



LM-79-08 Test Report

for

ESPEN TECHNOLOGY, INC.

SANTA FE SPRINGS CA 90670 USA 562-529-2938

LED LAMP

Model: LT40W/835-ID

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ16080008i

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

Review by:

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Aug. 04, 2016

Approved by:



Manager: Jim Zhang
Aug. 04, 2016

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: **LT40W/835-ID**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
111.5	1935.0	17.36	0.9666
CCT (K)	CRI	Stabilization Time (Light & Power)	
3396	84.6	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	: Mar. 09, 2016
Date of Test	: Mar. 15, 2016
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

TABLE OF CONTENT

LM-79-08 Test Report.....	1
Test Summary.....	2
Sample Photos.....	4
TEST RESULTS	5
Goniophotometer Method	6
Spectral Power Distribution - Sphere Spectroradiometer Method	7
Chromaticity Diagram - Sphere Spectroradiometer Method.....	8
Nominal CCT Quadrangles – Sphere Spectroradiometer Method	9
Zonal Lumen Tabulation- Goniophotometer Method	10
Illuminance Plots- Goniophotometer Method	11
Luminous Intensity Distribution Plots- Goniophotometer Method.....	13
Luminous Intensity Data- Goniophotometer Method.....	14
EQUIPMENT LIST	16
TEST METHODS	16
Seasoning of SSL Product.....	16
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements.....	16
Goniophotometer Method	17
Photometric and Electrical Measurements.....	17
Color Characteristics Measurements.....	17
Color Spatial Uniformity	17

Sample Photos



Figure 1- Overview of the sample

Equipment Under Test (EUT)

Name	: LED LAMP
Model	: LT40W/835-ID
Electrical Ratings	: 120-277V, 60Hz, 18W
Product Description	: 2G11 base, fixed end caps, 3500K, Frosted lens
Manufacturer	: ESPEN TECHNOLOGY, INC.
Address	: SANTA FE SPRINGS CA 90670 USA 562-529-2938

TEST RESULTS

Test ambient temperature was 24.5°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)	0.150	0.070
Power Factor	0.9666	0.8974
Test Power (W)	17.36	17.44
THD A%	23.72	16.09
Luminous Efficacy (lm/W)	111.5	111.6
Total Luminous Flux (lm)	1935.0	1946.0
Color Rendering Index (CRI)	84.6	
R9	14.8	
Correlated Color Temperature (CCT)(K)	3396	
Chromaticity Chroma x	0.4093	
Chromaticity Chroma y	0.3889	
Chromaticity Chroma u	0.2391	
Chromaticity Chroma v	0.3407	
Duv	0.0021	
Chromaticity Chroma u'	0.2391	
Chromaticity Chroma v'	0.5111	

Special Color Rendering Indices	
R1	83.6
R2	92.8
R3	95.9
R4	82.5
R5	84
R6	90.5
R7	84
R8	63.4
R9	14.8
R10	83
R11	82
R12	72
R13	86.2
R14	98.5

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 24.2°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)	0.150
Power Factor	0.9666
Test Power (W)	17.43
Luminous Efficacy (lm/W)	110.5
Total Luminous Flux (lm)	1925.8
Beam Angle (°)	114.3
Center Beam Candle Power (cd)	565
Spacing Criteria	1.22 (0°-180°)/ 1.27 (90°-270°)
Zonal Lumens in the 0°-60°Zone	65.49%
Zonal Lumens in the 60°-90°Zone	23.49%
Zonal Lumens in the 90°-120°Zone	6.82%
Zonal Lumens in the 120°-180°Zone	4.20%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

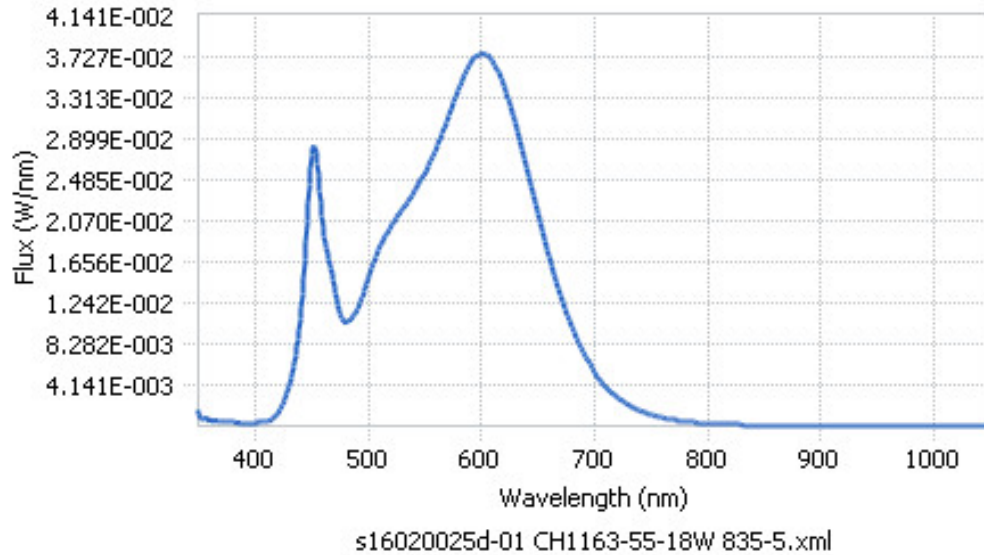
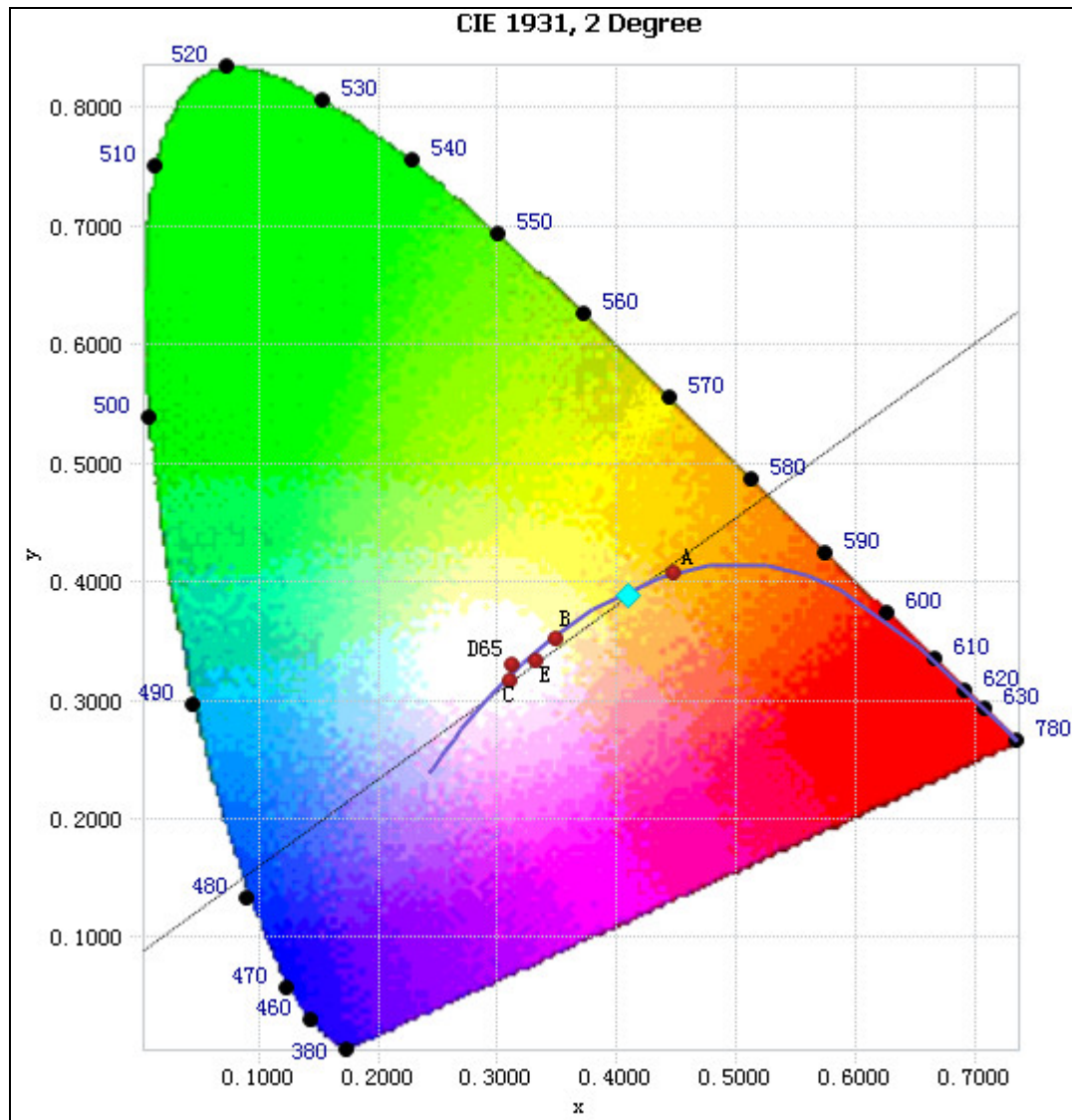


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.68E-04	485	1.09E-02	590	3.65E-02	695	6.35E-03
385	3.51E-04	490	1.18E-02	595	3.72E-02	700	5.42E-03
390	3.26E-04	495	1.31E-02	600	3.76E-02	705	4.65E-03
395	3.23E-04	500	1.50E-02	605	3.74E-02	710	3.97E-03
400	3.39E-04	505	1.66E-02	610	3.69E-02	715	3.41E-03
405	3.70E-04	510	1.81E-02	615	3.58E-02	720	2.93E-03
410	4.34E-04	515	1.94E-02	620	3.42E-02	725	2.50E-03
415	6.60E-04	520	2.02E-02	625	3.26E-02	730	2.13E-03
420	1.26E-03	525	2.09E-02	630	3.06E-02	735	1.82E-03
425	2.31E-03	530	2.18E-02	635	2.83E-02	740	1.55E-03
430	3.96E-03	535	2.25E-02	640	2.60E-02	745	1.32E-03
435	6.54E-03	540	2.35E-02	645	2.37E-02	750	1.13E-03
440	1.07E-02	545	2.44E-02	650	2.14E-02	755	9.78E-04
445	1.86E-02	550	2.54E-02	655	1.91E-02	760	8.40E-04
450	2.73E-02	555	2.67E-02	660	1.69E-02	765	7.25E-04
455	2.65E-02	560	2.79E-02	665	1.49E-02	770	6.18E-04
460	2.01E-02	565	2.95E-02	670	1.30E-02	775	5.33E-04
465	1.68E-02	570	3.08E-02	675	1.14E-02	780	4.55E-04
470	1.41E-02	575	3.26E-02	680	9.88E-03		
475	1.13E-02	580	3.40E-02	685	8.56E-03		
480	1.05E-02	585	3.55E-02	690	7.40E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4093, 0.3889)

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

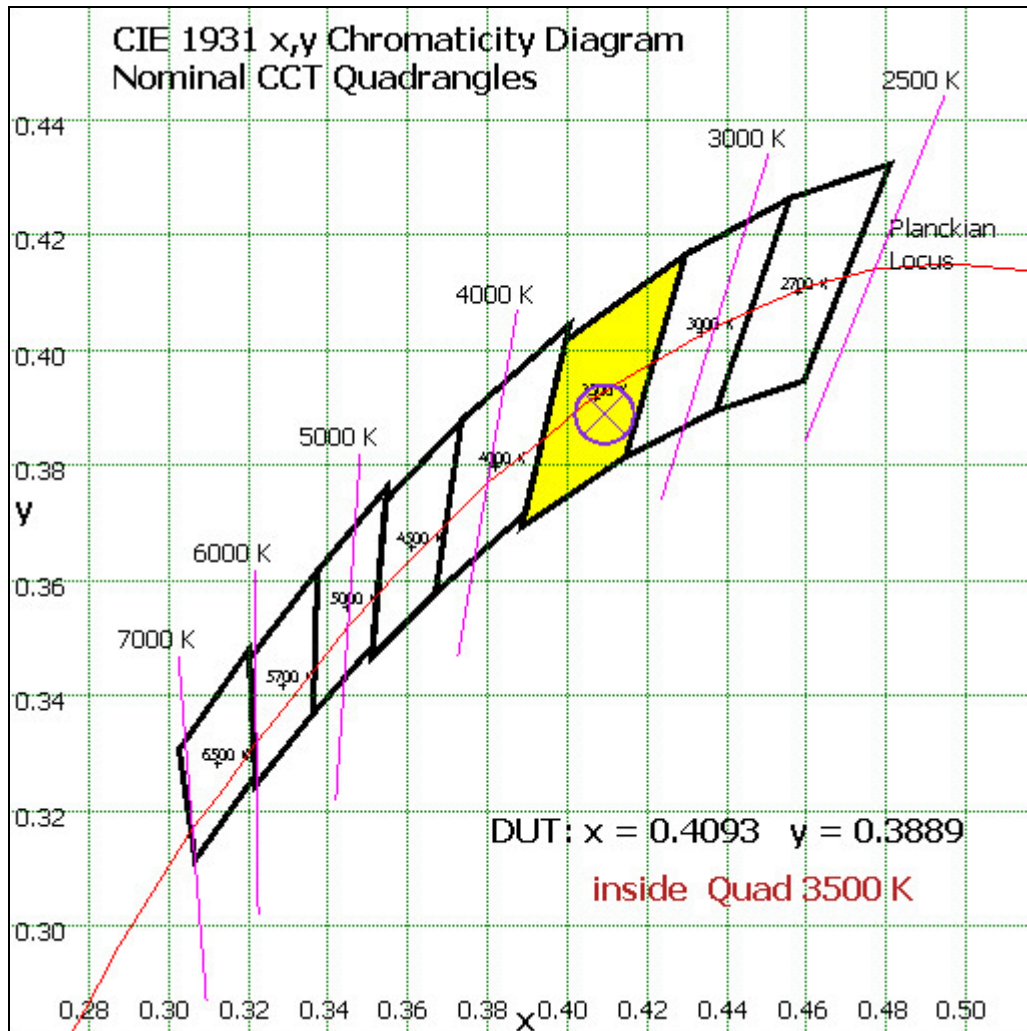


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

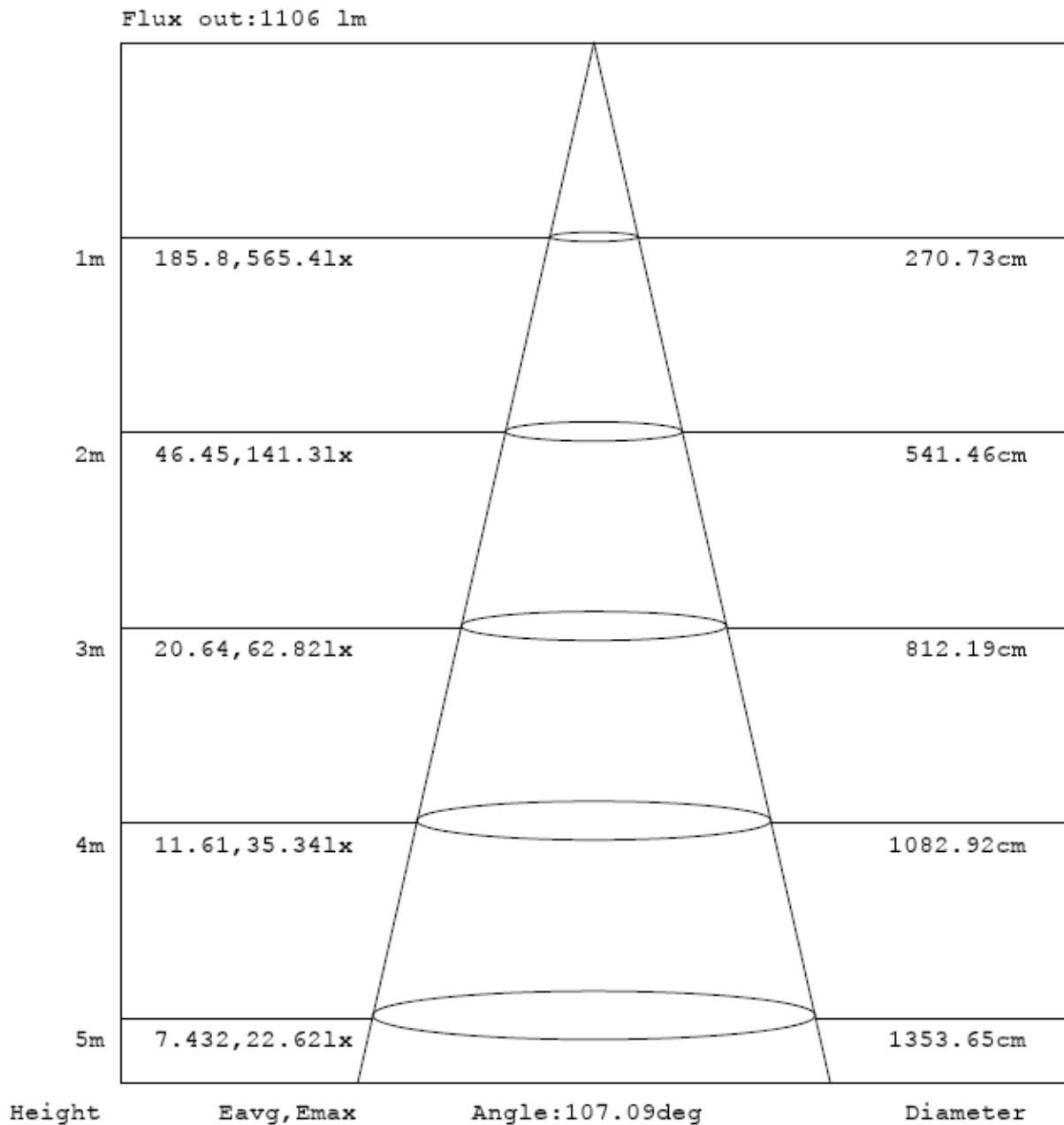
Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	53.366	2.77%
10- 20	152.077	7.90%
20- 30	228.783	11.88%
30- 40	274.553	14.26%
40- 50	286.418	14.87%
50- 60	266.01	13.81%
60- 70	217.954	11.32%
70- 80	150.572	7.82%
80- 90	83.923	4.36%
90-100	54.338	2.82%
100-110	43.188	2.24%
110-120	33.716	1.75%
120-130	26.155	1.36%
130-140	20.46	1.06%
140-150	15.678	0.81%
150-160	10.934	0.57%
160-170	6.154	0.32%
170-180	1.495	0.08%
Total	1925.8	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1261.207	65.49%
60- 90	452.449	23.49%
0-90	1713.656	88.99%
90- 180	212.118	11.01%
0- 180	1925.8	100%

Table 5: Zonal Lumen Data

Illuminance Plots- Goniophotometer Method



Note:The Curves indicate the illuminated area and the average illumination when the luminaire is at different distance.

Chart 4: Beam Angle

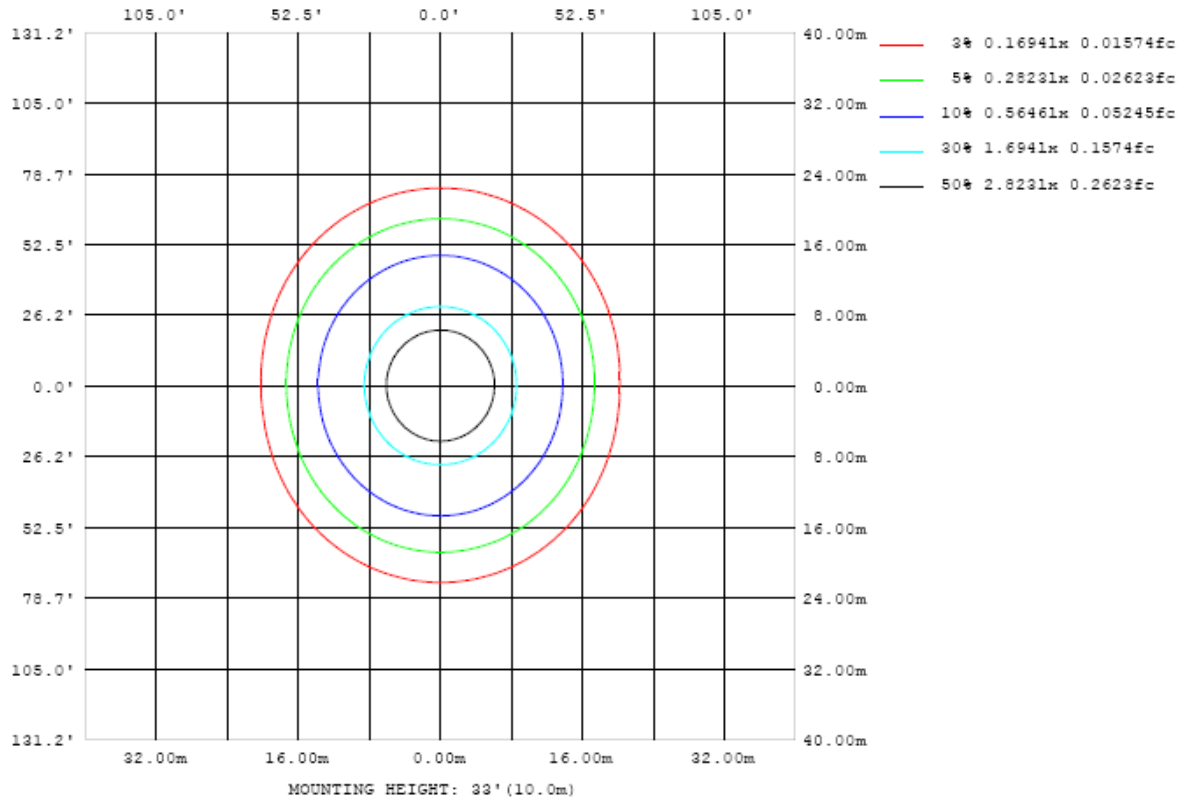


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

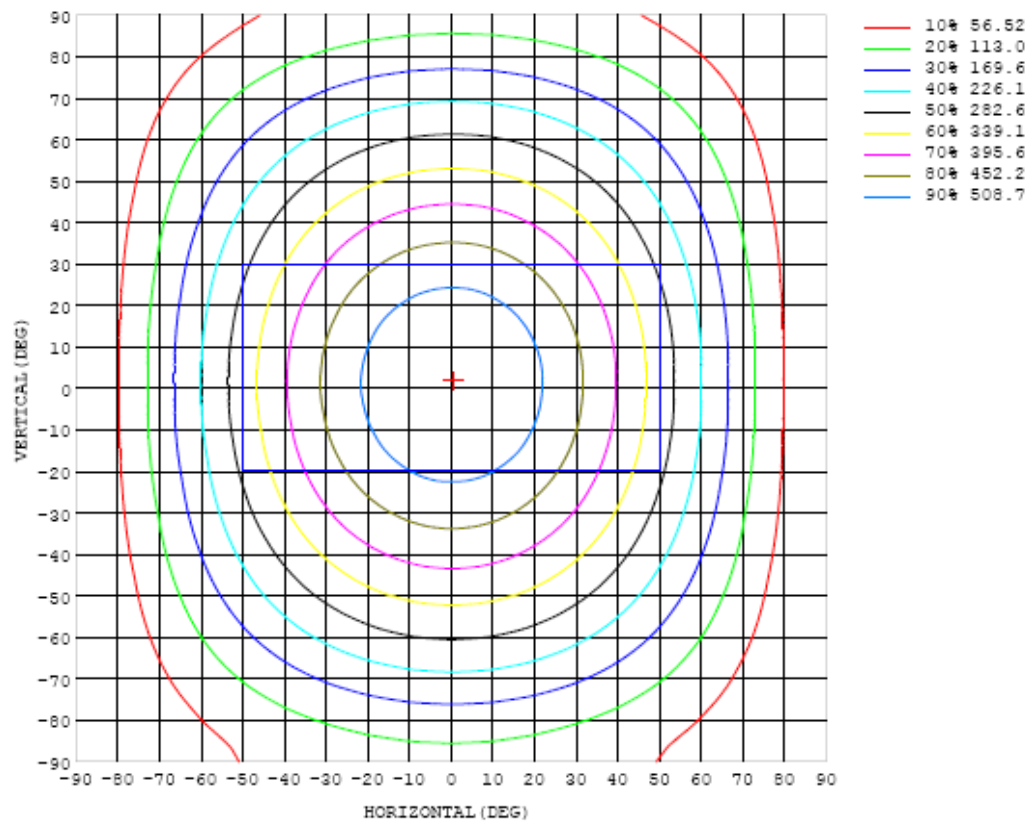


Chart 6: Isocandela Plot

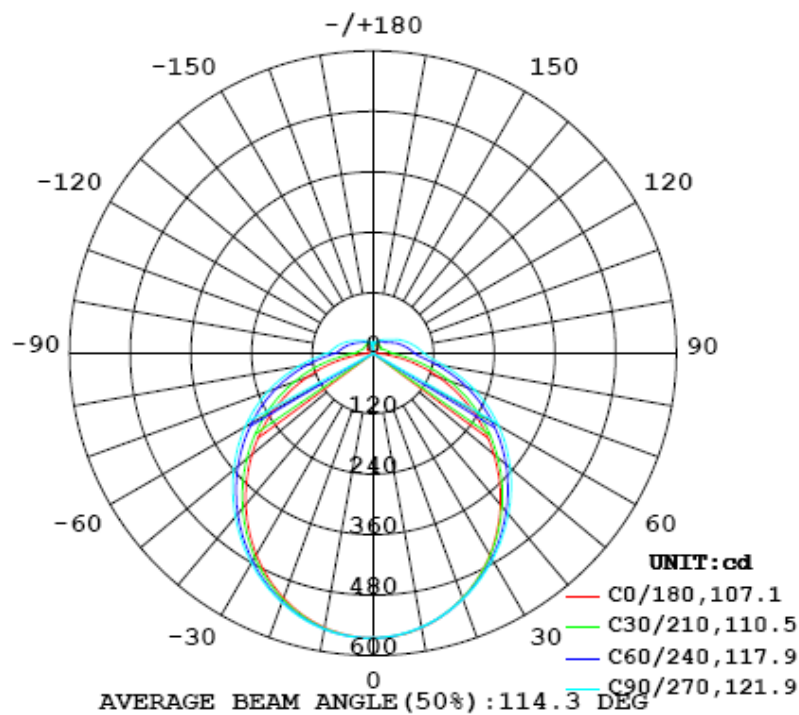


Chart 7: Polar Candela Distribution

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	565	565	565	565	565	565	565	565	565	565	565	565	565	565	565	565	565	565	565
5	562	562	561	562	561	561	561	561	561	561	561	561	561	561	561	561	561	561	562
10	553	552	552	552	552	552	552	552	552	552	551	551	551	551	551	551	551	552	552
15	538	537	537	537	537	538	538	537	538	537	537	537	537	536	536	535	536	536	537
20	517	517	517	517	517	518	519	519	519	519	519	518	518	517	516	515	515	515	517
25	492	492	491	492	493	494	496	497	497	497	497	496	495	493	492	490	490	490	491
30	462	462	462	464	465	467	470	471	472	472	472	470	468	466	464	462	460	460	462
35	428	428	429	431	434	437	441	443	445	445	444	443	440	436	433	430	428	426	428
40	392	392	393	397	401	405	410	413	416	416	415	413	409	404	400	395	392	390	392
45	353	353	356	360	365	371	377	382	385	386	385	381	376	370	364	359	354	352	353
50	312	313	316	322	329	336	343	349	353	354	352	348	342	335	328	320	315	311	312
55	270	271	275	282	291	300	308	315	320	321	319	314	307	299	290	281	274	270	270
60	227	228	234	242	252	262	272	280	285	286	284	279	271	262	251	241	233	227	227
65	183	185	192	202	213	225	235	244	249	251	249	243	235	224	212	201	191	184	183
70	138	141	150	161	174	187	198	207	212	214	212	206	197	186	174	161	149	140	139
75	94.4	98.2	108	122	136	149	161	170	176	178	176	170	160	149	135	121	108	97.4	95.3
80	53.9	58.5	70.6	85.2	100	114	126	136	142	144	141	135	126	114	100	85.4	70.9	58.4	54.5
85	19.6	25.9	39.6	55.6	70.6	85.2	97.8	108	114	116	114	108	98.3	86.0	71.8	56.9	41.0	27.0	21.0
90	0.28	8.39	22.9	39.2	55.4	70.0	82.8	92.6	98.9	101	99.1	93.5	84.3	72.0	58.0	42.2	26.2	11.5	3.24
95	0.54	5.30	18.3	33.6	49.0	62.9	75.1	84.5	90.4	92.4	90.7	85.3	76.6	65.0	51.6	36.6	21.6	8.64	3.55
100	1.50	4.41	15.2	29.1	43.4	56.8	68.0	76.9	82.4	84.4	82.7	77.7	69.4	58.9	46.0	32.1	18.5	7.87	4.43
105	2.90	5.48	13.4	25.3	38.4	50.8	61.2	69.4	74.6	76.5	75.0	70.2	62.6	52.8	41.0	28.4	16.7	8.74	5.84
110	4.39	5.81	11.7	22.3	33.9	45.2	55.1	62.3	67.2	68.9	67.5	63.2	56.5	47.3	36.5	25.4	14.8	9.97	7.61
115	6.10	7.33	12.8	20.5	30.1	40.0	49.0	56.0	60.2	61.7	61.4	56.8	50.4	42.0	32.8	23.3	16.0	11.3	9.57
120	8.18	8.87	14.0	18.1	27.3	35.6	43.3	49.5	53.6	55.0	53.9	50.3	44.7	37.6	29.5	21.3	16.9	12.7	11.4
125	10.2	10.4	14.3	19.8	24.1	32.3	38.5	43.7	47.2	48.5	47.5	44.5	39.7	33.8	27.3	22.5	17.7	14.0	13.2
130	12.2	11.2	15.1	20.3	24.6	28.7	35.0	39.0	41.7	42.7	41.9	39.5	36.0	31.6	27.2	22.6	18.6	15.3	14.9
135	13.9	12.7	16.8	20.1	24.7	28.3	31.4	34.9	37.7	38.5	37.9	36.2	33.6	30.2	26.5	22.7	19.5	16.5	16.5
140	15.5	15.0	17.8	20.1	24.1	27.6	30.6	32.9	34.5	35.3	35.0	33.7	31.6	28.9	25.9	22.9	20.3	17.6	18.0
145	17.2	16.2	18.7	21.0	23.3	26.5	29.0	31.0	32.3	32.8	32.4	31.4	29.8	27.7	25.4	23.1	21.0	18.5	19.1
150	18.2	16.5	19.2	21.5	23.2	25.2	27.4	29.0	30.0	30.4	30.2	29.4	28.2	26.6	24.9	23.2	21.3	19.0	19.8
155	18.7	16.5	19.9	21.7	23.2	24.5	25.8	27.1	27.9	28.3	28.2	27.6	26.8	25.7	24.5	23.3	21.3	19.0	20.2
160	19.0	15.9	20.8	21.8	22.9	24.0	24.9	25.5	26.1	26.3	26.3	26.0	25.4	24.7	24.0	22.5	22.1	19.0	20.1
165	16.8	14.9	19.1	22.4	22.2	22.5	23.7	24.4	24.7	24.9	24.9	24.7	24.4	23.2	22.6	23.1	21.4	16.7	18.2
170	13.8	11.8	12.7	14.8	20.8	23.3	23.2	22.4	22.2	22.4	22.4	22.4	22.4	21.0	19.0	17.4	14.8	14.0	15.4
175	11.4	10.5	9.98	9.76	9.45	10.8	14.7	18.5	20.5	20.3	18.1	14.1	12.9	12.3	12.3	12.3	12.4	12.4	12.4
180	14.7	14.6	14.0	13.0	11.0	7.39	7.09	6.60	0.00	0.00	0.00	1.70	6.12	10.3	12.1	12.9	16.6	16.8	14.8

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	565	565	565	565	565	565	565	565	565	565	565	565	565	565	565	565	565		
5	562	562	563	562	563	563	563	564	563	563	563	563	563	563	562	563	563		
10	553	553	554	554	555	556	556	556	556	556	556	556	555	556	554	554	554		
15	538	539	540	541	542	543	543	544	544	544	544	543	542	542	540	540	539		
20	518	519	520	522	523	525	525	527	527	527	526	526	524	523	521	520	519		
25	492	494	496	498	500	502	504	505	506	505	505	503	502	500	497	496	494		
30	463	465	468	470	474	476	478	480	481	481	480	478	475	472	469	467	464		
35	429	432	436	439	444	448	450	453	453	453	451	449	445	441	437	434	431		
40	393	396	401	406	411	416	420	423	424	423	421	417	413	408	402	398	395		
45	355	359	364	370	377	383	388	391	392	392	389	384	378	372	366	361	356		
50	315	319	326	334	341	349	354	359	360	359	355	350	343	335	327	321	316		
55	273	279	287	296	305	313	320	325	326	325	321	315	306	297	288	280	274		
60	230	237	247	257	268	277	285	290	292	291	286	278	269	259	248	239	232		
65	187	195	206	218	230	241	249	255	257	255	250	242	231	220	207	197	188		
70	143	153	166	179	192	204	213	219	221	219	214	205	194	181	167	155	145		
75	101	112	127	141	155	167	176	182	185	183	177	168	156	143	128	114	102		
80	60.9	74.4	89.7	105	119	132	141	147	149	147	142	133	120	106	90.8	75.3	62.0		
85	28.4	42.4	57.9	73.1	87.2	99.3	109	115	117	115	109	100	87.9	73.7	58.3	42.6	28.5		
90	10.4	23.1	37.2	51.2	64.4	75.7	84.4	89.8	91.8	90.1	84.6	75.7	64.1	50.7	36.2	21.7	8.67		
95	7.62	18.8	31.7	44.6	56.7	67.0	74.8	79.7	81.3	79.6	74.5	66.2	55.5	43.2	29.8	16.5	5.07		
100	7.58	16.3	28.1	40.1	51.4	61.1	68.4	73.0	74.6	72.9	68.1	60.3	50.1	38.5	26.1	13.9	4.72		
105	8.45	15.1	25.1	36.1	46.5	55.5	62.3	66.6	68.0	66.5	61.9	54.6	45.2	34.4	23.0	12.5	5.44		
110	9.59	14.9	22.9	32.4	41.9	50.1	56.4	60.3	61.6	60.2	56.0	49.2	40.6	30.7	20.7	12.3	6.60		
115	10.9	15.4	21.9	29.7	37.6	44.9	50.6	54.2	55.4	54.1	50.2	44.1	36.2	27.9	19.6	12.7	7.81		
120	12.3	16.0	21.2	27.9	34.5	40.5	45.2	48.3	49.4	48.2	44.8	39.6	33.1	26.0	19.0	13.5	9.18		
125	13.6	16.9	21.2	26.4	32.0	37.1	41.0	43.6	44.4	43.4	40.6	36.2	30.7	24.6	19.0	14.4	10.8		
130	15.0	17.8	21.3	25.5	29.9	34.1	37.5	39.6	40.3	39.5	37.0	33.3	28.6	23.7	19.3	15.5	12.0		
135	16.2	18.7	21.5	24.9	28.4	31.6	34.3	36.1	36.7	35.9	33.9	30.8	27.1	23.3	19.7	16.6	13.6		
140	17.4	19.6	21.8	24.5	27.2	29.7	31.7	33.0	33.4	32.8	31.3	28.9	26.1	23.1	20.3	17.8	14.9		
145	18.3	20.4	22.1	24.1	26.2	28.1	29.6	30.6	30.9	30.5	29.3	27.5	25.3	23.0	20.8	17.7	16.0		
150	19.1	20.9	22.3	23.9	25.4	26.8	27.8	28.6	28.8	28.5	27.6	26.3	24.7	23.0	21.4	19.0	16.5		
155	18.6	20.8	21.8	22.7	24.4	25.6	26.4	26.9	27.1	26.9	26.3	25.4	24.2	23.1	20.7	20.0	16.7		
160	18.5	20.6	21.9	22.4	23.0	24.2	25.1	25.5	25.6	25.5	25.2	24.7	23.9	21.8	22.3	20.7	17.3		
165	16.8	18.6	21.3	22.1	22.4	22.5	20.6	23.2	24.6	24.5	24.3	23.0	23.1	23.1	21.7	20.6	18.0		
170	14.9	14.5	14.7	16.4	18.5	21.5	22.7	21.6	20.3	22.3	22.6	22.4	22.8	22.6	18.4	14.7	13.7		
175	12.4	12.4	12.4	12.3	12.3	12.6	13.2	15.2	16.9	20.0	17.5	17.7	14.9	11.9	10.7	11.2	11.5		
180	14.8	14.6	14.1	13.0	11.2	9.19	6.86	4.88	4.57	3.35	3.82	6.28	6.90	9.11	11.1	12.9	13.9		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Jul. 17, 2015	Jul. 16, 2016
Digital Power Meter	PF2010A	HZTE028-01	Jul. 17, 2015	Jul. 16, 2016
AC Power Supply	PCR 500L	HZTE001-08	Jul. 17, 2015	Jul. 16, 2016
DC Power Supply	WY12010	HZTE004-03	Jul. 17, 2015	Jul. 16, 2016
Temperature Meter	TES1310	HZTE017-01	Jul. 17, 2015	Jul. 16, 2016
Standard source	D908	HZTE012-01	Jul. 23, 2015	Jul. 22, 2016
Integrate Sphere system	2M	HZTE015-01	Jul. 16, 2015	Jul. 15, 2016
Digital Power Meter	WT210	HZTE008-01	Jul. 17, 2015	Jul. 16, 2016
AC Power Supply	PCR 500L	HZTE001-07	Jul. 17, 2015	Jul. 16, 2016
DC Power Supply	6154	HZTE004-04	Jul. 17, 2015	Jul. 16, 2016
Temperature and humidity recorder	JR900	HZTE018-01	Jul. 21, 2015	Jul. 20, 2016
Standard source	SCL-1400	HZTE012-02	Oct. 21, 2015	Oct. 20, 2016

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 1.06% 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 1.94% with a coverage factor $k=2$.

Color Characteristics Measurements

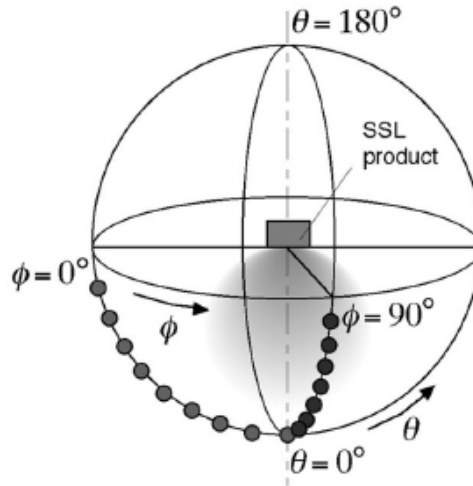
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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