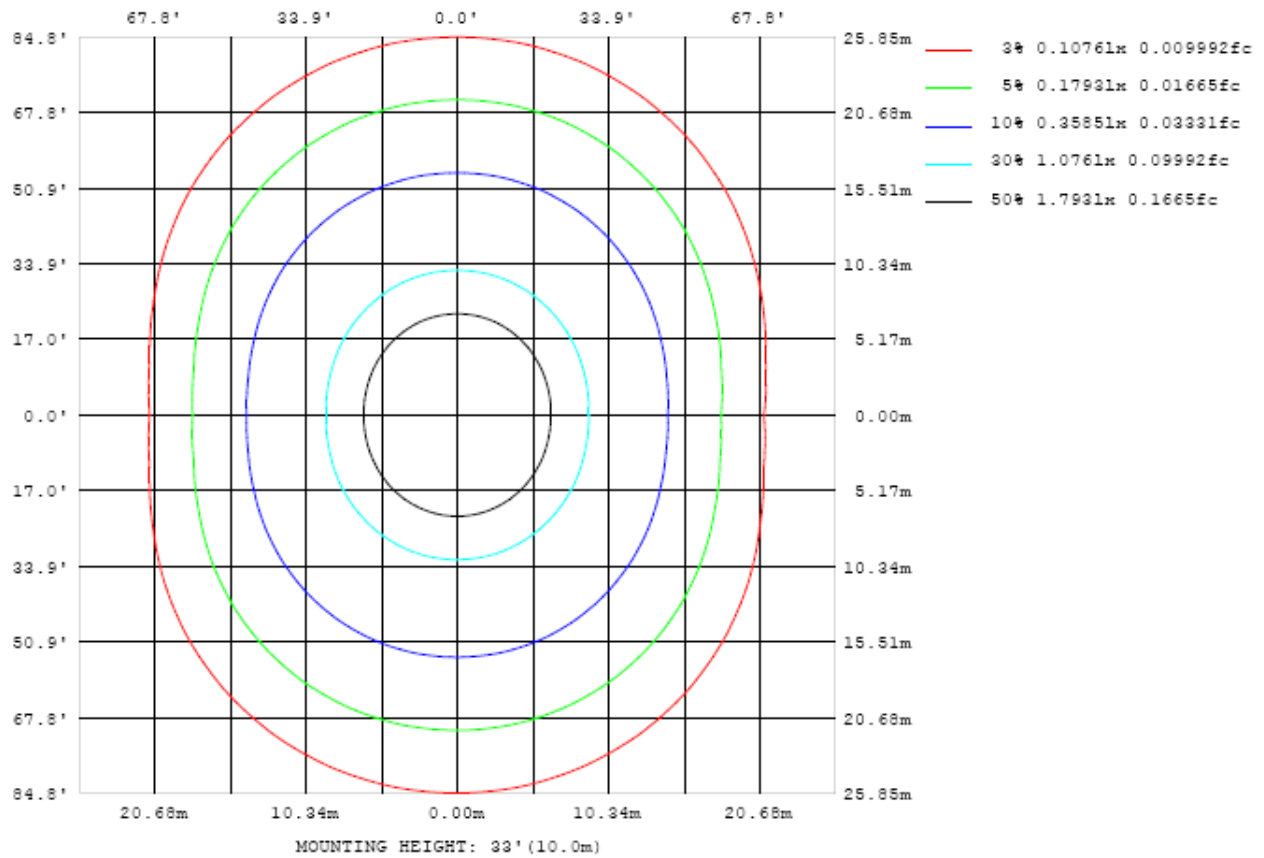


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

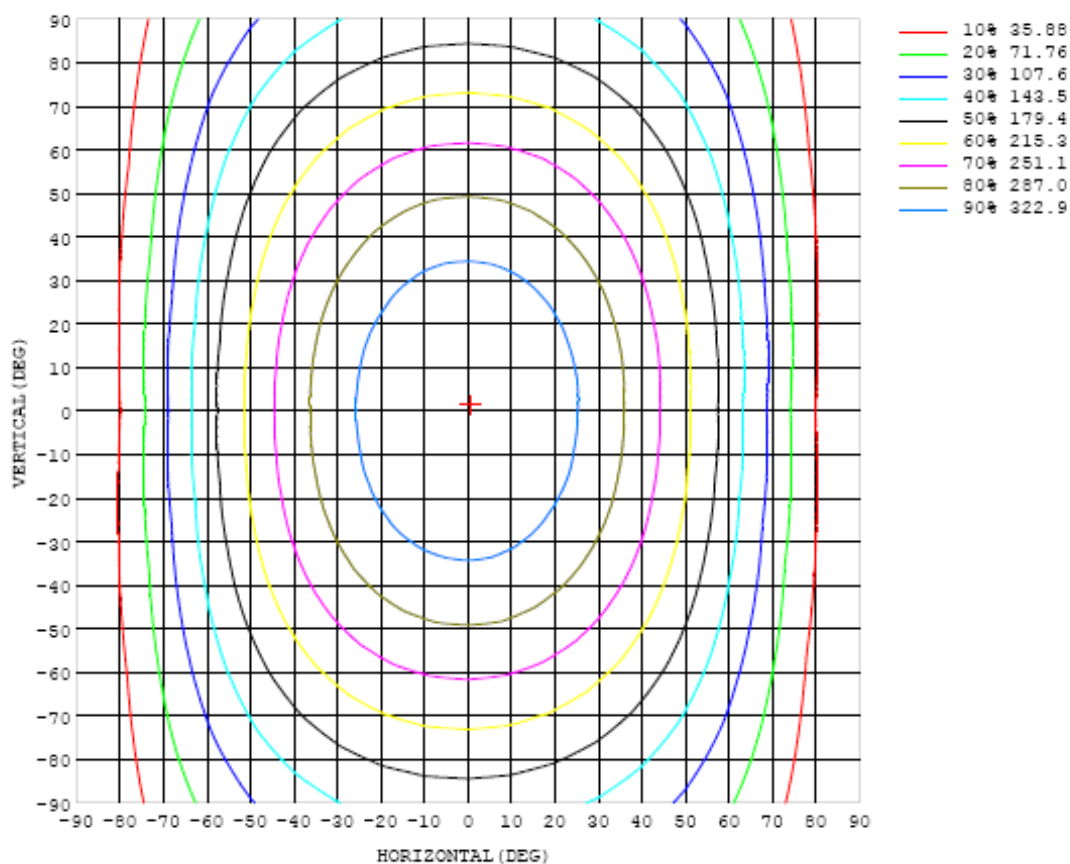


Chart 6: Isocandela Plot

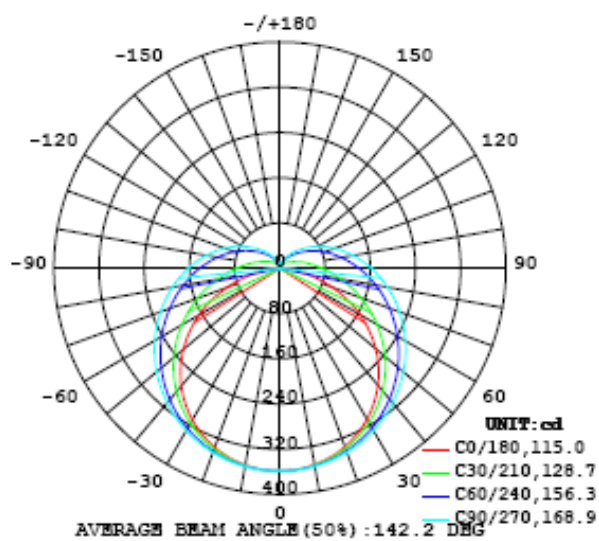


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1		UNIT: cd																	
C (DEG) y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	359	359	359	359	359	359	359	359	359	359	359	359	359	359	359	359	359	359	359
5	357	357	357	358	357	357	357	358	358	358	358	358	358	357	357	358	357	358	357
10	353	353	353	354	353	354	355	355	356	356	355	355	355	355	354	354	354	354	353
15	346	346	347	347	348	349	350	351	352	352	352	351	350	350	349	348	347	347	347
20	336	336	337	339	340	342	344	345	346	346	346	346	344	343	341	340	338	337	337
25	323	324	325	328	330	333	335	338	339	340	339	339	336	334	331	329	327	325	325
30	308	309	311	315	318	322	326	329	331	331	331	330	327	324	320	316	313	311	310
35	290	292	295	300	305	310	315	318	320	322	321	319	316	311	307	301	297	293	292
40	270	271	276	283	289	296	302	306	309	310	310	307	303	298	291	284	278	273	272
45	247	249	255	264	272	280	288	293	297	298	298	295	290	283	274	266	257	251	249
50	221	224	232	243	254	264	273	279	284	285	284	281	274	266	256	246	235	226	223
55	193	197	207	221	234	246	257	264	269	271	270	266	259	249	238	224	211	199	195
60	163	168	182	199	214	229	240	249	254	256	255	250	242	231	218	202	185	171	165
65	131	138	155	175	194	210	223	233	239	241	240	234	226	213	198	179	159	141	134
70	98.5	107	129	152	174	192	206	216	223	225	224	218	209	195	178	156	133	110	100
75	65.8	77.5	103	130	154	174	189	200	207	209	208	202	192	177	158	135	108	81.1	66.9
80	35.1	50.4	79.9	110	135	156	172	184	191	193	192	186	175	160	139	114	84.8	54.7	35.6
85	10.6	28.5	60.5	91.0	117	139	156	168	175	178	176	170	159	143	122	95.9	65.8	33.2	10.5
90	0.22	14.9	44.9	74.9	101	123	140	152	159	162	160	154	143	127	106	79.7	50.0	19.2	0.12
95	0.28	8.39	33.3	61.7	86.8	108	125	137	144	147	145	139	128	111	91.1	66.3	38.1	11.7	0.28
100	0.44	5.74	25.4	50.5	73.8	94.2	110	122	129	132	130	124	113	97.6	77.9	54.8	29.4	8.23	0.39
105	0.62	4.54	19.7	41.3	63.0	81.6	96.9	108	115	117	116	110	99.3	84.8	66.8	45.2	23.1	6.54	0.59
110	0.79	4.04	16.0	33.6	52.9	70.7	84.3	94.7	101	104	102	96.5	86.6	73.0	56.4	37.1	18.9	5.65	0.87
115	1.06	3.81	13.3	27.7	43.9	59.5	72.4	82.1	88.2	90.5	88.9	83.7	74.5	62.3	47.0	30.8	15.8	5.23	1.17
120	1.32	3.71	11.2	23.1	36.5	49.7	61.4	70.0	75.5	77.6	76.2	71.3	63.4	52.2	39.4	25.8	13.5	4.92	1.48
125	1.56	3.59	9.75	19.4	30.5	41.6	51.3	58.9	63.8	65.7	64.4	60.2	53.1	43.8	32.9	21.7	11.7	4.63	1.79
130	1.81	3.42	8.63	16.2	25.4	34.6	42.8	49.1	53.3	54.9	53.9	50.3	44.3	36.5	27.5	18.3	10.3	4.35	2.06
135	2.07	3.19	7.68	13.7	21.1	28.5	35.3	40.5	44.1	45.3	44.6	41.6	36.6	30.2	22.8	15.5	9.04	4.19	2.25
140	2.21	3.18	6.70	11.6	17.3	23.3	28.7	33.0	35.8	36.9	36.3	33.9	29.8	24.7	18.8	13.1	7.62	4.01	2.42
145	2.28	3.35	5.99	9.85	14.2	18.8	23.0	26.3	28.6	29.5	29.0	27.1	23.9	19.9	15.4	10.9	6.47	3.85	2.59
150	2.38	3.45	5.26	8.16	11.6	14.9	18.1	20.6	22.3	23.0	22.6	21.2	18.8	15.8	12.5	8.99	5.95	3.78	2.70
155	2.38	3.28	4.54	6.79	9.14	11.7	14.0	15.8	17.0	17.5	17.2	16.2	14.5	12.4	9.95	6.73	5.11	3.63	2.74
160	2.35	2.93	4.23	5.51	7.21	8.83	10.5	11.7	12.5	12.9	12.7	12.0	11.0	9.46	7.18	5.51	4.04	3.23	2.71
165	2.31	2.58	3.48	4.54	5.49	6.66	7.63	8.34	8.85	9.18	9.09	8.70	7.95	6.11	4.96	4.00	3.34	2.82	2.65
170	2.36	2.44	2.69	3.48	4.30	4.61	5.13	5.67	6.03	6.23	6.19	5.54	4.48	3.76	3.58	3.38	3.07	2.64	2.64
175	2.94	2.98	3.01	3.04	3.25	3.23	3.46	3.73	4.26	4.36	4.45	4.64	3.04	3.30	3.21	3.27	3.09	3.07	3.10
180	0.98	0.98	0.98	0.97	0.96	0.95	0.94	0.93	0.91	0.90	0.91	0.91	0.92	0.93	0.94	0.94	0.95	0.95	0.95

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	359	359	359	359	359	359	359	359	359	359	359	359	359	359	359	359	359		
5	357	357	358	357	357	358	358	358	358	358	358	357	358	357	358	357	357		
10	354	354	354	354	355	355	356	356	356	356	355	355	354	354	354	353	353		
15	347	347	348	349	350	351	352	352	352	352	351	351	350	348	348	347	346		
20	338	339	340	342	343	345	346	347	347	347	346	344	343	341	339	338	337		
25	326	327	330	332	334	337	339	340	340	340	338	336	334	331	329	326	325		
30	311	313	316	320	324	327	330	332	332	331	329	327	323	319	316	312	310		
35	294	297	302	307	311	316	319	321	322	321	319	315	311	306	301	296	292		
40	274	278	285	291	297	303	307	310	311	310	307	302	297	290	284	277	273		
45	251	257	266	275	282	289	294	298	298	297	294	289	282	274	265	257	250		
50	226	234	245	256	266	275	280	284	285	284	280	274	265	255	245	234	226		
55	199	210	223	237	248	258	266	270	271	270	265	258	248	236	223	210	199		
60	171	184	201	217	230	242	250	255	256	254	249	241	230	216	201	185	171		
65	141	158	178	196	212	225	234	239	241	239	234	225	212	196	178	159	142		
70	110	132	155	176	194	208	217	223	225	223	217	208	194	176	156	133	111		
75	79.6	106	133	157	175	191	201	207	209	207	201	191	176	157	134	108	81.5		
80	51.9	82.2	112	138	158	174	185	191	193	191	185	174	159	139	114	84.6	54.5		
85	29.8	62.3	93.4	120	142	158	169	175	178	175	169	158	142	121	95.2	64.7	32.6		
90	16.2	46.5	77.2	104	125	142	154	160	162	160	154	142	126	105	79.0	48.9	18.4		
95	9.10	35.0	63.5	89.1	110	127	139	145	148	145	139	127	111	90.4	65.2	37.1	10.8		
100	6.31	26.6	52.3	76.3	96.6	112	124	131	133	130	124	113	97.1	77.3	53.7	28.3	7.27		
105	4.95	20.7	42.7	64.8	83.8	98.8	110	116	118	116	110	99.2	84.4	65.8	43.9	21.8	5.55		
110	4.45	16.8	34.8	54.2	71.8	86.0	96.4	103	104	102	96.5	86.4	72.4	55.0	35.6	17.6	4.78		
115	4.21	13.9	28.8	45.0	60.5	73.6	83.3	89.2	91.0	89.1	83.5	74.0	60.9	45.5	29.3	14.3	4.36		
120	4.06	11.9	24.0	37.6	50.7	61.8	70.6	76.1	77.8	76.1	70.8	62.1	50.8	37.9	24.3	11.9	4.15		
125	4.00	10.4	20.2	31.4	42.4	51.9	59.2	63.8	65.3	63.8	59.3	51.9	42.5	31.5	20.2	10.3	4.00		
130	3.96	9.09	17.1	26.2	35.3	43.3	49.5	53.4	54.6	53.3	49.5	43.3	35.2	26.2	16.9	9.00	3.92		
135	3.90	7.80	14.3	21.8	29.2	35.8	40.9	44.1	45.1	44.0	40.8	35.7	29.0	21.6	14.1	7.96	3.89		
140	3.85	7.06	12.0	17.9	23.8	29.0	33.3	35.9	36.7	35.8	33.2	29.0	23.7	17.7	11.9	7.11	3.88		
145	3.81	6.34	10.1	14.5	19.1	23.3	26.5	28.6	29.3	28.6	26.5	23.2	19.0	14.3	10.0	6.37	3.90		
150	3.77	5.70	8.09	11.7	15.0	18.2	20.7	22.3	22.8	22.3	20.7	18.2	15.1	11.7	8.47	5.79	3.91		
155	3.55	4.97	6.67	8.94	11.6	13.7	15.6	16.9	17.2	16.9	15.8	14.0	11.8	9.49	7.25	5.35	3.79		
160	3.01	3.93	5.26	6.71	8.64	10.1	11.4	12.2	12.5	12.3	11.7	10.7	9.28	7.77	6.30	5.03	3.48		
165	2.66	3.11	3.70	4.48	5.44	6.85	8.08	8.61	8.87	8.85	8.55	7.99	7.24	6.37	5.48	4.61	3.09		
170	2.64	2.47	3.07	3.46	3.69	4.01	4.58	5.87	6.21	6.23	6.13	5.89	5.42	4.96	4.49	3.58	2.79		
175	3.10	3.07	2.90	3.11	3.12	3.24	3.00	2.65	3.41	4.44	4.33	3.94	3.67	3.37	3.25	3.11	2.97		
180	0.95	0.95	0.94	0.94	0.93	0.92	0.91	0.91	0.90	0.91	0.93	0.94	0.95	0.96	0.97	0.98	0.98		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 02, 2019	Aug. 01, 2020
Digital Power Meter	PF2010A	HZTE028-01	Aug. 02, 2019	Aug. 01, 2020
AC Power Supply	DPS1060	HZTE001-06	Aug. 02, 2019	Aug. 01, 2020
DC Power Supply	WY12010	HZTE004-03	Aug. 02, 2019	Aug. 01, 2020
Temperature recorder	JM624U	HZTE018-08	Aug. 02, 2019	Aug. 01, 2020
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 02, 2019	Aug. 01, 2020
Standard source	D908	HZTE012-01	Aug. 02, 2019	Aug. 01, 2020
Integrate Sphere system	3M	HZTE015-04	Aug. 02, 2019	Aug. 01, 2020
Digital Power Meter	WT210	HZTE008-01	Aug. 02, 2019	Aug. 01, 2020
AC Power Supply	PCR 500L	HZTE001-07	Aug. 02, 2019	Aug. 01, 2020
DC Power Supply	IT6154	HZTE004-04	Aug. 02, 2019	Aug. 01, 2020
Standard source	SCL-1400	HZTE012-02	Aug. 02, 2019	Aug. 01, 2020
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 02, 2019	Aug. 01, 2020
Temperature Meter	TES1310	HZTE017-01	Aug. 02, 2019	Aug. 01, 2020

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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