



## LM-79-08 TEST REPORT

for

### RAB Lighting INC

170 Ludlow Avenue, Northvale, New Jersey 07647 USA

### LED Tube

**Model: T8-13-U6G-830-SD-HYB**

### Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ20090061c

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

Review by:

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Sep. 29, 2020

Approved by:



Manager: Jim Zhang  
Sep. 29, 2020

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: **T8-13-U6G-830-SD-HYB**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
127.9	1861.0	14.55	0.9974
CCT (K)	CRI	Stabilization Time (Light & Power)	
2899	81.2	60	

Table 1: Executive Data Summary

Note: The above results are recorded/ derived from measurements made using an Integrating Sphere.

### Test specifications:

<b>Date of Receipt</b>	: Aug. 24, 2017
<b>Date of Test</b>	: Aug. 25, 2017- Jul. 14, 2020
<b>Test item</b>	: Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters
<b>Reference Standard</b>	: 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**

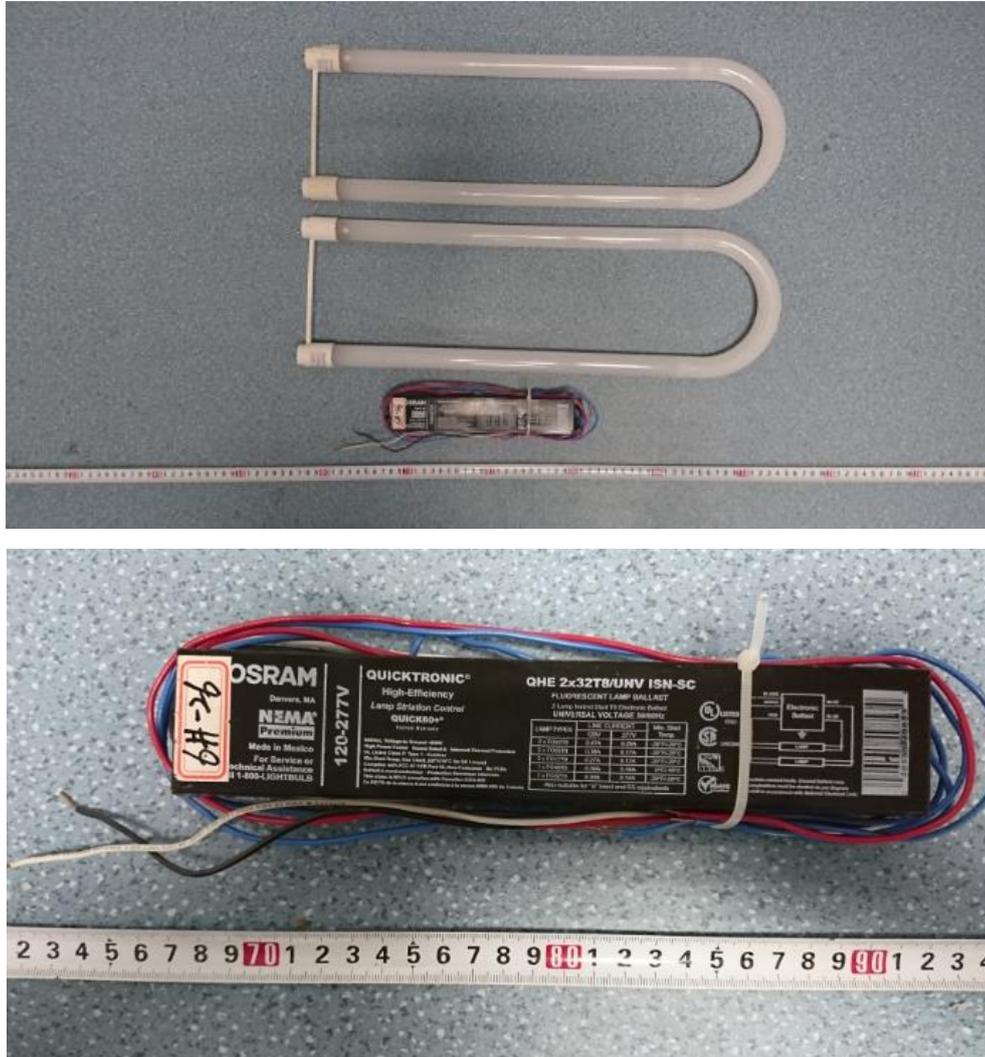


Figure 1- Overview of the sample

**Equipment Under Test(EUT)**

<b>Name</b>	: LED Tube
<b>Model</b>	: T8-13-U6G-830-SD-HYB
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz
<b>Product Description</b>	: 2G13 base, 3000K LED Tubes supplied by a high frequency fluorescent lamp ballast: QHE 2x32T8/UNV ISN-SC

## TEST RESULTS

Test ambient temperature was 24.7 °C.

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 65 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result	
	Test Voltage (V)	120.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.243	0.111
Power Factor	0.9974	0.9593
Test Power (W)/2	14.55	14.70
THD A%	4.52	12.57
Luminous Efficacy (lm/W)	127.9	126.7
Total Luminous Flux (lm)	1861.0	1862.0
Color Rendering Index (CRI)	81.2	
R9	1.1	
Correlated Color Temperature (CCT)(K)	2899	
Chromaticity Chroma x	0.4427	
Chromaticity Chroma y	0.4036	
Chromaticity Chroma u	0.2545	
Chromaticity Chroma v	0.3480	
Duv	-0.0010	
Chromaticity Chroma u'	0.2545	
Chromaticity Chroma v'	0.5220	

Special Color Rendering Indices	
R1	79.8
R2	91.8
R3	94
R4	78
R5	80.3
R6	90.4
R7	80.1
R8	54.9
R9	1.1
R10	81.6
R11	77.3
R12	72.1
R13	82.8
R14	97.4

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 24.9 °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)	0.244
Power Factor	0.9969
Power (W)/2	14.57
Luminous Efficacy (lm/W)	126.0
Total Luminous Flux (lm)	1835.8
Beam Angle ( ° )	110.2 (0°-180°) / 166.1 (90°-270°)
Center Beam Candle Power (cd)	372
Maximum Beam Candle Power (cd)	371.6 (At: C=120.0, Gamma=2.0)
Spacing Criteria	1.24 (0°-180°) / 1.38 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	50.10%
Zonal Lumens in the 60 °-90 °Zone	26.83%
Zonal Lumens in the 90 °-120 °Zone	13.17%
Zonal Lumens in the 120 °-180 °Zone	9.90%

Table 3: Test data per Goniophotometer Method

**Spectral Power Distribution - Sphere Spectroradiometer Method**

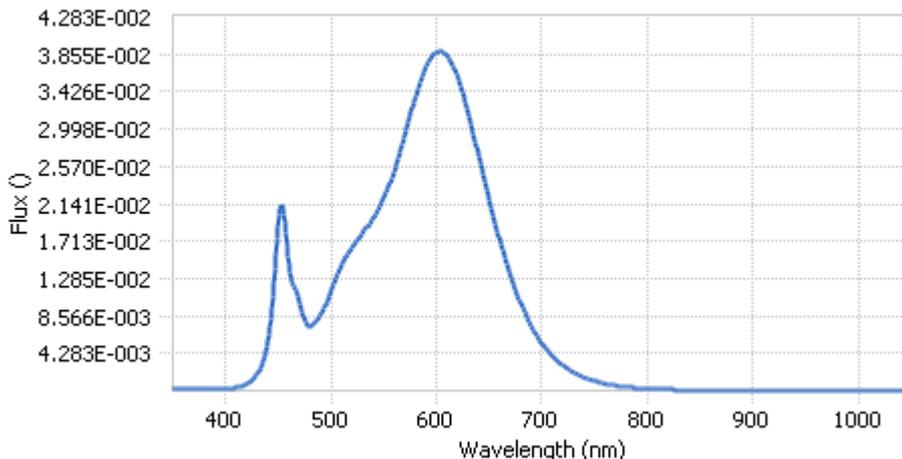
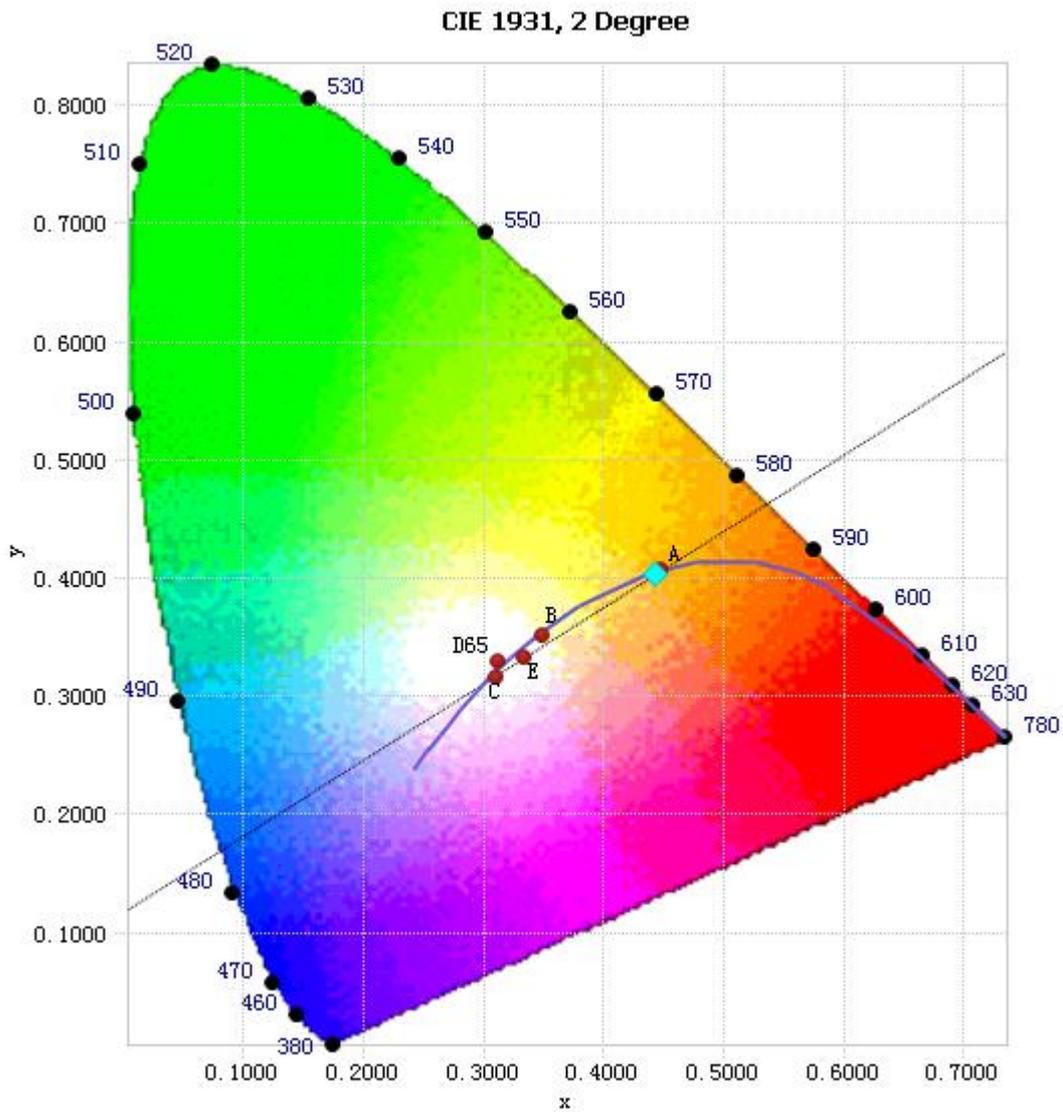


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.84E-04	485	7.89E-03	590	3.71E-02	695	6.34E-03
385	2.47E-04	490	8.66E-03	595	3.81E-02	700	5.44E-03
390	2.77E-04	495	9.92E-03	600	3.88E-02	705	4.63E-03
395	2.57E-04	500	1.15E-02	605	3.88E-02	710	3.95E-03
400	2.97E-04	505	1.30E-02	610	3.84E-02	715	3.37E-03
405	3.14E-04	510	1.44E-02	615	3.73E-02	720	2.88E-03
410	3.80E-04	515	1.56E-02	620	3.59E-02	725	2.45E-03
415	5.13E-04	520	1.64E-02	625	3.40E-02	730	2.11E-03
420	7.62E-04	525	1.72E-02	630	3.18E-02	735	1.79E-03
425	1.21E-03	530	1.81E-02	635	2.94E-02	740	1.52E-03
430	1.93E-03	535	1.88E-02	640	2.69E-02	745	1.28E-03
435	3.26E-03	540	1.98E-02	645	2.43E-02	750	1.10E-03
440	5.71E-03	545	2.09E-02	650	2.18E-02	755	9.48E-04
445	1.08E-02	550	2.21E-02	655	1.95E-02	760	8.03E-04
450	1.89E-02	555	2.36E-02	660	1.73E-02	765	6.84E-04
455	2.03E-02	560	2.53E-02	665	1.52E-02	770	5.96E-04
460	1.44E-02	565	2.73E-02	670	1.32E-02	775	5.12E-04
465	1.20E-02	570	2.94E-02	675	1.15E-02	780	4.36E-04
470	1.04E-02	575	3.14E-02	680	1.00E-02		
475	8.05E-03	580	3.37E-02	685	8.64E-03		
480	7.40E-03	585	3.56E-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): (0.4427, 0.4036)

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

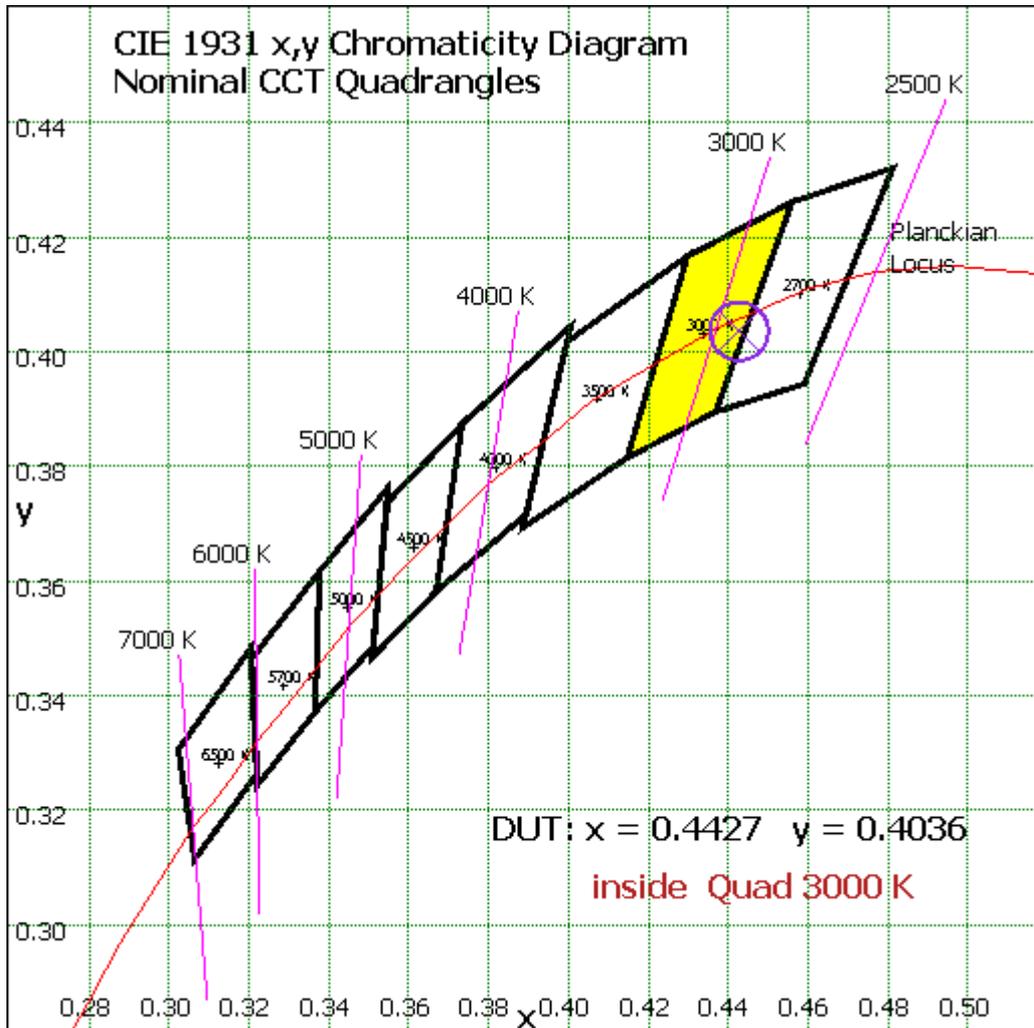


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

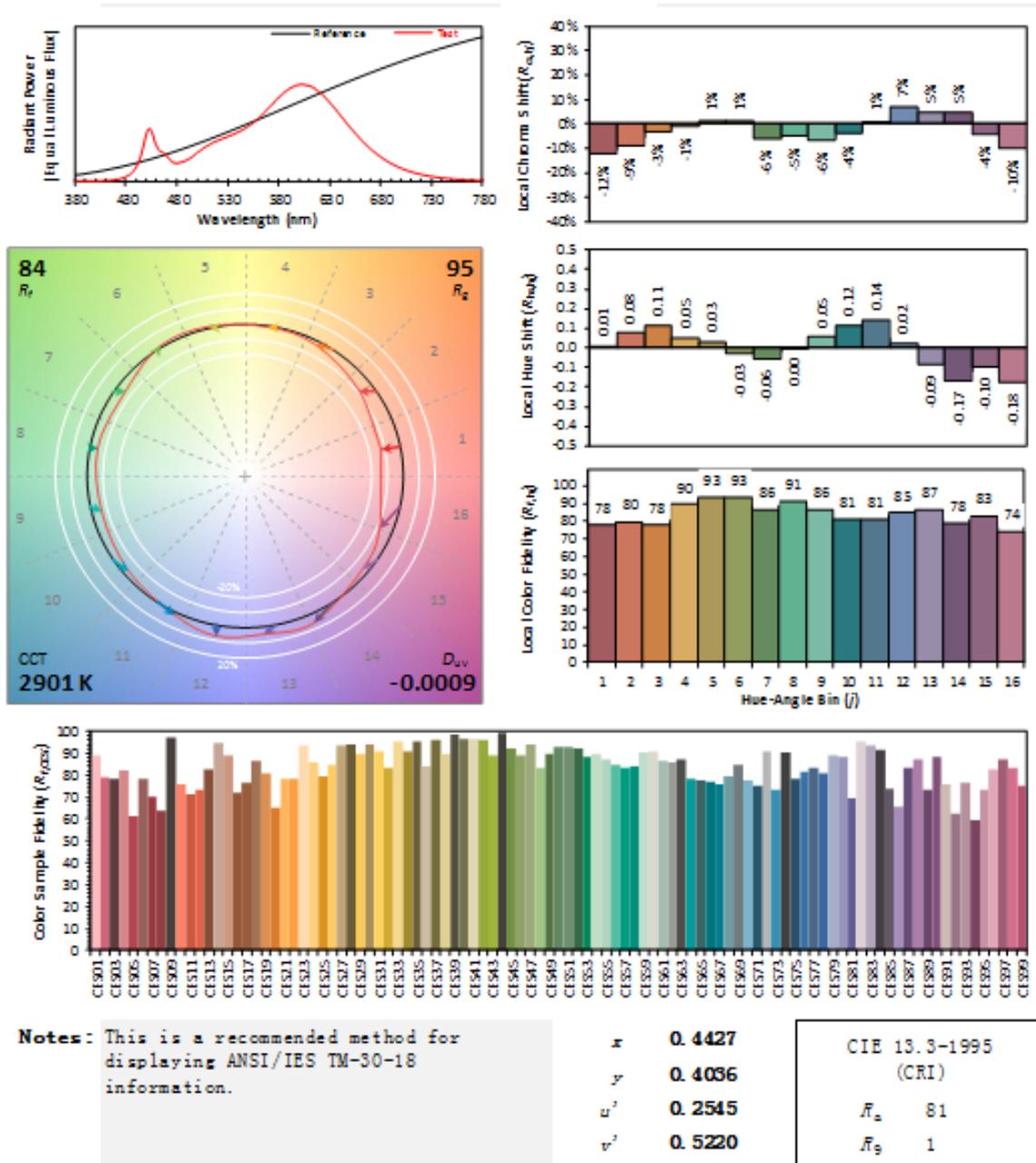
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: RAB Lighting INC

Date: 2017/08/25

Model: T8-13-U6G-830-SD-HYB



Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.

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	35.211	1.92%
10- 20	101.652	5.54%
20- 30	156.877	8.55%
30- 40	195.533	10.65%
40- 50	214.978	11.71%
50- 60	215.495	11.74%
60- 70	199.869	10.89%
70- 80	171.798	9.36%
80- 90	120.826	6.58%
90-100	77.382	4.22%
100-110	88.17	4.80%
110-120	76.233	4.15%
120-130	60.981	3.32%
130-140	47.214	2.57%
140-150	34.764	1.89%
150-160	23.108	1.26%
160-170	12.442	0.68%
170-180	3.288	0.18%
Total	1835.8	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	919.746	50.10%
60- 90	492.493	26.83%
0-90	1412.239	76.93%
90- 180	423.582	23.07%
0- 180	1835.8	100%

Table 5: Zonal Lumen

**Illuminance Plots- Goniophotometer Method**

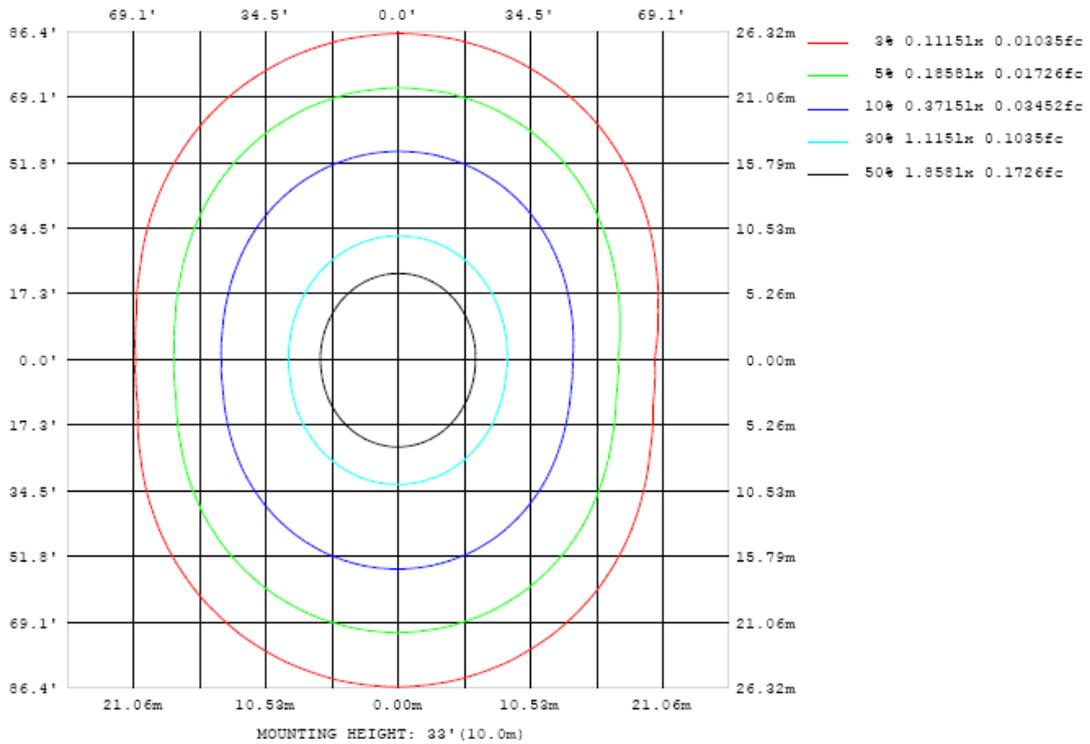


Chart 5: Illuminance Plot (Footcandles)

**Luminous Intensity Distribution Plots- Goniophotometer Method**

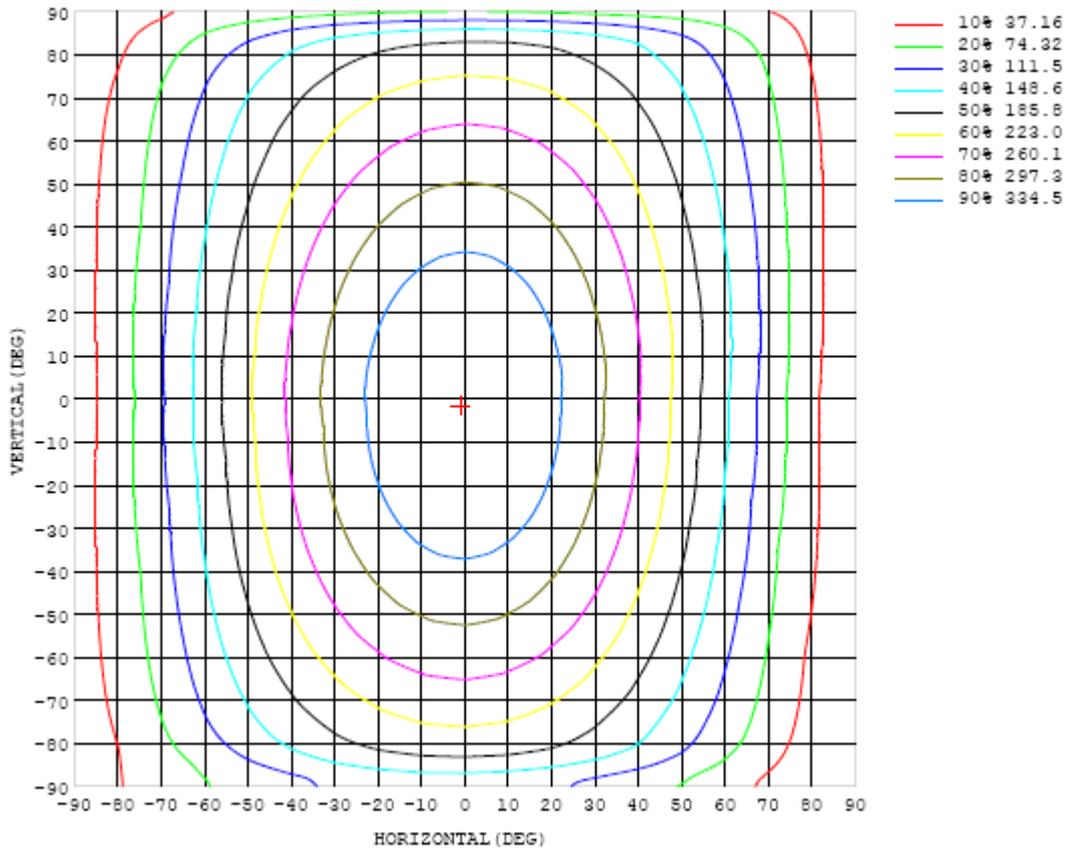


Chart 6: Isocandela Plot

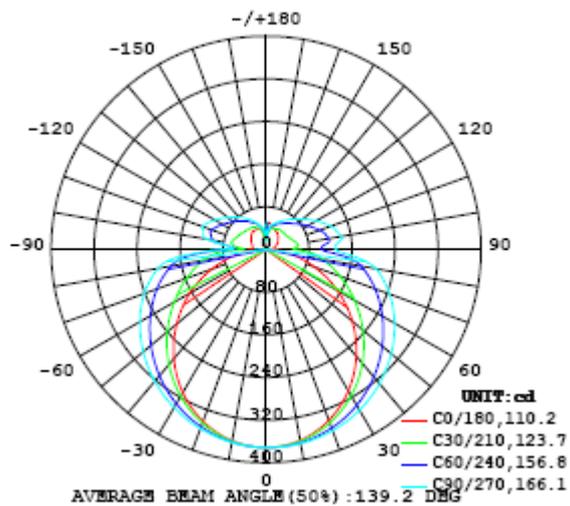


Chart 7: Polar Candela Distribution

**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	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372
5	369	369	370	370	370	370	371	371	371	371	371	371	371	371	371	370	370	370	370
10	363	364	364	365	366	367	368	369	369	369	370	369	369	368	367	366	365	364	364
15	354	354	356	357	359	361	363	365	366	366	366	365	364	362	360	358	357	355	355
20	341	342	344	346	349	353	356	359	361	362	361	360	358	355	351	348	345	343	343
25	325	326	329	333	338	343	348	352	354	355	355	353	349	345	340	335	331	328	328
30	306	307	311	317	323	331	337	343	346	348	347	344	339	333	327	320	315	310	310
35	285	286	291	299	307	317	325	332	337	339	338	334	328	320	311	303	296	290	290
40	261	263	269	279	290	301	312	320	326	328	327	322	315	305	295	284	275	268	267
45	236	238	246	257	271	285	297	307	314	317	315	310	301	289	277	264	253	244	243
50	209	212	221	235	251	267	282	294	301	304	302	296	286	273	258	243	229	219	217
55	182	185	196	213	231	250	266	279	287	290	288	281	270	255	239	222	206	193	191
60	153	157	171	190	211	232	250	264	272	276	274	266	254	238	220	200	181	166	164
65	124	129	145	168	191	214	233	248	257	261	258	251	238	221	201	179	158	140	136
70	95.8	101	121	146	172	196	216	231	241	245	242	234	221	203	182	159	135	114	108
75	69.1	75.6	98.3	127	154	178	198	214	223	227	225	217	203	185	164	140	114	89.1	80.4
80	44.4	52.4	78.7	108	135	160	180	195	204	208	206	197	184	166	145	121	94.3	68.3	55.9
85	25.1	33.9	60.2	87.6	111	130	145	157	164	168	166	161	150	136	119	98.5	74.7	50.0	36.5
90	8.02	11.5	30.5	52.2	72.4	89.3	104	117	126	130	130	125	116	104	89.1	72.2	53.3	35.2	25.8
95	10.7	15.7	35.3	57.6	78.9	95.9	110	122	129	133	133	129	121	109	94.3	75.2	53.9	35.5	25.6
100	14.3	18.5	36.6	59.5	82.2	101	117	131	139	143	141	135	124	109	92.2	73.6	52.1	34.2	25.8
105	16.7	20.2	35.2	56.2	77.9	97.5	114	125	133	136	134	128	119	105	87.6	68.6	48.8	33.7	26.7
110	19.1	22.0	34.5	52.3	71.9	90.0	106	118	125	129	127	121	111	97.1	81.3	63.6	46.6	33.8	28.1
115	22.1	24.2	34.4	49.6	66.4	82.7	97.2	108	115	118	117	111	102	89.2	75.2	59.7	45.0	34.6	30.0
120	24.9	26.8	34.9	47.6	62.1	76.5	88.9	98.9	105	108	107	102	93.1	82.3	69.9	56.5	44.1	35.8	32.1
125	27.0	29.3	36.0	46.2	58.5	70.7	82.1	90.1	95.7	97.8	97.0	92.7	85.3	76.4	65.4	54.0	43.8	37.3	34.3
130	28.9	31.9	37.4	45.5	55.5	65.8	75.2	82.5	87.1	89.1	88.3	84.7	79.0	70.8	61.5	52.1	43.9	38.9	36.5
135	31.8	34.1	38.9	45.2	53.2	61.6	69.3	75.6	79.8	81.5	81.1	78.1	72.8	66.0	58.3	50.7	44.2	40.6	38.7
140	34.6	35.8	40.3	45.2	51.4	58.1	64.3	69.4	72.8	74.4	74.0	71.5	67.3	61.8	55.7	49.7	44.6	42.1	40.8
145	37.3	38.8	41.5	45.3	50.2	55.3	60.0	64.0	66.7	67.9	67.7	65.8	62.6	58.4	53.7	48.8	44.7	43.1	42.1
150	37.9	38.7	40.5	43.8	48.6	53.1	56.7	59.6	61.6	62.5	62.3	61.0	58.6	55.5	51.7	46.9	45.1	43.8	41.7
155	40.2	39.6	40.2	41.9	45.4	49.8	53.5	56.1	57.5	58.0	57.9	57.0	55.2	52.2	48.3	45.7	45.2	44.6	41.5
160	42.4	40.2	42.0	43.3	44.9	46.9	48.7	50.3	52.5	53.2	52.9	51.9	49.9	48.5	46.5	44.8	45.1	44.7	41.0
165	45.1	38.6	39.9	40.5	41.7	44.2	46.9	48.0	48.3	48.7	48.5	47.9	47.0	45.3	43.9	44.1	45.0	42.9	39.5
170	48.5	31.7	34.2	37.5	39.8	41.3	42.3	43.5	45.0	45.3	43.5	41.9	42.0	41.9	39.8	38.5	37.1	33.8	33.3
175	48.3	45.9	23.8	24.6	25.0	28.7	33.3	35.3	34.3	36.6	37.3	33.9	30.1	28.4	27.1	26.1	24.7	24.4	24.6
180	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7

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	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372		
5	370	370	370	370	370	370	370	370	370	370	370	370	370	370	370	370	369		
10	365	365	365	366	366	367	367	367	367	367	367	366	366	365	365	364	364		
15	356	356	357	359	360	361	362	363	363	363	362	361	360	358	357	356	355		
20	344	345	347	349	351	354	356	357	358	357	356	354	351	348	346	344	343		
25	329	330	333	337	341	345	348	350	351	350	348	345	341	337	333	330	327		
30	311	314	318	323	329	334	339	341	342	341	339	335	329	323	317	313	309		
35	291	294	300	308	315	322	328	331	333	332	328	323	316	308	300	293	289		
40	269	274	281	291	300	309	316	321	322	321	317	310	301	291	281	272	266		
45	245	251	261	273	284	295	303	309	311	309	304	296	286	273	261	250	242		
50	220	228	240	254	267	280	289	296	298	297	291	282	269	255	240	227	217		
55	194	204	219	235	250	264	275	282	285	284	277	267	253	236	219	203	191		
60	169	181	197	216	233	249	261	268	272	270	263	252	236	218	198	180	165		
65	142	157	177	197	216	233	245	254	257	255	248	236	220	199	178	156	138		
70	115	134	157	180	199	216	229	238	241	239	232	220	203	182	158	133	112		
75	90.0	112	138	162	183	199	212	220	224	222	215	203	186	165	140	112	86.9		
80	67.8	93.1	120	143	163	180	192	200	204	202	196	184	169	147	122	93.3	65.0		
85	49.1	72.4	95.7	117	134	146	155	161	164	164	161	154	143	126	102	75.2	47.2		
90	28.0	34.9	42.7	50.4	58.0	64.7	70.3	73.7	74.8	73.9	70.7	65.1	59.9	54.9	46.8	38.1	21.5		
95	32.7	44.7	55.2	62.0	66.6	68.8	69.6	69.4	68.4	65.9	61.9	56.9	51.9	48.5	45.6	36.9	21.4		
100	33.2	48.3	64.9	77.8	90.9	103	110	111	111	109	107	103	92.3	79.2	64.0	45.9	25.4		
105	33.0	46.5	64.7	83.0	96.6	106	114	119	121	120	116	109	98.7	84.0	64.4	44.8	26.4		
110	33.5	45.4	61.3	78.8	94.6	108	118	124	125	124	120	112	97.5	80.2	61.2	43.8	27.4		
115	34.4	44.1	58.7	73.8	88.7	101	111	117	119	118	113	104	91.4	75.0	58.4	42.8	29.1		
120	35.7	43.5	56.3	69.7	82.6	94.0	103	108	110	109	105	96.8	84.7	70.2	55.9	42.2	30.9		
125	37.3	43.4	54.1	66.1	77.3	87.0	94.8	99.9	102	101	96.8	89.2	78.5	66.3	53.5	42.1	32.7		
130	39.0	43.6	52.4	62.6	72.4	80.8	87.5	91.9	93.3	92.6	89.0	82.2	73.1	62.5	51.7	42.2	34.7		
135	40.7	44.0	51.2	59.5	67.8	75.1	80.8	84.6	85.8	85.2	81.7	75.7	68.0	59.2	50.2	42.3	36.6		
140	42.3	44.2	50.4	57.0	63.7	69.7	74.5	77.7	78.7	78.0	74.8	69.9	63.6	56.3	48.7	42.3	38.5		
145	43.5	44.7	49.5	54.7	60.1	64.9	68.8	71.3	71.9	71.1	68.5	64.2	59.2	53.3	47.2	42.3	40.3		
150	43.2	44.4	48.5	53.0	56.8	60.1	63.7	65.5	65.7	64.2	62.3	58.6	54.8	50.4	45.6	42.1	42.1		
155	41.5	42.7	45.9	50.2	53.6	55.4	57.8	59.9	59.5	57.4	56.1	53.0	50.3	47.3	44.0	41.9	43.7		
160	39.3	40.7	43.5	46.7	49.4	51.4	51.4	54.3	53.3	50.5	49.9	47.3	45.8	44.2	42.3	41.5	45.0		
165	37.8	37.2	39.0	43.8	47.1	46.1	45.1	48.8	47.2	43.7	43.7	41.7	41.1	41.0	40.4	40.8	45.7		
170	31.8	32.5	27.7	38.1	45.7	40.0	39.0	43.2	41.0	37.0	37.3	36.1	36.1	37.3	38.1	39.5	44.6		
175	25.1	18.5	17.7	45.9	39.3	32.7	33.9	37.6	34.8	30.5	30.4	30.8	30.1	32.4	34.5	36.3	39.5		
180	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7		

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  $4\pi$ . 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**

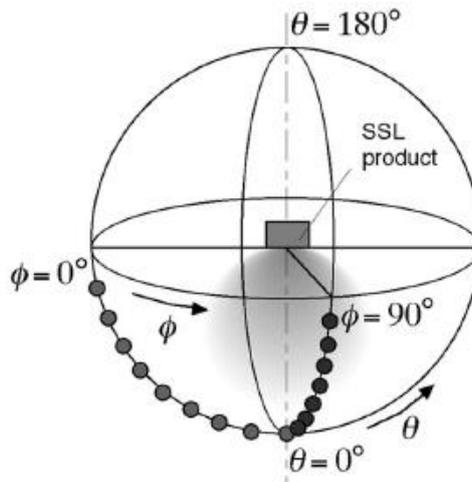
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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