

LM-79-08 TEST REPORT

for

Signify North America Corporation

200 Franklin Square Drive, Somerset, NJ 08873, USA

LED Tube

Model: 9290023251

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19080034d

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: 9290023251

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
156.4	1606.8	10.27	0.9817
CCT (K)	CRI	Stabilization Time (Light & Power)	
3509	82.6	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. 02, 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	: 9290023251
Electrical Ratings	: 120-277V, 50/60Hz, 10.5W
Product Description	: 10.5T8/MAS/48-835/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	0.9817	0.9219
Test Power (W)	10.27	10.54
THD A%	16.86	19.92
Luminous Efficacy (lm/W)	156.4	153.0
Total Luminous Flux (lm)	1606.8	1612.9
Color Rendering Index (CRI)	82.6	
R9	5.9	
Correlated Color Temperature (CCT)(K)	3509	
Chromaticity Chroma x	0.4046	
Chromaticity Chroma y	0.3902	
Chromaticity Chroma u	0.2355	
Chromaticity Chroma v	0.3406	
Duv	0.0002	
Chromaticity Chroma u'	0.2355	
Chromaticity Chroma v'	0.5110	

Special Color Rendering Indices	
R1	80.9
R2	90.3
R3	96.1
R4	80.6
R5	81
R6	86.9
R7	84
R8	61
R9	5.9
R10	77.2
R11	79.7
R12	63.8
R13	83.3
R14	98.4

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	0.9745
Power (W)	10.27
Luminous Efficacy (lm/W)	154.3
Total Luminous Flux (lm)	1584.2
Beam Angle (°)	111.5 (0°-180°) / 155.6 (90°-270°)
Center Beam Candle Power (cd)	364
Maximum Beam Candle Power (cd)	364.0 (At: C=260.0, Gamma=2.5)
Spacing Criteria	1.26 (0°-180°) / 1.38 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	56.25%
Zonal Lumens in the 60 °-90 °Zone	28.19%
Zonal Lumens in the 90 °-120 °Zone	11.80%
Zonal Lumens in the 120 °-180 °Zone	3.75%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

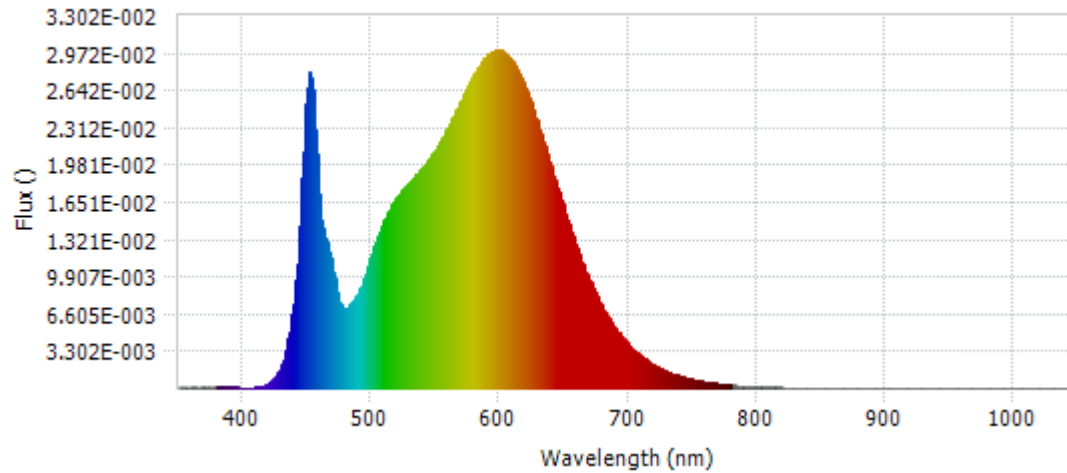
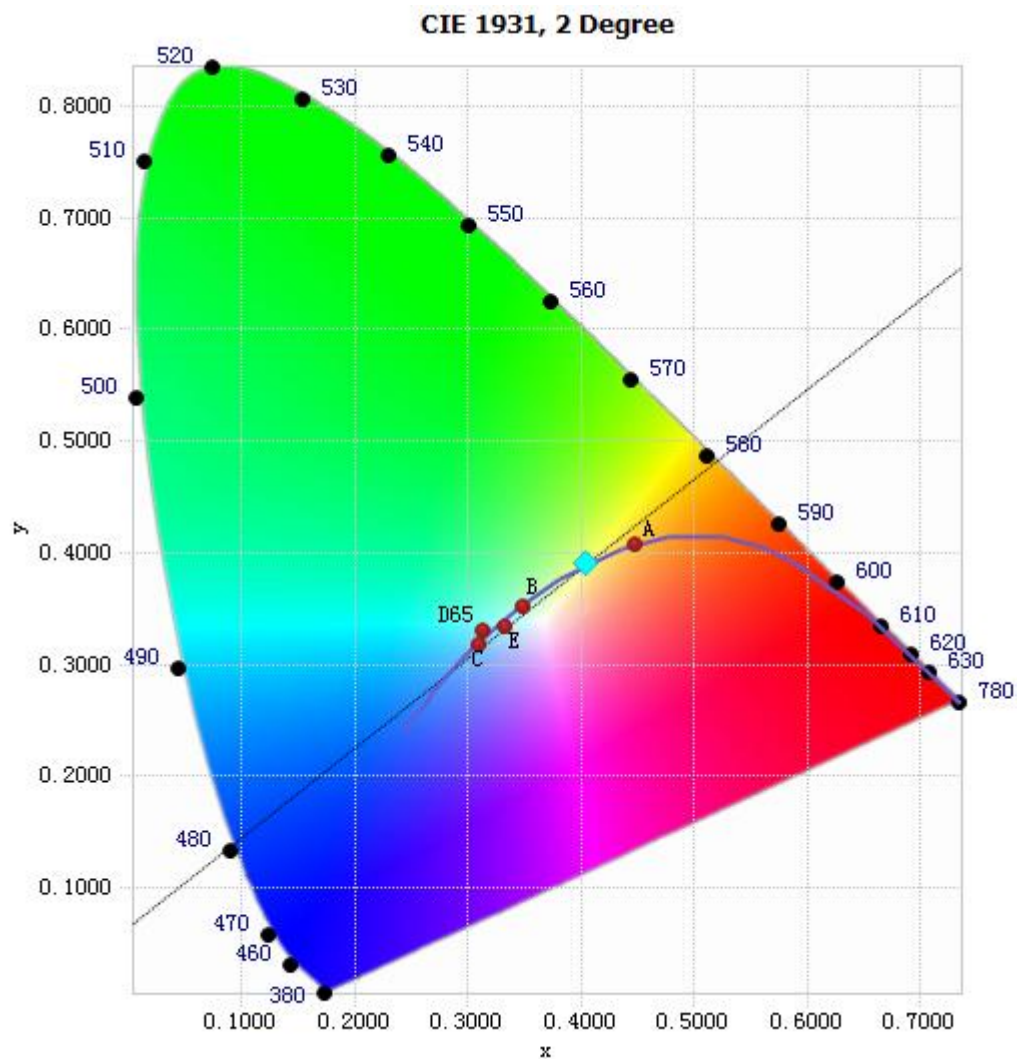


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.11E-04	485	7.68E-03	590	2.95E-02	695	4.59E-03
385	1.08E-04	490	8.59E-03	595	2.99E-02	700	3.92E-03
390	1.08E-04	495	1.01E-02	600	2.99E-02	705	3.34E-03
395	1.00E-04	500	1.19E-02	605	2.96E-02	710	2.85E-03
400	7.53E-05	505	1.36E-02	610	2.89E-02	715	2.45E-03
405	7.10E-05	510	1.49E-02	615	2.80E-02	720	2.07E-03
410	1.09E-04	515	1.61E-02	620	2.66E-02	725	1.78E-03
415	2.27E-04	520	1.70E-02	625	2.51E-02	730	1.51E-03
420	4.81E-04	525	1.77E-02	630	2.34E-02	735	1.28E-03
425	1.04E-03	530	1.83E-02	635	2.15E-02	740	1.09E-03
430	2.19E-03	535	1.89E-02	640	1.96E-02	745	9.26E-04
435	4.41E-03	540	1.96E-02	645	1.77E-02	750	7.96E-04
440	8.42E-03	545	2.04E-02	650	1.59E-02	755	6.76E-04
445	1.64E-02	550	2.12E-02	655	1.41E-02	760	5.75E-04
450	2.66E-02	555	2.22E-02	660	1.25E-02	765	4.90E-04
455	2.48E-02	560	2.32E-02	665	1.10E-02	770	4.19E-04
460	1.60E-02	565	2.44E-02	670	9.57E-03	775	3.54E-04
465	1.29E-02	570	2.56E-02	675	8.33E-03	780	3.07E-04
470	1.03E-02	575	2.68E-02	680	7.22E-03		
475	7.66E-03	580	2.79E-02	685	6.23E-03		
480	7.08E-03	585	2.89E-02	690	5.36E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4046, 0.3902)

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

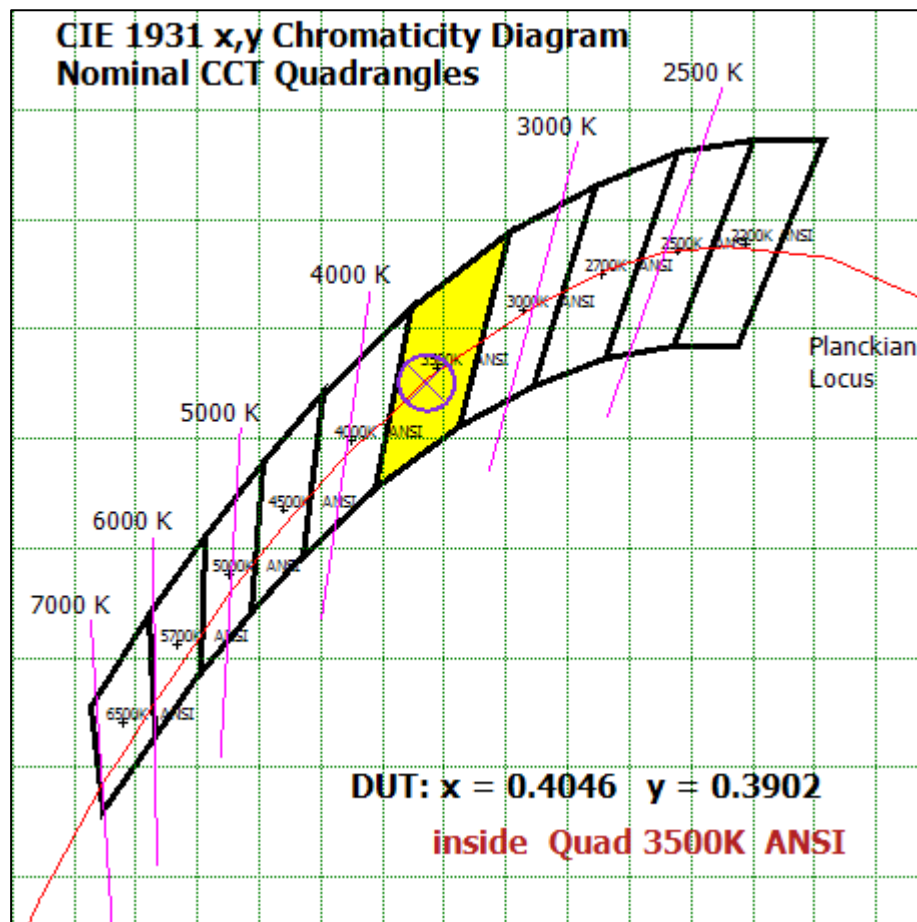


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

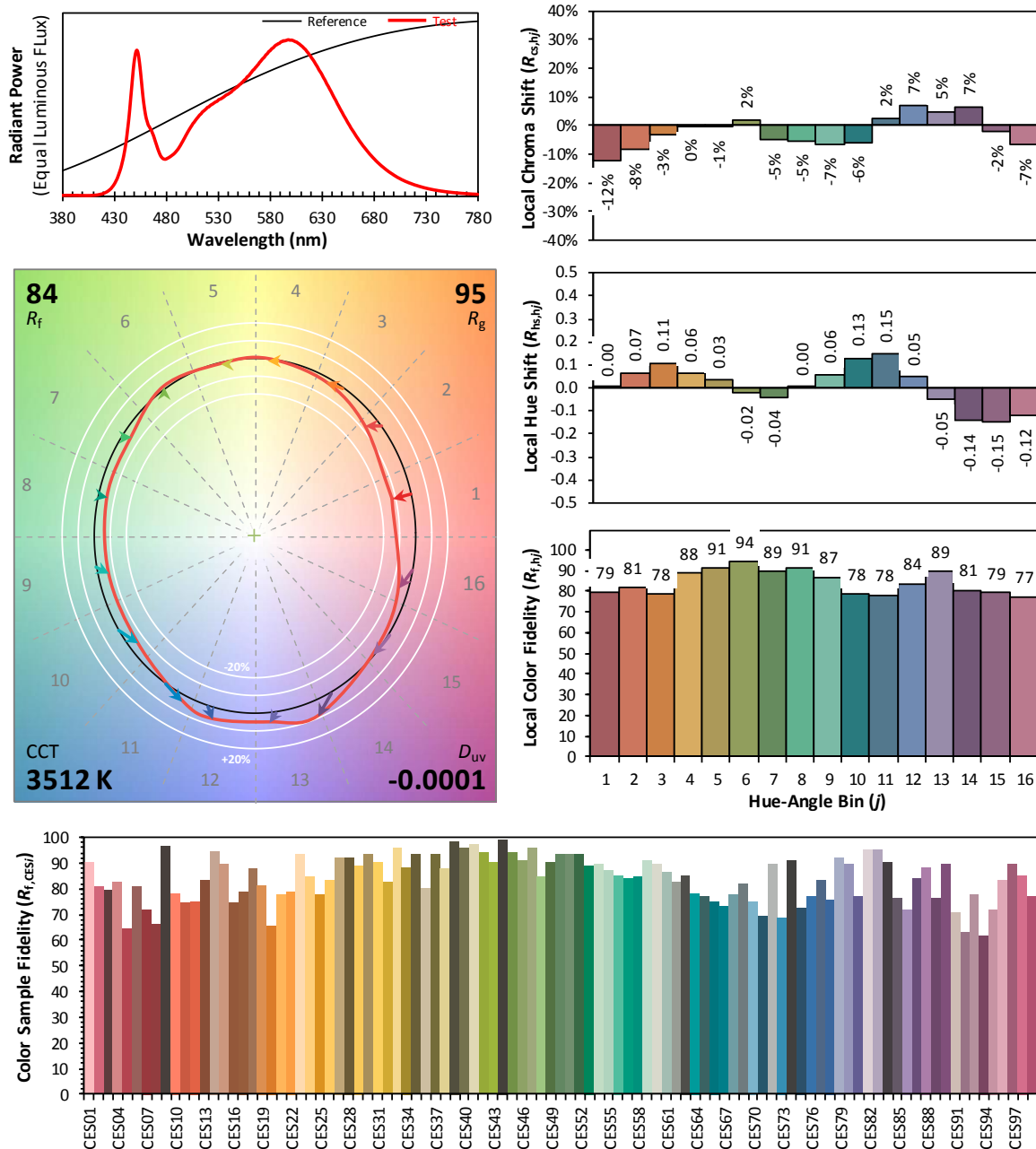


Chart 4: Full Report Created with the IES TM-30 Calculator

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	34.46	2.18%
10- 20	99.571	6.29%
20- 30	153.658	9.70%
30- 40	190.952	12.05%
40- 50	208.024	13.13%
50- 60	204.419	12.90%
60- 70	183.027	11.55%
70- 80	149.77	9.45%
80- 90	113.847	7.19%
90-100	84.242	5.32%
100-110	60.874	3.84%
110-120	41.886	2.64%
120-130	27.093	1.71%
130-140	16.526	1.04%
140-150	9.238	0.58%
150-160	4.515	0.29%
160-170	1.721	0.11%
170-180	0.368	0.02%
Total	1584.2	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	891.084	56.25%
60- 90	446.644	28.19%
0-90	1337.728	84.44%
90- 180	246.463	15.56%
0- 180	1584.2	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

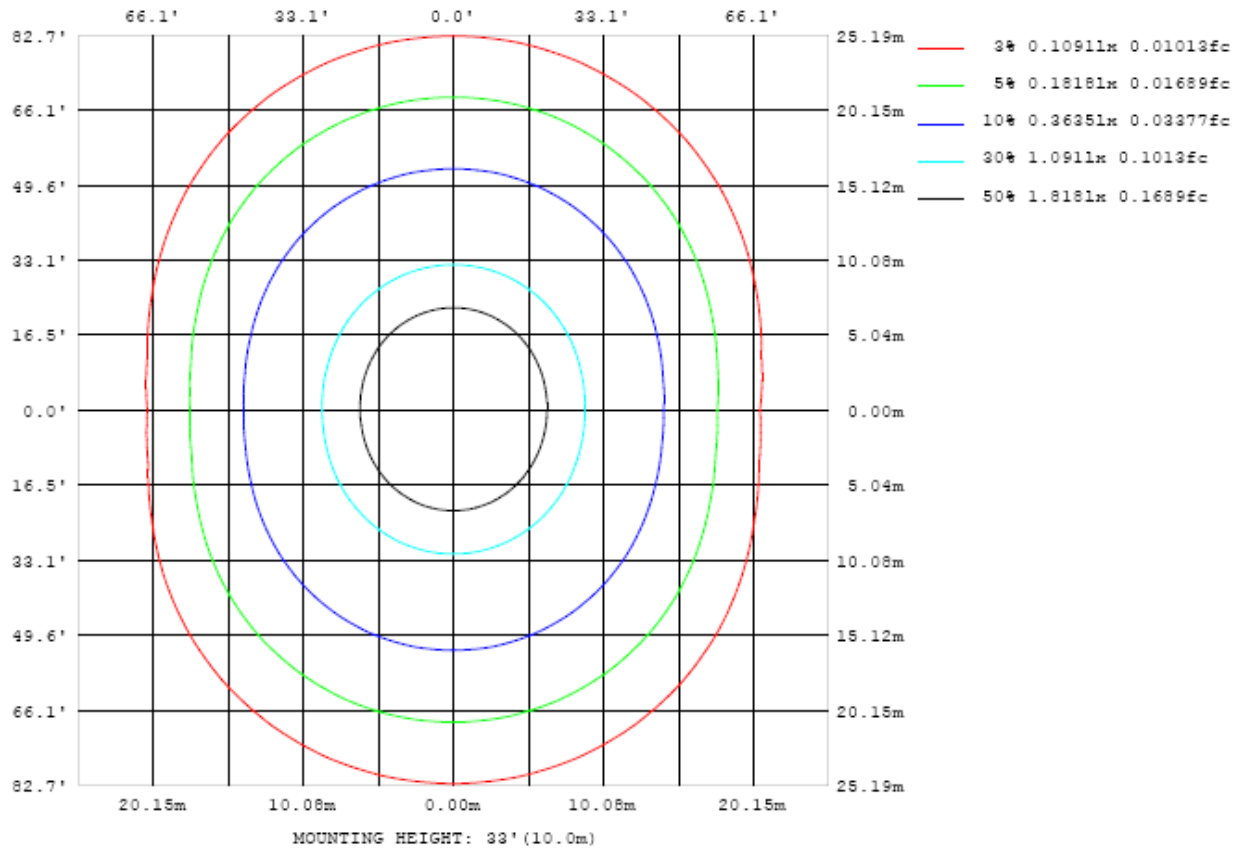


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

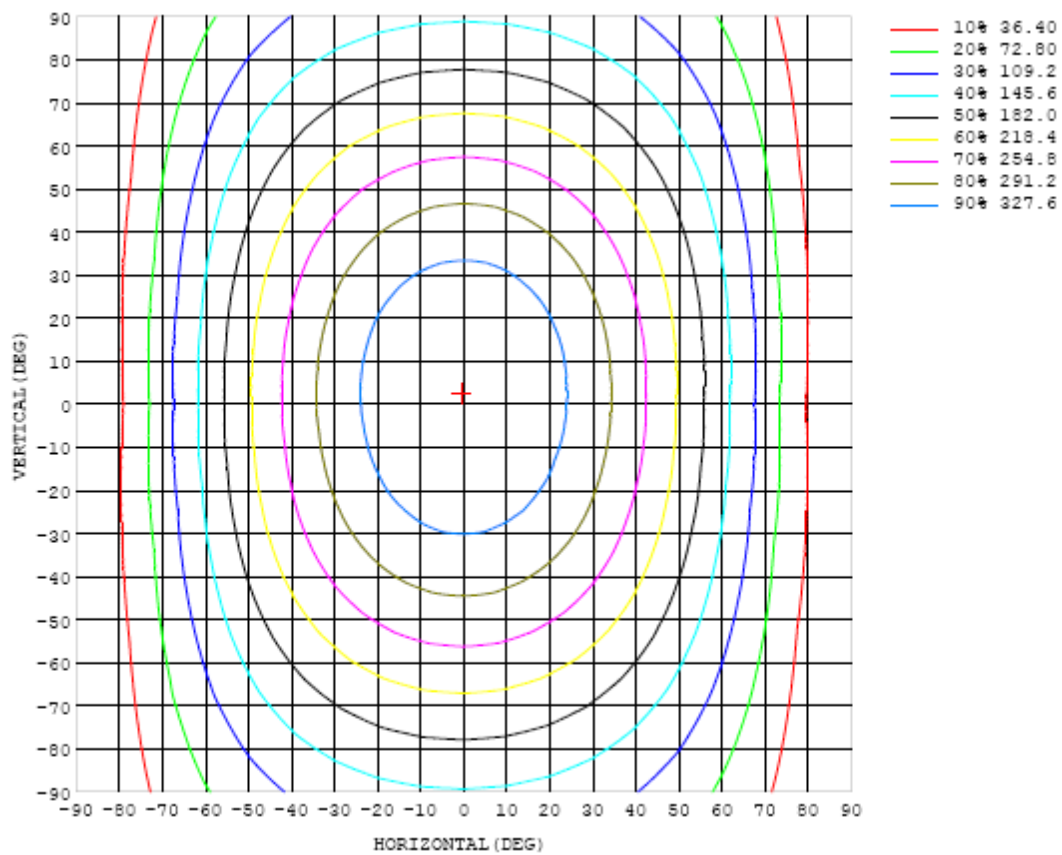


Chart 6: Isocandela Plot

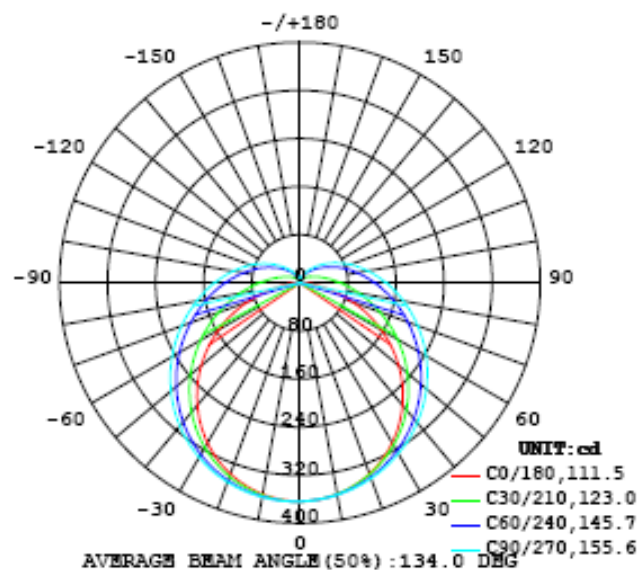


Chart 7: Polar Candela Distribution

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	364	364	364	364	364	364	364	364	364	364	364	364	364	364	364	364	364	364	364
5	362	362	361	361	361	362	362	362	362	362	362	362	362	362	362	362	362	362	362
10	357	357	357	357	357	357	358	358	358	358	358	358	358	357	357	357	357	357	357
15	349	349	349	349	350	351	352	352	353	353	353	353	352	351	350	350	349	349	349
20	338	338	338	339	341	342	344	345	346	346	346	345	344	343	341	339	338	338	338
25	324	324	325	327	329	332	334	336	337	338	337	336	334	332	329	327	325	324	324
30	307	307	309	312	315	319	323	325	327	328	328	326	323	320	316	312	309	307	308
35	287	288	291	295	300	305	310	313	316	316	316	314	310	306	301	296	291	288	288
40	266	266	270	276	283	289	295	300	303	304	303	300	296	290	283	277	271	266	266
45	241	242	248	255	264	272	279	285	289	290	289	286	280	273	265	256	248	242	241
50	215	217	224	233	245	254	263	269	273	275	274	270	264	256	245	235	224	217	214
55	186	189	199	211	224	236	245	253	257	259	258	254	247	237	225	212	199	189	186
60	156	161	172	188	203	216	228	236	241	243	241	237	229	218	204	189	173	160	156
65	125	131	146	164	182	197	209	218	224	225	224	219	211	199	184	166	147	131	125
70	93.4	101	120	141	161	178	191	201	207	209	207	202	193	180	163	144	122	101	92.5
75	62.4	72.4	95.5	120	142	160	174	184	190	192	190	185	175	162	144	122	97.8	73.2	60.8
80	33.4	46.8	73.3	99.8	123	142	156	167	173	175	174	168	158	144	126	103	76.2	48.6	31.6
85	10.4	26.2	55.0	82.3	106	125	140	151	157	159	157	152	142	128	109	85.6	58.5	29.1	8.85
90	0.20	13.6	40.5	67.6	90.9	110	125	135	141	144	142	136	126	112	93.7	70.3	44.2	16.8	0.11
95	0.25	7.51	30.1	55.1	77.4	96.0	110	121	127	129	127	122	112	98.4	80.3	58.7	33.7	10.2	0.25
100	0.38	5.16	22.5	44.8	66.0	83.2	97.1	107	113	115	113	108	98.9	85.6	68.7	48.3	25.8	7.32	0.39
105	0.57	4.13	17.5	36.3	55.5	71.7	84.7	94.1	99.8	102	100	95.3	86.5	74.0	58.4	39.4	20.4	5.88	0.62
110	0.77	3.77	14.3	29.6	46.2	61.4	73.2	82.0	87.5	89.5	88.1	83.3	75.0	63.7	48.8	32.4	16.8	5.23	0.88
115	1.04	3.65	11.9	24.5	38.4	51.6	62.8	70.7	75.8	77.6	76.4	71.9	64.5	53.7	40.8	27.1	14.2	4.93	1.21
120	1.34	3.64	10.2	20.6	32.2	43.3	52.8	60.3	65.0	66.7	65.5	61.4	54.3	45.2	34.4	22.8	12.3	4.74	1.56
125	1.65	3.55	9.07	17.3	27.0	36.4	44.5	50.7	54.7	56.2	55.2	51.7	45.9	38.2	29.0	19.4	10.8	4.56	1.91
130	1.96	3.47	8.17	14.7	22.7	30.4	37.3	42.6	46.1	47.3	46.5	43.5	38.6	32.0	24.4	16.6	9.60	4.33	2.21
135	2.27	3.42	7.39	12.7	19.0	25.3	31.0	35.4	38.3	39.4	38.7	36.2	32.1	26.7	20.5	14.2	8.61	4.26	2.43
140	2.49	3.46	6.59	10.9	15.9	20.9	25.5	29.1	31.5	32.4	31.8	29.8	26.5	22.1	17.1	12.2	7.33	4.15	2.65
145	2.65	3.48	6.02	9.47	13.3	17.2	20.7	23.6	25.5	26.2	25.8	24.2	21.5	18.1	14.3	10.4	6.58	4.10	2.83
150	2.77	3.68	5.40	8.03	11.0	13.9	16.6	18.8	20.2	20.8	20.5	19.3	17.3	14.7	11.8	8.84	6.05	4.07	2.95
155	2.77	3.56	4.88	6.82	8.94	11.2	13.1	14.7	15.7	16.2	15.9	15.1	13.7	11.8	9.64	6.90	5.33	3.94	2.99
160	2.70	3.15	4.45	5.74	7.33	8.76	10.1	11.3	12.0	12.3	12.1	11.6	10.6	9.13	7.09	5.70	4.47	3.58	2.92
165	2.58	2.83	3.60	4.91	5.81	6.82	7.72	8.38	8.91	9.14	9.07	8.72	7.79	6.19	5.20	4.22	3.63	3.14	2.78
170	2.60	2.69	2.92	3.54	4.43	5.08	5.52	6.03	6.34	6.47	6.39	5.59	4.64	3.93	3.86	3.61	3.30	2.95	2.79
175	3.24	3.32	3.36	3.40	3.59	3.75	3.81	3.97	4.57	4.63	3.33	2.92	3.48	3.62	3.59	3.57	3.51	3.40	3.33
180	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31

Table 6: Luminous Intensity Data

Table--2

UNIT: cd

C (DEG) γ (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	364	364	364	364	364	364	364	364	364	364	364	364	364	364	364	364	364		
5	362	362	363	363	363	363	363	364	364	364	363	363	363	363	363	362	362		
10	358	358	359	360	360	361	361	362	362	362	362	361	360	359	359	358	358		
15	350	351	352	354	355	356	357	358	358	358	357	356	355	353	352	351	350		
20	339	341	343	346	347	350	351	352	353	352	352	350	348	345	343	341	339		
25	326	328	331	335	338	341	343	344	345	345	343	341	338	334	331	328	325		
30	309	312	316	321	326	330	333	335	335	335	333	329	326	321	317	313	309		
35	290	294	300	306	312	317	321	323	324	323	321	317	312	306	300	294	290		
40	268	274	281	289	296	302	307	310	311	310	307	302	296	289	281	274	269		
45	244	251	260	269	278	286	291	295	296	295	292	286	279	270	261	252	245		
50	218	227	238	249	260	269	275	279	280	279	275	269	260	250	239	228	219		
55	191	201	215	228	240	250	257	262	263	262	258	251	241	229	216	203	192		
60	162	175	191	206	220	231	239	244	246	244	239	232	221	207	192	177	164		
65	132	149	167	185	200	212	221	226	228	226	221	212	201	186	169	151	135		
70	102	122	144	163	180	193	202	208	210	208	203	194	181	165	146	125	105		
75	72.7	96.8	122	144	161	175	184	190	192	190	185	175	162	145	124	100	76.6		
80	46.6	74.1	101	124	143	157	167	172	174	173	167	158	144	126	104	77.6	50.7		
85	26.2	55.1	82.8	107	126	140	150	156	158	157	151	141	127	108	85.3	58.4	30.0		
90	13.8	40.5	67.3	90.9	110	124	134	140	142	140	135	125	111	92.4	69.7	43.3	16.6		
95	7.60	29.9	54.6	77.0	95.3	109	119	125	127	125	120	110	96.3	78.4	56.6	32.2	9.37		
100	5.26	22.4	44.3	64.9	82.3	95.7	105	111	113	111	106	96.1	83.1	66.2	46.0	24.3	6.11		
105	4.17	17.3	35.8	54.5	70.6	83.2	92.2	97.6	99.4	97.8	92.5	83.6	71.3	55.6	37.2	18.4	4.64		
110	3.80	13.8	28.8	45.2	60.0	71.8	80.2	85.3	86.9	85.4	80.4	72.2	60.7	46.2	29.8	14.6	4.02		
115	3.66	11.6	23.8	37.2	50.2	61.1	68.9	73.6	75.3	73.8	69.2	61.4	50.8	37.9	24.3	11.9	3.73		
120	3.61	9.96	19.8	31.0	41.7	51.0	58.2	62.6	64.0	62.7	58.4	51.3	42.0	31.3	20.1	9.96	3.62		
125	3.64	8.74	16.7	25.9	34.8	42.6	48.5	52.2	53.5	52.3	48.6	42.7	35.0	26.0	16.8	8.66	3.59		
130	3.69	7.78	14.0	21.6	29.0	35.5	40.4	43.5	44.6	43.6	40.4	35.4	29.0	21.6	13.9	7.68	3.62		
135	3.73	6.83	12.0	18.0	24.0	29.3	33.4	36.0	36.9	36.0	33.4	29.2	23.9	17.9	11.8	6.92	3.69		
140	3.76	6.34	10.2	14.9	19.7	23.9	27.3	29.4	30.1	29.3	27.2	23.9	19.6	14.7	10.1	6.33	3.78		
145	3.83	5.85	8.78	12.3	16.0	19.3	21.9	23.6	24.1	23.6	21.9	19.2	16.0	12.2	8.72	5.83	3.87		
150	3.96	5.42	7.28	10.1	12.8	15.3	17.3	18.5	19.0	18.6	17.3	15.3	12.8	10.1	7.57	5.46	3.94		
155	3.81	4.89	6.22	8.13	10.1	11.9	13.2	14.1	14.5	14.2	13.3	12.0	10.3	8.44	6.67	5.19	3.93		
160	3.27	4.09	5.16	6.32	7.89	9.05	9.98	10.6	10.9	10.8	10.2	9.39	8.32	7.14	5.99	4.99	3.73		
165	2.78	3.38	3.83	4.49	5.38	6.67	7.45	7.85	8.05	8.04	7.79	7.35	6.76	6.10	5.40	4.75	3.40		
170	2.75	2.93	3.32	3.62	3.72	4.08	4.74	5.79	6.02	6.04	5.94	5.75	5.40	5.00	4.63	3.91	3.03		
175	3.13	3.11	3.31	3.33	3.36	3.35	3.03	2.92	3.96	4.55	4.61	4.30	4.02	3.69	3.42	3.30	3.22		
180	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31		

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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