

## LM-79-19 TEST REPORT

for

### RAB LIGHTING INC

408 W 14th St New York, NY 10014 United States

### LED Tube

**Model: T5HO-25-48G-850-SD-BYP**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ22110029o

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

Review by:



Engineer: April Zou  
Dec. 20, 2022

Approved by:



Manager: Jim Zhang  
Dec. 20, 2022

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: **T5HO-25-48G-850-SD-BYP**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
148.9	3806.9	25.56	0.9863
CCT (K)	CRI	Stabilization Time (Light & Power)	
5050	83.9	50	

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>	: Nov. 28, 2022
<b>Date of Test</b>	: Dec. 15, 2022
<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-79-2019 Approved Method: 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>	: T5HO-25-48G-850-SD-BYP
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz, 25W
<b>Product Description</b>	: 5000K

## TEST RESULTS

Test ambient temperature was 26.0 °C.

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

The stabilization time of the sample was 50 minutes, and the total operating time including stabilization was 55 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result	
	Test Voltage (V)	120.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.216	0.092
Power Factor	0.9863	0.9528
Test Power (W)	25.56	24.40
THD A%	13.28	18.26
Luminous Efficacy (lm/W)	148.9	157.4
Total Luminous Flux (lm)	3806.9	3840.0
Color Rendering Index (CRI)	83.9	
R9	10.2	
Correlated Color Temperature (CCT)(K)	5050	
Chromaticity Chroma x	0.3440	
Chromaticity Chroma y	0.3551	
Chromaticity Chroma u	0.2093	
Chromaticity Chroma v	0.3241	
Duv	0.0022	
Chromaticity Chroma u'	0.2093	
Chromaticity Chroma v'	0.4862	

Special Color Rendering Indices	
R1	82.4
R2	90.4
R3	94.4
R4	82.3
R5	82.7
R6	85.5
R7	86.7
R8	67.2
R9	10.2
R10	76.4
R11	81.5
R12	61.6
R13	84.8
R14	97.3

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 24.8 °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)	0.216
Power Factor	0.9870
Power (W)	25.62
Luminous Efficacy (lm/W)	149.5
Total Luminous Flux (lm)	3831.3
Beam Angle (°)	110.0 (0°-180°) / 175.9 (90°-270°)
Center Beam Candle Power (cd)	763
Maximum Beam Candle Power (cd)	766.1 (At: C=340.0, Gamma=3.5)
Spacing Criteria	1.20 (0°-180°) / 1.38 (90°-270°)
Zonal Lumens in the 0°-60° Zone	49.30%
Zonal Lumens in the 60°-90° Zone	27.13%
Zonal Lumens in the 90°-120° Zone	14.95%
Zonal Lumens in the 120°-180° Zone	8.62%

Table 3: Test data per Goniophotometer Method

**Spectral Power Distribution - Sphere Spectroradiometer Method**

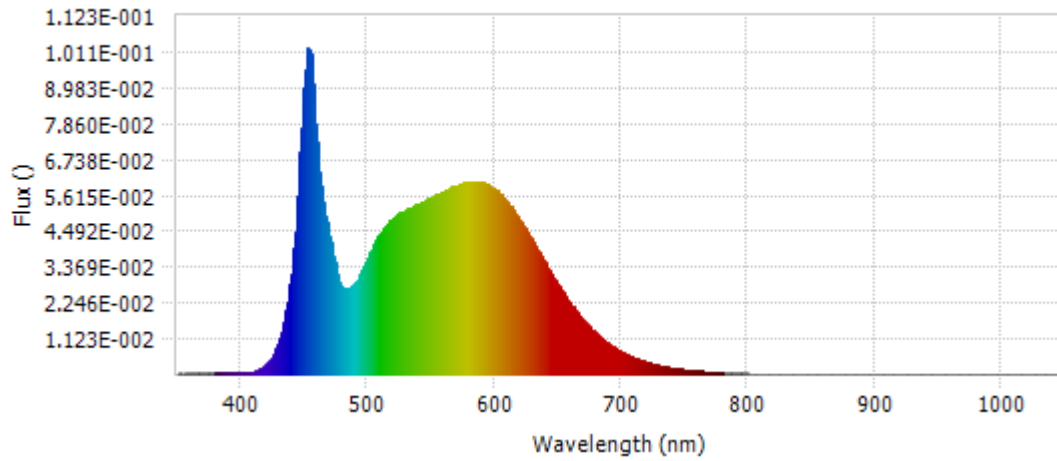
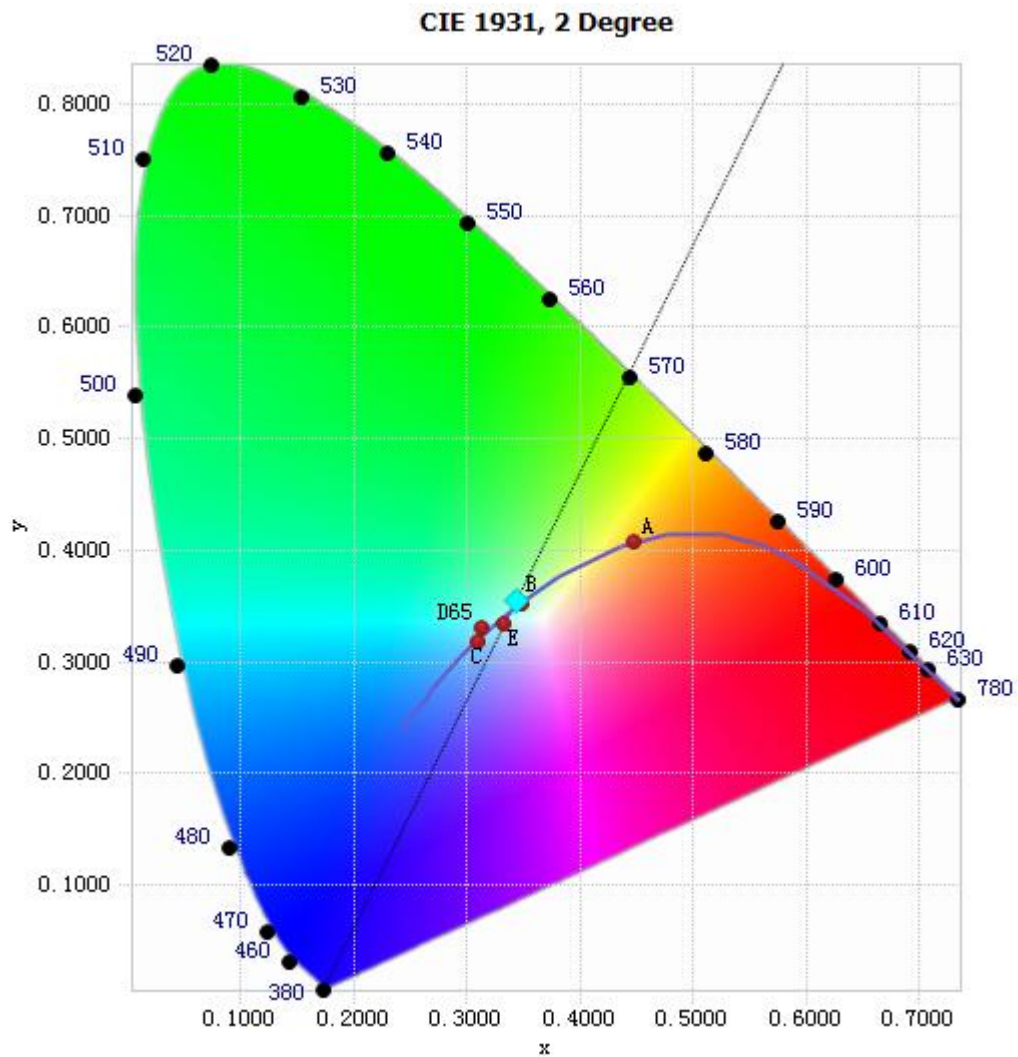


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.94E-04	485	2.69E-02	590	6.00E-02	695	8.27E-03
385	4.37E-04	490	2.88E-02	595	5.93E-02	700	7.13E-03
390	4.21E-04	495	3.19E-02	600	5.80E-02	705	6.08E-03
395	3.82E-04	500	3.64E-02	605	5.63E-02	710	5.21E-03
400	4.16E-04	505	4.07E-02	610	5.41E-02	715	4.46E-03
405	4.84E-04	510	4.41E-02	615	5.14E-02	720	3.88E-03
410	8.69E-04	515	4.70E-02	620	4.83E-02	725	3.32E-03
415	1.60E-03	520	4.90E-02	625	4.52E-02	730	2.82E-03
420	3.01E-03	525	5.04E-02	630	4.18E-02	735	2.40E-03
425	5.69E-03	530	5.14E-02	635	3.84E-02	740	2.06E-03
430	1.03E-02	535	5.23E-02	640	3.49E-02	745	1.74E-03
435	1.83E-02	540	5.34E-02	645	3.15E-02	750	1.50E-03
440	3.17E-02	545	5.42E-02	650	2.82E-02	755	1.30E-03
445	5.61E-02	550	5.53E-02	655	2.51E-02	760	1.12E-03
450	9.00E-02	555	5.62E-02	660	2.21E-02	765	9.51E-04
455	1.00E-01	560	5.72E-02	665	1.95E-02	770	8.09E-04
460	7.28E-02	565	5.83E-02	670	1.70E-02	775	6.86E-04
465	5.38E-02	570	5.91E-02	675	1.48E-02	780	6.02E-04
470	4.34E-02	575	5.98E-02	680	1.29E-02		
475	3.30E-02	580	6.04E-02	685	1.12E-02		
480	2.72E-02	585	6.05E-02	690	9.62E-03		

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

**Chromaticity Diagram - Sphere Spectroradiometer Method**



Tristimulus values(x, y): (0.3440, 0.3551)

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

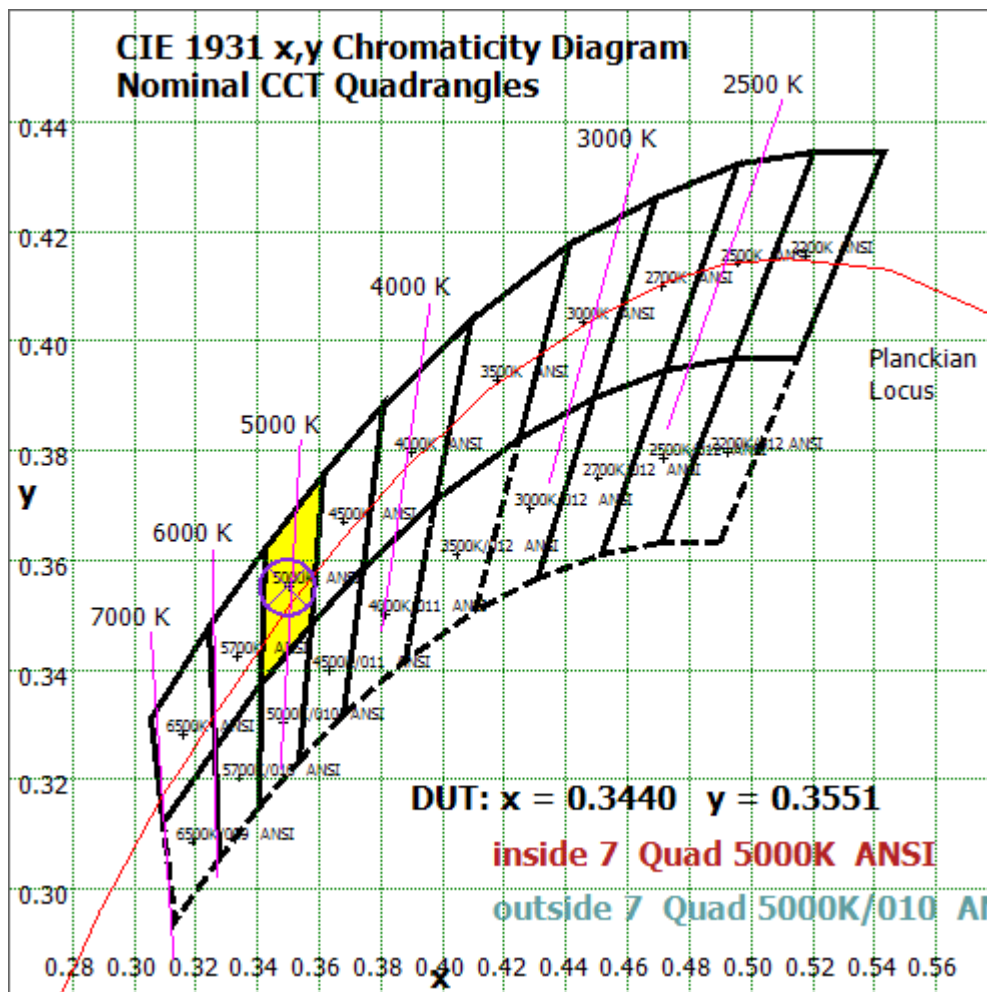


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

**Color Rendition Report – Sphere Spectroradiometer Method**

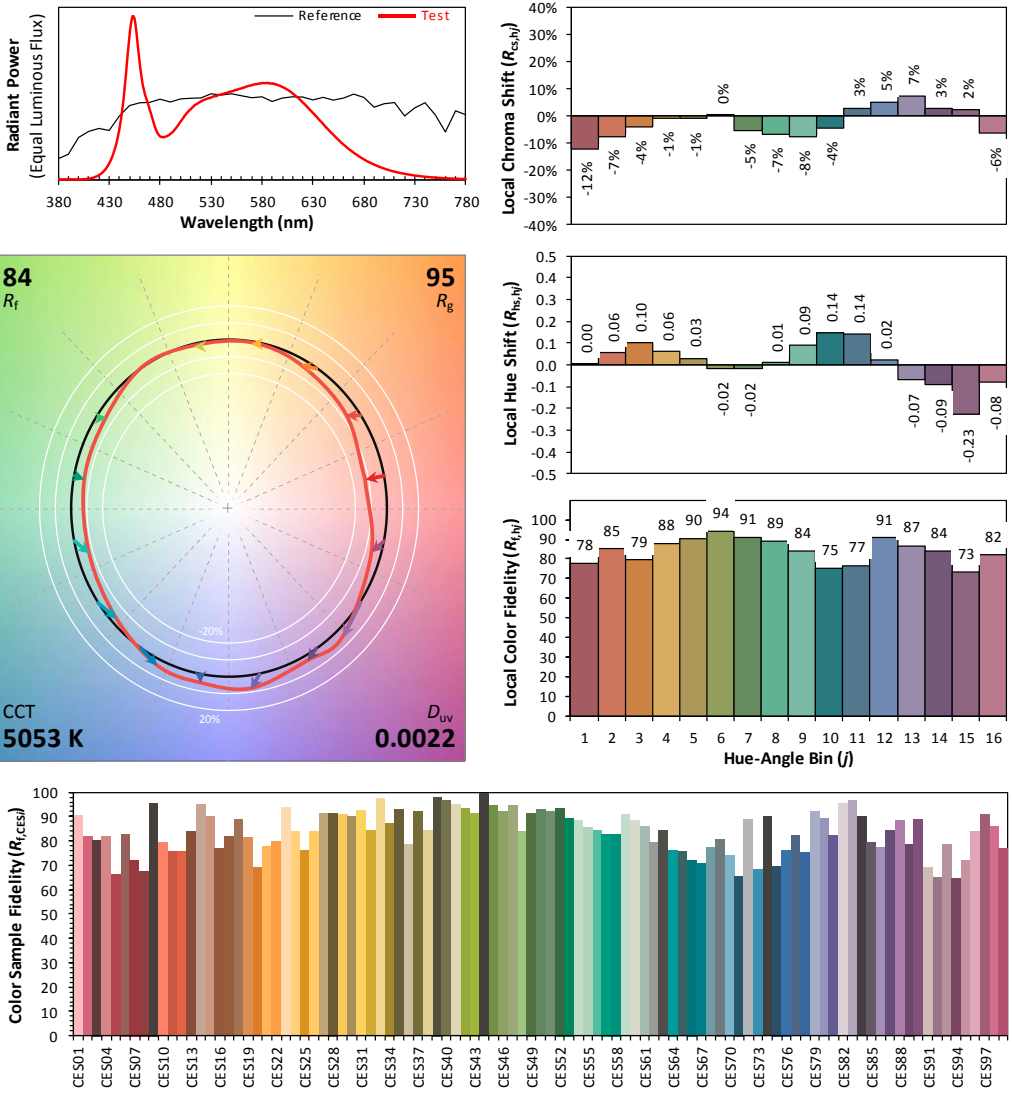
**ANSI/IES TM-30-18 Color Rendition Report**

**Source:** LED

**Manufacturer:** RAB LIGHTING INC

**Date:** 2022/12/15

**Model:** T5HO-25-48G-850-SD-BYP



<b>Notes:</b> This is a recommended method for displaying ANSI/IES TM-30-18 information.	$x$	<b>0.3440</b>	CIE 13.3-1995 (CRI) $R_a$ 84 $R_g$ 10
	$y$	<b>0.3551</b>	
	$u'$	<b>0.2093</b>	
	$v'$	<b>0.4862</b>	

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	72.356	1.89%
10- 20	208.869	5.45%
20- 30	322.531	8.42%
30- 40	402.215	10.50%
40- 50	441.739	11.53%
50- 60	441.16	11.51%
60- 70	406.302	10.60%
70- 80	348.512	9.10%
80- 90	284.586	7.43%
90-100	231.368	6.04%
100-110	188.687	4.92%
110-120	152.723	3.99%
120-130	121.254	3.16%
130-140	90.538	2.36%
140-150	63.682	1.66%
150-160	38.19	1.00%
160-170	14.477	0.38%
170-180	2.104	0.05%
Total	3831.3	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1888.87	49.30%
60- 90	1039.4	27.13%
0-90	2928.27	76.43%
90- 180	903.023	23.57%
0- 180	3831.3	100%

Table 5: Zonal Lumen

**Illuminance Plots- Goniophotometer Method**

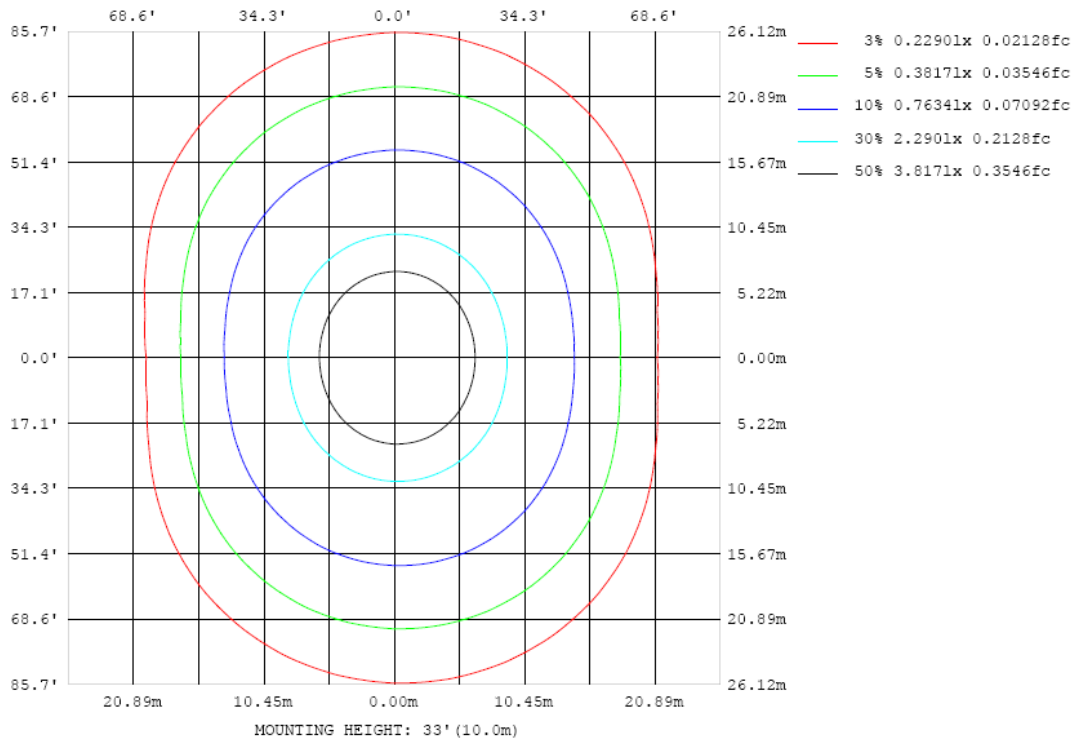


Chart 5: Illuminance Plot (Footcandles)

**Luminous Intensity Distribution Plots- Goniophotometer Method**

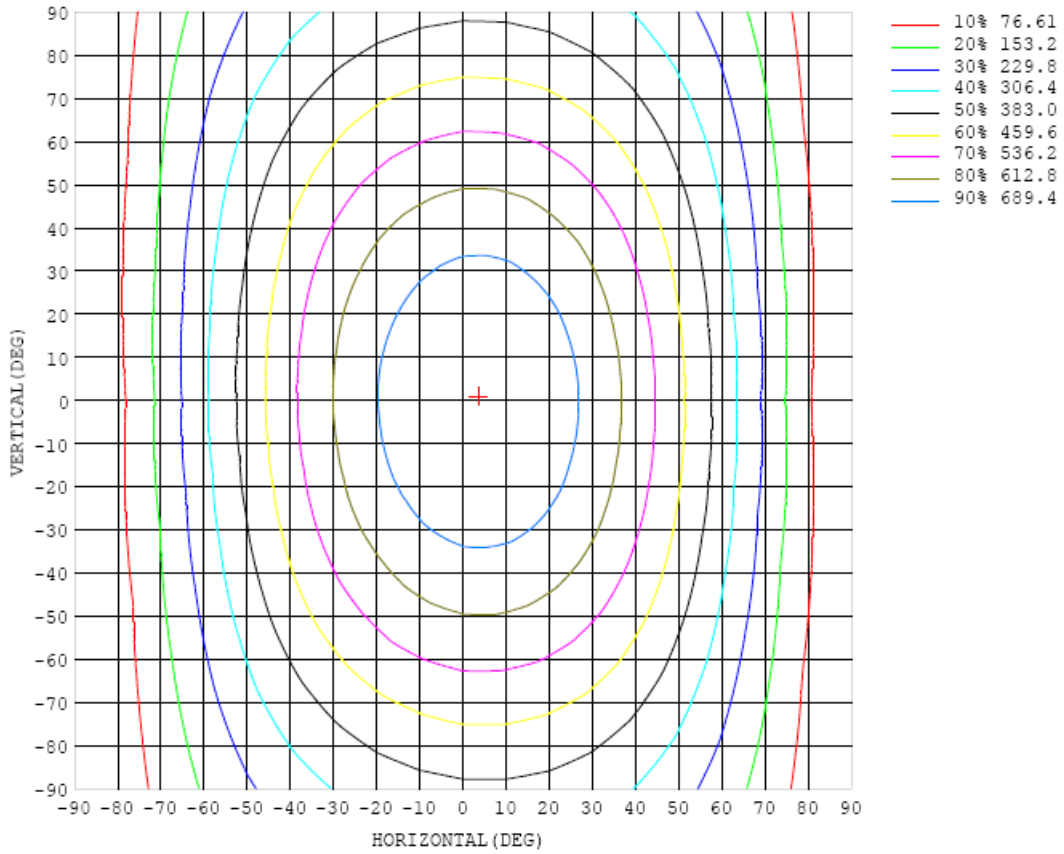


Chart 6: Isocandela Plot

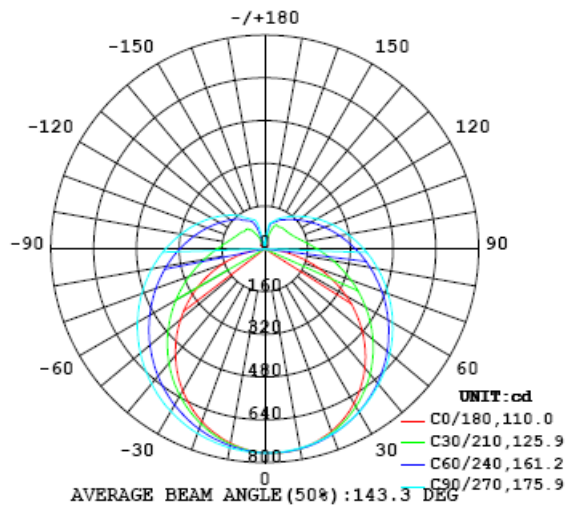


Chart 7: Polar Candela Distribution

**Luminous Intensity Data- Goniophotometer Method**

Table--1 UNIT: cd

C (DEG) \ γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763
5	765	765	764	765	764	764	764	763	763	763	762	759	759	757	755	755	754	754	755
10	759	759	759	760	761	761	760	759	757	757	754	752	749	747	744	741	740	739	739
15	747	747	748	749	751	751	752	751	750	748	744	740	735	731	727	722	719	717	716
20	727	728	730	733	736	738	739	740	738	737	732	726	718	711	703	697	691	688	687
25	700	702	705	709	715	720	723	725	725	723	716	708	697	687	677	666	658	654	653
30	667	669	674	682	691	698	705	708	708	705	697	687	673	661	646	632	621	615	614
35	627	630	638	649	662	673	682	687	687	685	675	664	647	631	612	594	579	571	569
40	582	585	597	613	629	644	656	663	665	662	652	638	618	598	575	553	533	522	520
45	531	536	551	572	593	613	627	637	640	637	627	610	588	563	536	509	485	470	467
50	475	482	501	528	555	579	597	609	613	610	599	581	556	528	496	464	435	416	412
55	415	425	449	482	515	544	565	580	584	582	570	551	524	492	456	418	383	359	353
60	352	364	395	435	475	508	533	549	555	552	540	520	491	456	416	372	331	301	293
65	285	301	341	389	434	472	500	517	524	522	509	488	458	422	377	328	280	242	231
70	217	238	287	344	394	436	466	485	493	490	478	457	426	387	340	286	231	184	170
75	149	177	236	300	356	401	432	452	462	460	447	426	394	354	305	248	186	130	111
80	85.4	121	190	261	320	366	400	421	431	429	417	396	364	324	273	214	147	83.1	57.1
85	32.0	75.2	152	226	287	335	369	390	400	399	388	367	336	295	245	185	117	49.6	16.8
90	2.25	46.7	122	196	257	304	339	360	371	370	359	339	308	269	220	161	94.8	31.4	0.71
95	0.70	32.2	101	171	230	277	311	332	343	342	332	313	283	246	198	142	80.5	24.1	0.36
100	0.89	28.2	87.4	151	207	252	285	305	316	316	306	288	260	224	179	127	69.5	25.6	0.51
105	1.66	30.5	79.8	136	188	229	260	280	290	291	282	266	239	205	163	112	66.9	30.2	0.86
110	3.05	35.4	76.1	125	171	209	238	257	267	268	260	244	219	187	146	106	66.9	36.9	1.79
115	6.22	41.8	76.4	117	157	191	218	235	245	246	239	224	200	169	138	102	68.3	43.8	4.69
120	10.5	48.9	77.5	111	145	175	199	216	224	225	218	204	184	160	130	98.9	70.9	49.8	7.60
125	14.4	54.9	79.8	107	136	162	183	197	205	206	200	189	171	149	124	97.2	74.4	55.4	11.3
130	11.8	46.6	83.4	105	128	150	168	180	187	189	184	174	159	140	118	96.6	75.2	60.4	17.4
135	5.78	32.3	88.0	103	122	140	155	166	172	173	169	161	148	132	114	96.8	78.5	62.9	21.9
140	4.42	31.3	90.2	103	118	132	144	153	158	159	156	149	138	125	111	95.6	80.7	53.1	20.1
145	8.58	37.7	87.2	99.1	113	124	134	141	145	146	144	138	130	120	109	93.9	83.3	43.2	16.8
150	11.3	27.5	70.8	98.2	107	118	126	131	134	135	133	129	123	115	103	90.4	80.1	37.4	14.1
155	13.3	14.7	55.6	98.9	102	109	117	122	125	125	124	121	115	107	98.0	87.3	70.8	34.2	13.9
160	10.0	15.7	36.3	79.7	102	103	107	110	112	113	112	109	105	99.8	87.1	74.0	48.8	19.7	15.6
165	15.0	16.8	20.7	44.4	78.8	96.6	99.7	101	102	103	102	101	95.2	84.9	71.5	53.8	27.3	11.4	12.0
170	15.0	12.4	20.3	20.9	28.0	48.6	68.0	79.7	86.3	88.7	88.2	81.0	69.7	57.1	41.0	23.1	17.3	16.8	12.8
175	15.0	12.3	13.7	17.9	20.5	21.9	22.1	22.8	24.1	25.0	24.7	21.6	16.1	13.7	14.2	14.9	14.7	15.8	14.0
180	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96

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	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763		
5	756	755	756	756	757	758	759	760	762	762	763	764	764	765	766	766	765		
10	739	741	742	743	745	748	751	753	757	757	758	759	760	761	761	761	760		
15	717	720	723	726	730	735	740	743	747	748	750	750	750	750	749	748	747		
20	689	692	697	704	711	718	724	730	735	737	739	738	736	734	731	729	728		
25	655	660	668	678	687	697	707	714	721	723	723	721	717	713	708	704	702		
30	617	623	635	648	661	675	687	695	703	705	705	701	695	688	680	673	669		
35	573	583	598	615	632	649	664	674	682	685	684	677	669	658	646	636	630		
40	525	538	558	580	601	622	638	651	659	661	660	651	639	625	609	594	585		
45	474	491	516	542	568	592	611	625	634	637	633	622	608	589	568	549	536		
50	420	442	472	504	534	561	582	598	607	609	604	591	573	551	524	499	482		
55	365	392	428	465	499	529	553	569	580	580	574	559	538	511	479	447	424		
60	307	341	384	427	464	497	522	540	550	550	543	526	502	469	432	394	363		
65	250	292	341	389	430	465	491	509	520	520	512	493	466	429	386	340	301		
70	194	245	301	353	397	433	461	479	490	489	480	459	430	390	341	287	238		
75	143	202	264	319	365	403	431	449	459	458	448	427	395	352	298	236	178		
80	98.1	165	230	288	335	373	401	419	429	428	417	395	362	316	259	191	123		
85	64.4	136	202	260	307	345	373	390	400	398	387	365	331	284	224	154	77.6		
90	45.1	113	178	235	281	318	345	363	371	369	358	336	302	255	195	124	48.1		
95	37.5	97.8	159	213	258	293	319	336	344	343	331	309	275	229	171	103	32.4		
100	36.3	88.3	144	194	236	270	295	311	319	317	305	283	251	207	153	88.3	27.3		
105	38.1	83.0	133	178	217	249	273	287	294	292	281	260	229	188	138	80.6	28.5		
110	40.6	80.5	124	164	200	230	252	265	272	269	259	239	210	172	127	74.2	32.7		
115	44.9	80.3	117	154	185	212	232	245	250	248	238	219	193	158	117	73.7	37.4		
120	48.9	80.9	112	144	172	196	214	225	230	228	219	202	177	147	108	75.9	42.8		
125	46.5	78.9	108	136	160	181	197	207	212	210	201	185	163	135	106	77.8	47.9		
130	13.5	68.1	101	128	151	168	182	191	195	193	184	170	151	128	105	76.1	34.4		
135	5.07	65.9	101	118	141	157	168	175	179	176	168	157	140	119	102	69.0	7.01		
140	14.0	67.5	97.6	112	127	144	156	161	163	161	155	144	128	114	100	65.9	4.52		
145	10.6	45.9	86.1	109	121	130	138	143	146	144	138	130	121	110	95.2	56.1	9.07		
150	13.6	8.23	61.6	95.6	110	122	128	132	133	132	128	123	115	109	75.7	24.4	11.8		
155	16.3	18.5	25.0	60.1	97.7	112	119	122	123	122	120	116	112	95.6	44.8	6.61	12.0		
160	16.6	13.0	10.5	14.4	38.0	81.6	102	113	116	115	114	110	91.9	47.2	18.8	9.70	10.9		
165	15.2	17.9	17.0	11.7	19.5	9.99	12.2	39.1	66.4	68.0	55.8	38.8	18.7	17.6	18.5	9.00	14.6		
170	15.5	22.0	16.3	18.3	13.7	15.2	9.36	6.74	15.9	23.8	21.1	19.4	19.0	12.2	9.53	10.9	17.1		
175	14.1	21.0	19.7	20.2	28.8	21.0	13.5	10.3	5.81	8.75	12.9	18.0	22.9	19.2	14.8	12.5	17.8		
180	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96	9.96		

Table 7: Luminous Intensity Data

**EQUIPMENT LIST**

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 05, 2022	Aug. 04, 2023
Digital Power Meter	PF2010A	HZTE028-01	Aug. 05, 2022	Aug. 04, 2023
AC Power Supply	DPS1060	HZTE001-06	Aug. 05, 2022	Aug. 04, 2023
DC Power Supply	WY12010	HZTE004-03	Aug. 05, 2022	Aug. 04, 2023
Temperature recorder	JM624U	HZTE018-08	Aug. 05, 2022	Aug. 04, 2023
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 05, 2022	Aug. 04, 2023
Standard source	D908	HZTE012-01	Aug. 05, 2022	Aug. 04, 2023
Integrate Sphere system	3M	HZTE015-04	Aug. 05, 2022	Aug. 04, 2023
Digital Power Meter	WT210	HZTE008-01	Aug. 05, 2022	Aug. 04, 2023
AC Power Supply	PCR 500L	HZTE001-07	Aug. 05, 2022	Aug. 04, 2023
DC Power Supply	IT6154	HZTE004-04	Aug. 05, 2022	Aug. 04, 2023
Standard source	SCL-1400	HZTE012-02	Aug. 05, 2022	Aug. 04, 2023
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 05, 2022	Aug. 04, 2023
Temperature Meter	TES1310	HZTE017-01	Aug. 05, 2022	Aug. 04, 2023

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 3 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 Tubes) 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 20 min, taken 10 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 Tubes) 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 20 min, taken 10 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.

\*\*\* End of Report \*\*\*

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