

LM-79-19 TEST REPORT

for

Espen Technology Inc.

12257 Florence Ave., Santa Fe Springs, CA 90670

LED Tube

Model: L48T8/8F/12G-ID DE

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ25040011a

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

Review by:

Wei Fei



Approved by:

April Zou

Engineer: Wei Fei
Apr. 07, 2025

Manager: April Zou
Apr. 07, 2025

Note: This report does not imply product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

TEST SUMMARY

Tested Model	L48T8/8F/12G-ID DE 2700K Setting	L48T8/8F/12G-ID DE 3500K Setting	L48T8/8F/12G-ID DE 5000K Setting
Luminous Efficacy (Lumens /Watt)	137.1	153.2	150.2
Total Luminous Flux (Lumens)	1698.6	1876.4	1878.0
Power (Watts)	12.39	12.25	12.50
Power Factor	0.9794	0.9797	0.9790
CCT (K)	2761	3445	5061
CRI	82.5	85.4	83.8
Stabilization Time (Light & Power)	50 mins	50 mins	50 mins
Note	2700K	3500K	5000K

Table 1: Executive Data Summary

Test specifications:

Date of Receipt	: Feb. 24, 2023
Date of Test	: Feb. 27, 2023
Test item	: Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters
Reference Standard	: IESNA LM-79-2019 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)

Name	: LED Tube
Model	: L48T8/8F/12G-ID DE
Electrical Ratings	: 120-277V, 50/60Hz,12W
Product Description	: Color- Tunable 2700K/3000K/3500K/4000K/5000K

TEST RESULTS (2700K Setting)

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	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.105	0.049
Power Factor	0.9794	0.9176
Test Power (W)	12.39	12.36
THD A%	18.26	18.66
Luminous Efficacy (lm/W)	137.1	135.6
Total Luminous Flux (lm)	1698.6	1675.4
Color Rendering Index (CRI)	82.5	
R9	6.9	
Correlated Color Temperature (CCT)(K)	2761	
Chromaticity Chroma x	0.4554	
Chromaticity Chroma y	0.4105	
Chromaticity Chroma u	0.2596	
Chromaticity Chroma v	0.3511	
Duv	0.0004	
Chromaticity Chroma u'	0.2596	
Chromaticity Chroma v'	0.5266	

Special Color Rendering Indices	
R1	81.6
R2	93.2
R3	93.2
R4	79.6
R5	82.1
R6	93
R7	80.5
R8	56.5
R9	6.9
R10	85.1
R11	79.7
R12	75.5
R13	84.5
R14	96.9

Table 2: Test data per Sphere-Spectroradiometer Method

Note: According to CIE 1976 (u', v') diagram, $u' = u = 4x/(-2x+12y+3)$, $v' = 3v/2 = 9y/(-2x+12y+3)$.

Spectral Power Distribution - Sphere Spectroradiometer Method

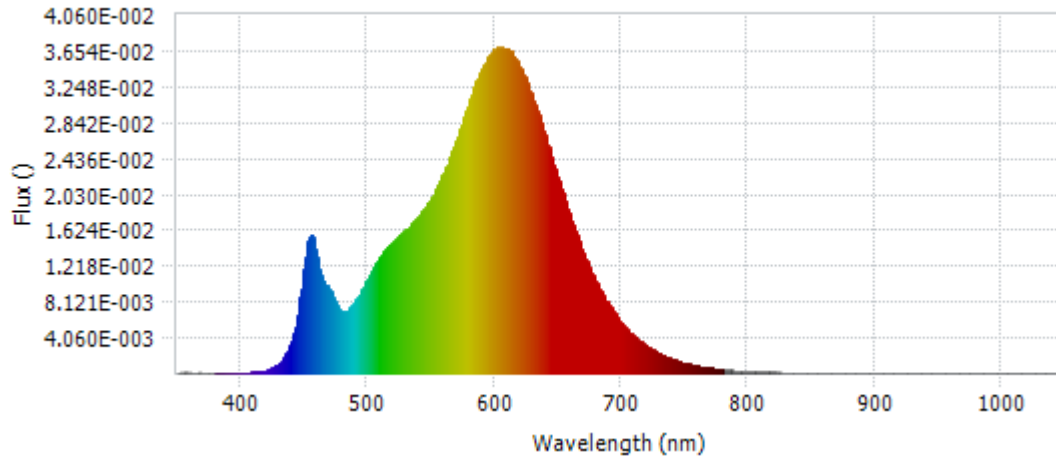
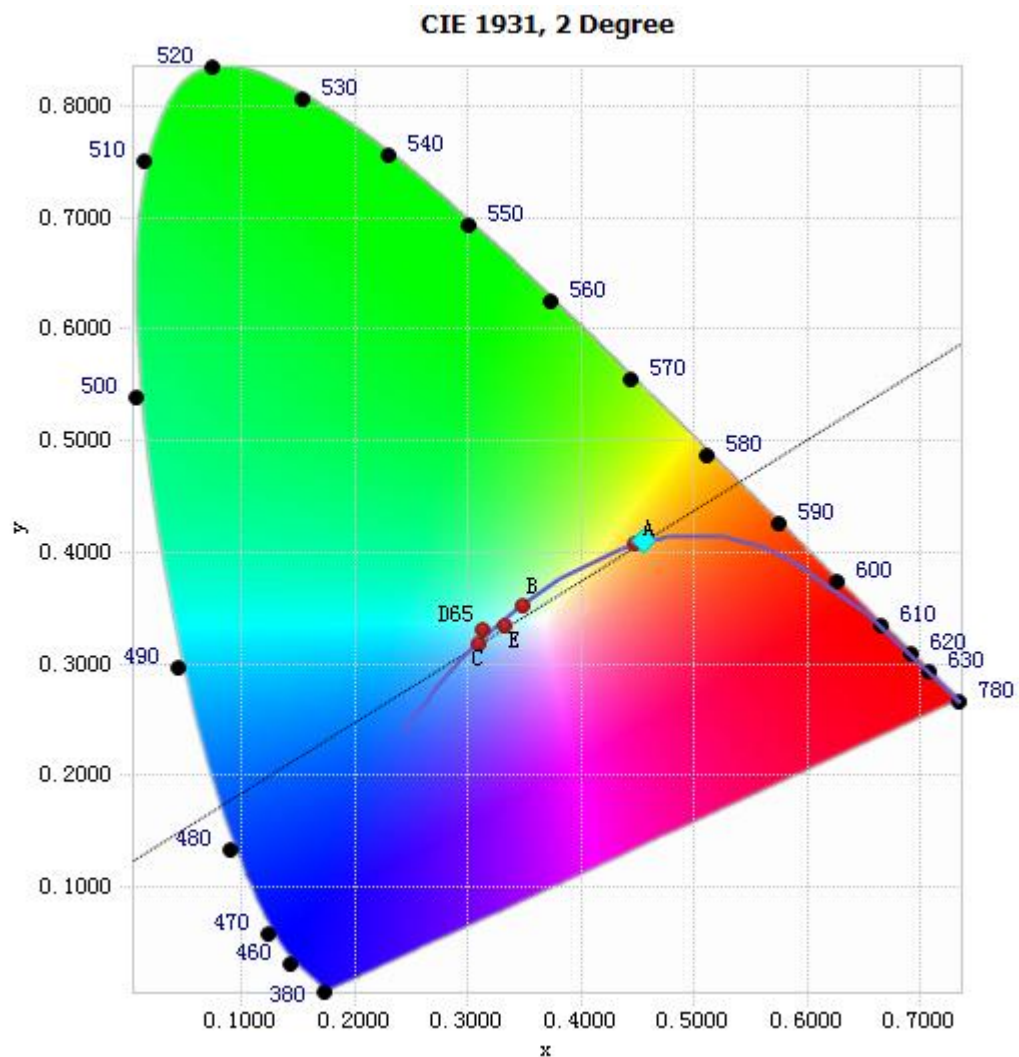


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	8.63E-05	485	7.28E-03	590	3.44E-02	695	6.76E-03
385	1.03E-04	490	8.13E-03	595	3.58E-02	700	5.80E-03
390	9.69E-05	495	9.31E-03	600	3.67E-02	705	4.95E-03
395	9.75E-05	500	1.07E-02	605	3.69E-02	710	4.25E-03
400	8.75E-05	505	1.21E-02	610	3.67E-02	715	3.61E-03
405	9.63E-05	510	1.32E-02	615	3.60E-02	720	3.10E-03
410	1.38E-04	515	1.42E-02	620	3.47E-02	725	2.65E-03
415	2.30E-04	520	1.48E-02	625	3.32E-02	730	2.25E-03
420	3.50E-04	525	1.56E-02	630	3.13E-02	735	1.91E-03
425	6.59E-04	530	1.63E-02	635	2.93E-02	740	1.63E-03
430	1.16E-03	535	1.69E-02	640	2.70E-02	745	1.39E-03
435	2.05E-03	540	1.77E-02	645	2.46E-02	750	1.19E-03
440	3.68E-03	545	1.87E-02	650	2.22E-02	755	1.01E-03
445	6.64E-03	550	1.98E-02	655	2.00E-02	760	8.63E-04
450	1.19E-02	555	2.11E-02	660	1.77E-02	765	7.32E-04
455	1.58E-02	560	2.27E-02	665	1.57E-02	770	6.27E-04
460	1.33E-02	565	2.45E-02	670	1.37E-02	775	5.34E-04
465	1.05E-02	570	2.64E-02	675	1.20E-02	780	4.52E-04
470	9.48E-03	575	2.85E-02	680	1.04E-02		
475	7.89E-03	580	3.06E-02	685	9.07E-03		
480	6.94E-03	585	3.28E-02	690	7.87E-03		

Table 3: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4554, 0.4105)

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

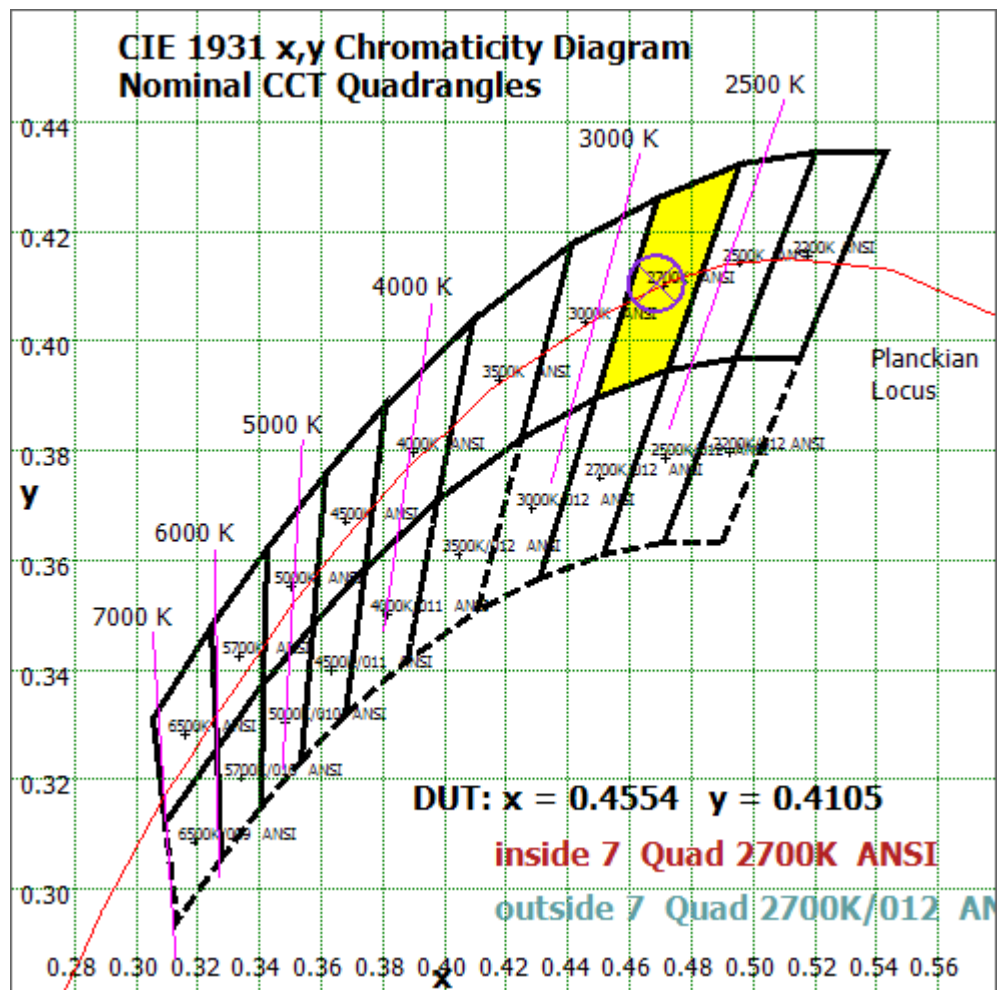


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

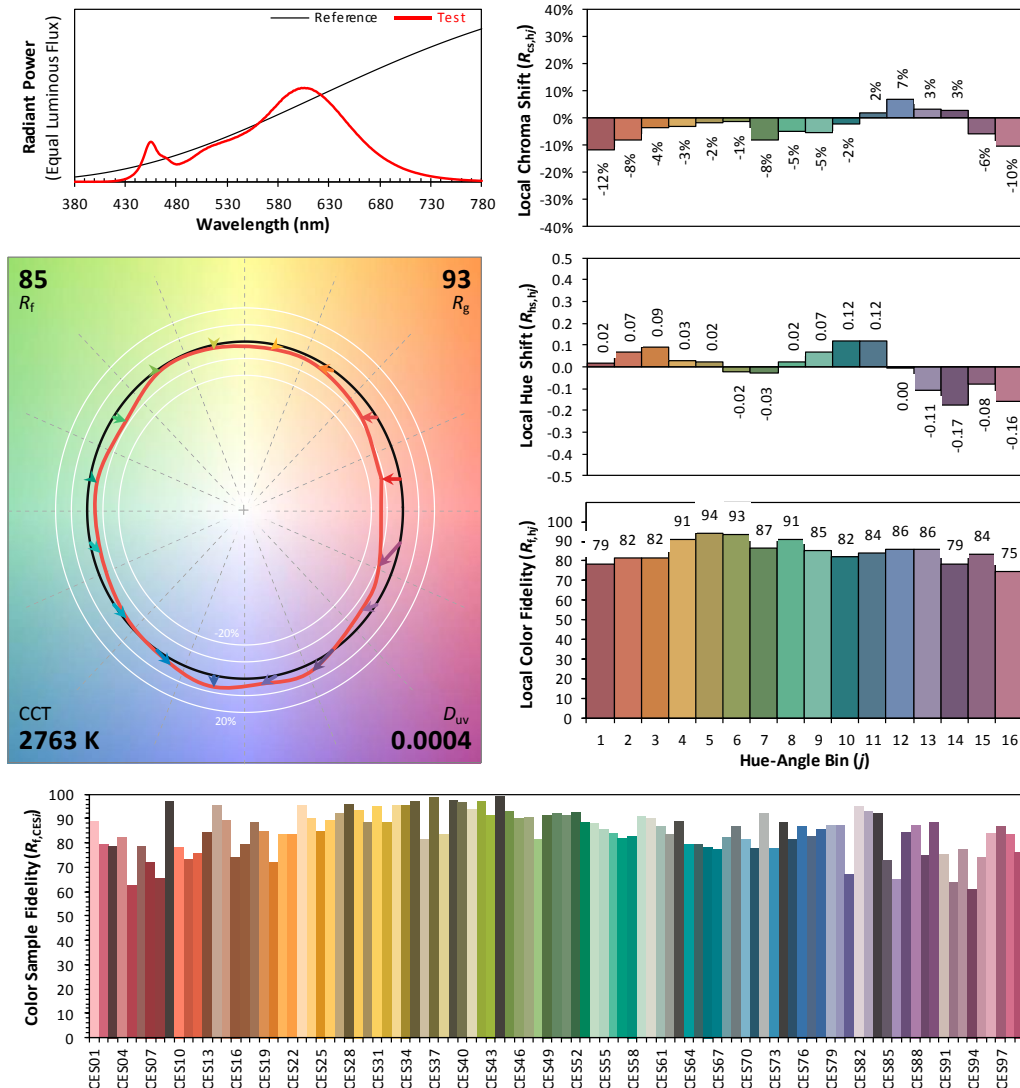
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: Espen Technology Inc.

Date: 2023/02/27

Model: L48T8/8F/12G-ID DE



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

x 0.4554
 y 0.4105
 u' 0.2596
 v' 0.5266

CIE 13.3-1995
(CRI)
 R_a 83
 R_9 7

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.

Goniophotometer Method

Test ambient temperature was 25.0 °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)	0.106
Power Factor	0.9796
Power (W)	12.44
Luminous Efficacy (lm/W)	137.7
Total Luminous Flux (lm)	1713.1
Beam Angle (°)	112.3 (0°-180°) / 214.0 (90°-270°)
Center Beam Candle Power (cd)	297
Maximum Beam Candle Power (cd)	297.4 (At: C=250.0, Gamma=0.5)
Spacing Criteria	1.28 (0°-180°) / 1.40 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	43.96%
Zonal Lumens in the 60 °-90 °Zone	26.70%
Zonal Lumens in the 90 °-120 °Zone	17.49%
Zonal Lumens in the 120 °-180 °Zone	11.85%

Table 4: Test data per Goniophotometer Method

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	28.201	1.65%
10- 20	81.681	4.77%
20- 30	126.663	7.39%
30- 40	159.146	9.29%
40- 50	177.023	10.33%
50- 60	180.398	10.53%
60- 70	171.248	10.00%
70- 80	153.393	8.95%
80- 90	132.725	7.75%
90-100	115.009	6.71%
100-110	99.547	5.81%
110-120	85.124	4.97%
120-130	70.867	4.14%
130-140	55.582	3.24%
140-150	40.719	2.38%
150-160	25.162	1.47%
160-170	9.192	0.54%
170-180	1.416	0.08%
Total	1713.1	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	753.112	43.96%
60- 90	457.366	26.70%
0-90	1210.48	70.66%
90- 180	502.618	29.34%
0- 180	1713.1	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

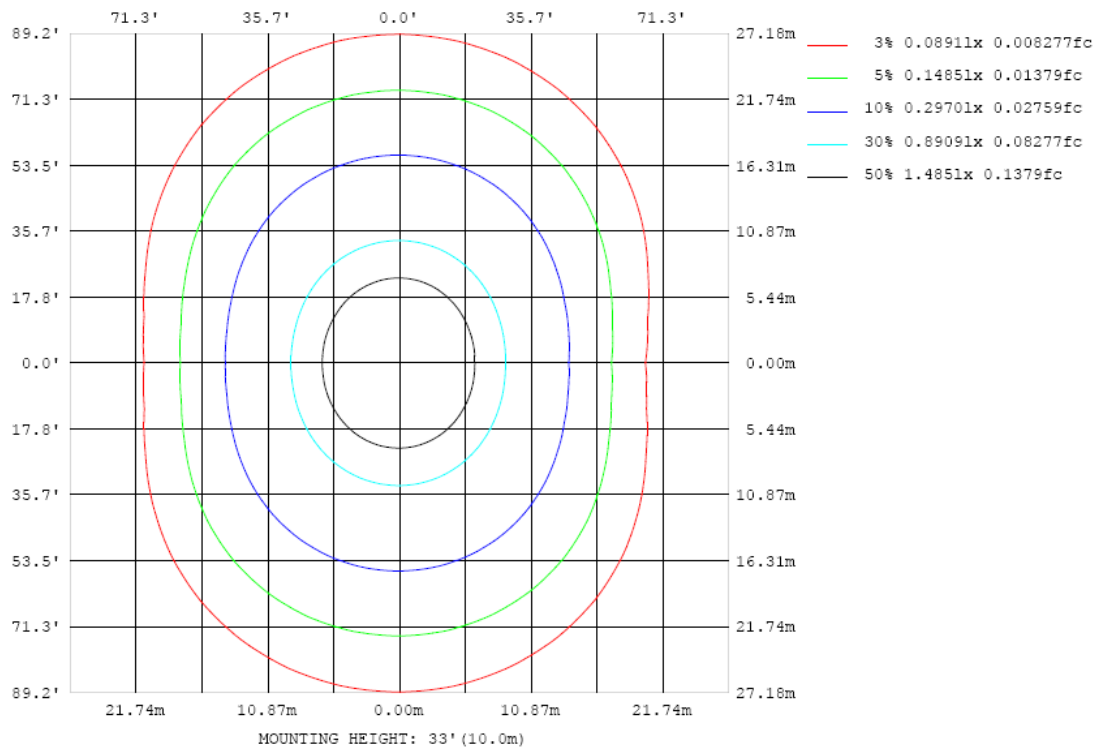


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

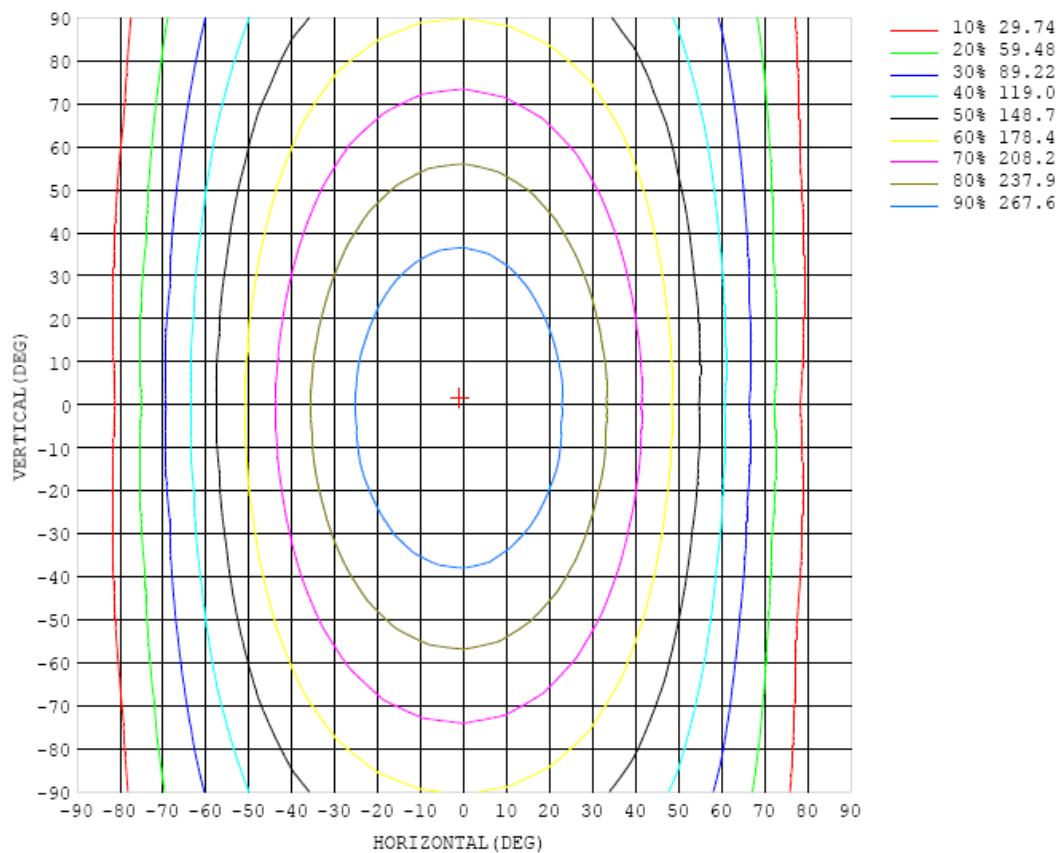


Chart 6: Isocandela Plot

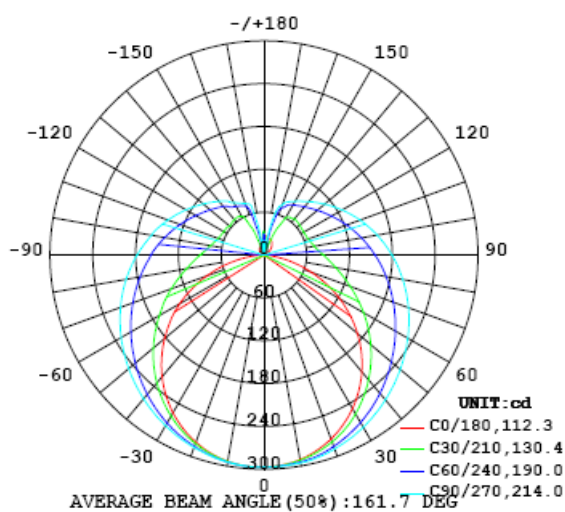


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DEG) γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	297	297	297	297	297	297	297	297	297	297	297	297	297	297	297	297	297	297	297
5	295	295	295	296	296	296	296	297	297	297	297	297	297	297	297	297	297	297	297
10	291	291	291	292	293	294	294	295	296	296	296	296	295	295	294	294	293	293	293
15	284	284	285	286	288	290	291	293	293	293	294	293	293	292	290	289	288	287	287
20	274	275	276	279	281	283	285	287	288	289	289	289	287	286	284	282	280	279	279
25	262	263	266	269	272	275	278	282	283	284	284	283	281	279	276	274	271	269	268
30	248	249	253	257	261	266	271	275	277	278	278	277	274	270	266	262	259	256	255
35	232	233	238	243	250	256	262	267	271	272	272	269	265	261	255	249	245	241	240
40	213	215	221	228	237	245	253	259	263	265	264	261	257	250	243	235	229	224	222
45	193	196	203	212	223	234	243	251	255	257	257	253	247	239	230	220	211	205	203
50	171	175	183	195	209	222	233	242	247	249	248	244	237	228	216	204	193	185	182
55	147	152	163	178	195	210	223	233	239	241	240	235	227	216	202	187	173	163	160
60	123	128	142	161	181	198	213	224	230	233	232	226	217	204	188	171	153	140	137
65	96.7	104	122	144	167	187	203	215	221	224	223	217	207	193	175	154	133	117	111
70	70.3	79.4	102	129	154	176	193	205	213	215	214	208	197	182	162	139	114	93.1	85.5
75	45.6	57.1	83.9	115	142	165	183	196	204	207	205	199	187	171	150	124	96.0	70.7	59.6
80	22.3	37.1	69.2	102	132	156	174	187	195	198	196	189	177	161	138	111	80.0	50.3	35.0
85	5.51	22.8	58.0	91.9	122	146	165	178	186	189	187	180	168	151	128	100.0	67.5	33.8	13.9
90	0.38	15.8	49.9	83.4	113	137	156	169	177	179	178	171	159	142	119	90.6	58.2	23.4	1.12
95	1.12	11.9	44.2	76.5	106	129	147	160	168	170	169	162	150	133	111	82.8	51.2	17.8	0.24
100	1.51	12.9	41.0	71.1	98.8	121	139	151	158	161	159	153	141	125	103	75.8	45.2	14.8	0.22
105	1.27	15.6	40.4	68.2	93.0	114	131	143	150	152	150	144	133	117	95.6	70.2	41.6	16.7	0.22
110	1.09	19.2	41.4	66.0	88.1	108	123	134	141	143	142	135	125	109	89.2	66.3	41.5	19.9	0.26
115	2.26	22.4	43.4	64.8	84.2	102	116	126	132	135	133	127	117	102	84.0	64.1	42.7	23.9	1.69
120	5.25	22.3	46.0	64.4	81.0	96.5	109	119	124	126	125	119	110	96.6	80.4	63.1	44.8	27.5	3.92
125	8.56	12.9	48.9	64.6	78.5	91.9	103	112	117	118	117	112	103	91.8	77.7	62.9	47.4	29.6	6.33
130	11.5	5.78	50.3	65.2	76.7	87.9	97.6	105	109	111	110	105	97.7	87.7	75.5	63.3	50.3	26.3	7.72
135	14.4	4.21	51.4	66.1	75.3	84.6	92.6	98.9	103	104	103	99.0	92.7	84.2	74.0	64.1	52.9	16.6	8.90
140	17.2	12.8	45.2	66.2	74.3	81.8	88.3	93.5	96.6	97.7	96.7	93.5	88.3	81.2	73.0	65.1	52.0	6.34	10.1
145	19.8	7.47	29.8	64.3	73.2	79.4	84.5	88.6	91.0	92.0	91.1	88.6	84.4	78.9	72.4	63.4	47.9	3.72	11.1
150	21.8	3.57	9.23	58.6	69.8	76.9	81.2	84.3	86.1	86.9	86.2	84.3	81.1	76.9	70.6	58.8	30.1	12.3	11.9
155	23.1	8.46	7.86	33.9	65.5	71.1	76.9	80.2	81.9	82.5	82.0	80.5	77.8	71.8	64.6	44.0	8.42	9.15	12.7
160	23.5	20.6	16.4	10.4	38.3	61.1	69.6	72.4	73.8	74.7	74.0	72.5	69.6	61.4	40.9	15.4	3.58	5.95	13.4
165	23.3	19.6	3.17	17.1	8.15	13.5	40.5	49.8	58.2	61.8	61.1	55.5	41.0	28.3	7.34	4.88	12.0	3.80	13.9
170	25.2	15.3	20.0	5.78	13.6	14.3	6.99	8.63	11.2	11.4	11.3	9.41	7.87	8.26	12.1	10.8	6.24	20.7	18.3
175	27.1	21.8	21.2	26.5	21.9	13.8	6.27	6.45	6.18	8.00	6.70	6.30	6.32	6.33	8.64	17.3	27.5	28.7	25.0
180	28.7	28.3	28.0	27.4	26.6	25.6	24.4	22.1	21.1	0.00	21.1	18.6	17.8	19.6	20.7	21.3	21.7	23.2	28.6

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	297	297	297	297	297	297	297	297	297	297	297	297	297	297	297	297	297		
5	296	297	297	297	297	297	297	297	297	297	296	296	296	296	296	295	296		
10	293	294	294	294	294	294	295	295	295	294	294	293	293	292	292	291	291		
15	287	288	289	289	290	291	291	291	291	291	290	289	288	287	286	285	284		
20	279	280	281	282	284	285	287	287	287	286	285	283	281	279	277	276	275		
25	269	270	272	274	277	279	281	282	282	281	279	277	273	270	267	265	263		
30	256	258	261	264	268	272	275	276	276	275	272	269	264	260	255	252	250		
35	241	244	248	253	259	264	268	269	270	268	265	260	255	248	242	237	234		
40	224	228	234	241	248	255	260	262	263	261	257	251	244	235	227	220	216		
45	205	210	219	228	237	245	251	255	255	253	249	242	233	222	212	202	196		
50	184	192	203	215	226	235	243	246	248	245	240	232	221	209	195	183	175		
55	163	172	186	201	214	226	234	238	240	237	231	222	209	195	179	164	154		
60	141	154	169	187	203	216	225	230	231	229	222	212	198	181	162	145	130		
65	117	133	154	173	191	206	216	221	223	220	213	202	187	168	147	125	106		
70	93.3	114	138	161	180	196	207	213	214	211	204	192	176	157	132	105	82.3		
75	69.9	95.1	124	150	170	186	197	204	205	202	195	183	166	145	118	88.0	59.9		
80	48.8	78.8	110	138	160	176	188	195	196	193	186	173	157	134	106	73.3	40.7		
85	31.6	65.4	99.0	128	151	167	179	185	187	184	177	164	148	124	95.5	61.9	27.0		
90	21.0	55.7	89.6	119	142	159	170	176	178	175	168	157	139	116	87.0	53.9	20.1		
95	17.2	49.5	82.0	110	133	150	161	167	169	166	159	148	130	108	80.2	48.9	18.6		
100	17.7	45.9	76.1	103	125	141	153	159	160	159	151	139	123	101	75.0	46.3	20.1		
105	20.5	44.6	71.7	96.6	117	133	144	150	152	150	143	131	115	95.1	71.2	45.6	23.5		
110	24.5	44.9	68.6	91.2	110	125	136	142	143	141	135	124	109	90.1	68.6	46.3	28.0		
115	29.2	46.2	66.5	86.6	104	118	128	133	135	133	127	117	103	86.0	67.0	48.0	32.9		
120	34.0	48.3	65.4	82.8	98.3	111	120	125	127	125	119	110	97.6	82.6	66.2	50.4	37.4		
125	36.9	50.9	65.1	79.9	93.3	104	113	117	119	117	112	104	93.0	80.1	66.1	51.9	40.2		
130	28.8	52.3	63.4	77.6	89.0	98.6	106	110	111	110	105	98.4	89.0	78.0	63.5	54.1	31.3		
135	9.43	54.4	64.2	74.9	85.4	93.5	99.6	103	104	103	99.4	93.5	85.6	74.3	65.1	55.7	16.8		
140	7.33	56.3	64.7	71.4	81.1	88.9	94.0	97.1	98.2	97.1	94.0	89.1	80.4	72.6	66.0	57.4	9.71		
145	12.2	46.5	65.1	71.5	76.6	82.1	88.2	91.4	92.3	91.4	87.7	82.5	77.8	72.3	66.0	52.1	6.80		
150	12.2	28.4	62.6	70.5	75.0	78.8	81.9	83.6	84.5	83.8	82.1	79.4	75.8	71.7	66.1	33.3	13.8		
155	5.70	7.88	44.0	63.0	73.1	75.9	78.2	79.5	80.3	79.9	78.6	76.7	74.2	70.7	55.6	13.1	12.1		
160	10.6	14.6	8.24	40.7	61.7	72.3	74.9	76.0	76.7	76.6	75.6	74.3	72.3	60.3	31.8	8.46	8.73		
165	24.8	5.10	13.6	7.54	23.6	39.3	56.2	71.4	72.9	72.8	70.3	60.2	47.4	27.4	10.6	12.8	7.47		
170	21.0	20.4	6.40	12.9	11.6	5.11	7.78	15.8	16.5	17.1	15.3	13.5	10.9	7.91	16.1	9.50	7.30		
175	25.0	30.9	23.4	12.5	8.07	8.69	9.10	8.81	6.93	6.43	10.4	10.6	8.09	7.36	10.3	15.0	26.3		
180	28.7	28.5	28.4	27.6	26.1	24.6	23.5	22.5	20.1	0.86	15.8	21.8	21.8	22.3	22.6	22.9	23.5		

Table 7: Luminous Intensity Data

TEST RESULTS (3500K Setting)

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	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.104	0.048
Power Factor	0.9797	0.9155
Test Power (W)	12.25	12.23
THD A%	17.92	19.23
Luminous Efficacy (lm/W)	153.2	151.4
Total Luminous Flux (lm)	1876.4	1851.9
Color Rendering Index (CRI)	85.4	
R9	19.2	
Correlated Color Temperature (CCT)(K)	3445	
Chromaticity Chroma x	0.4056	
Chromaticity Chroma y	0.3851	
Chromaticity Chroma u	0.2382	
Chromaticity Chroma v	0.3393	
Duv	-0.0025	
Chromaticity Chroma u'	0.2382	
Chromaticity Chroma v'	0.5090	

Special Color Rendering Indices	
R1	85.5
R2	94.9
R3	94.4
R4	82.7
R5	85.5
R6	92.2
R7	83.3
R8	64.4
R9	19.2
R10	87.6
R11	82.9
R12	69.9
R13	88.4
R14	97.9

Table 8: Test data per Sphere-Spectroradiometer Method

Note: According to CIE 1976 (u', v') diagram, $u' = u = 4x/(-2x+12y+3)$, $v' = 3v/2 = 9y/(-2x+12y+3)$.

Spectral Power Distribution - Sphere Spectroradiometer Method

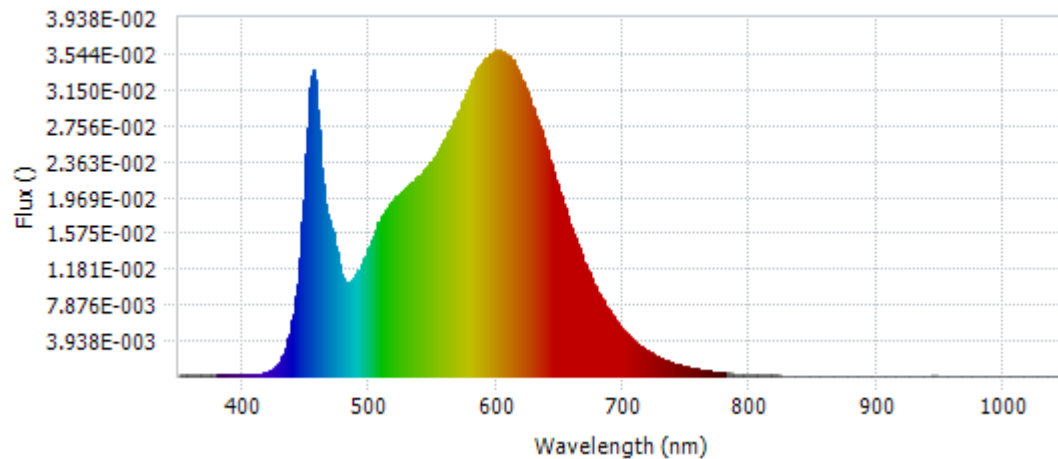
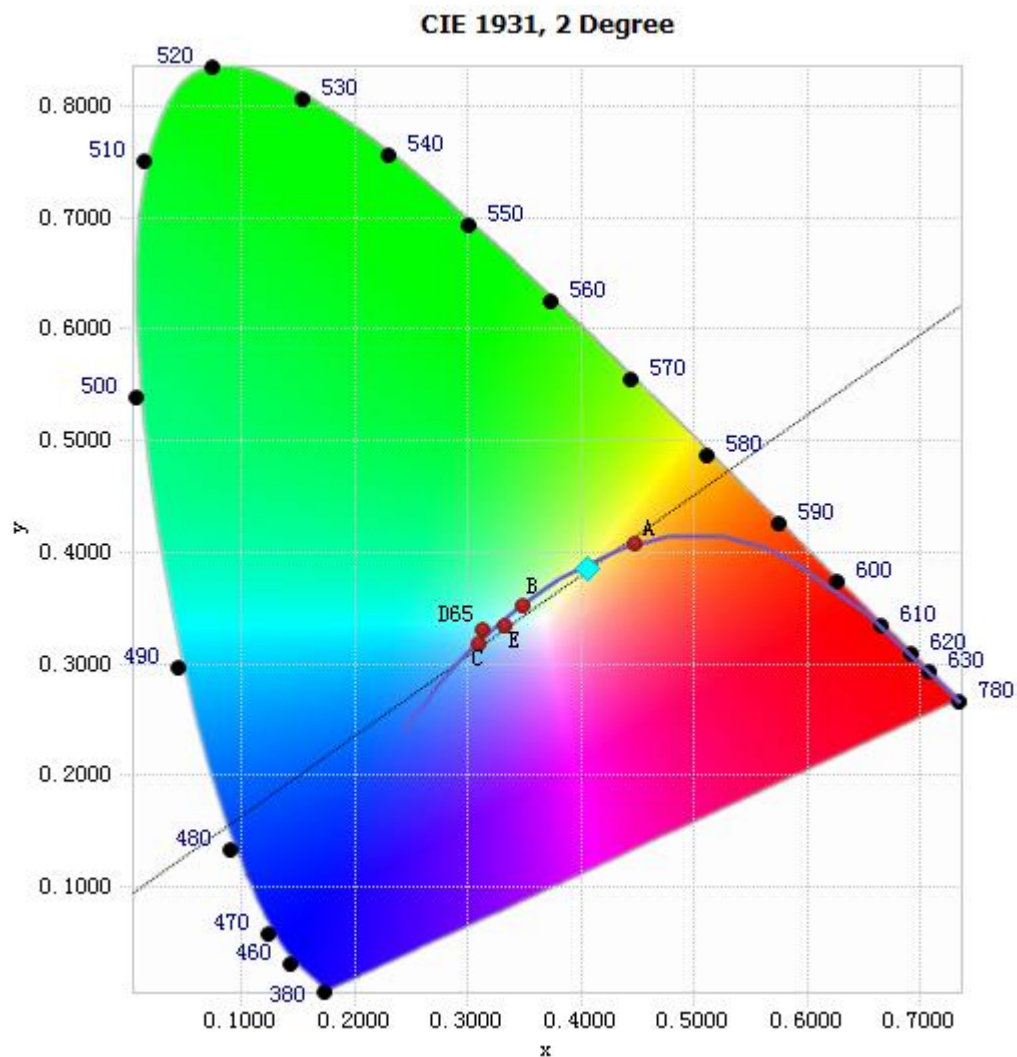


Chart 8: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.69E-04	485	1.04E-02	590	3.47E-02	695	5.98E-03
385	1.46E-04	490	1.14E-02	595	3.54E-02	700	5.13E-03
390	1.61E-04	495	1.26E-02	600	3.58E-02	705	4.37E-03
395	1.61E-04	500	1.44E-02	605	3.56E-02	710	3.73E-03
400	1.45E-04	505	1.62E-02	610	3.51E-02	715	3.17E-03
405	1.37E-04	510	1.76E-02	615	3.41E-02	720	2.73E-03
410	1.94E-04	515	1.88E-02	620	3.26E-02	725	2.32E-03
415	2.86E-04	520	1.95E-02	625	3.10E-02	730	1.97E-03
420	5.27E-04	525	2.03E-02	630	2.90E-02	735	1.67E-03
425	9.70E-04	530	2.09E-02	635	2.70E-02	740	1.43E-03
430	1.86E-03	535	2.14E-02	640	2.48E-02	745	1.23E-03
435	3.61E-03	540	2.21E-02	645	2.25E-02	750	1.05E-03
440	6.91E-03	545	2.29E-02	650	2.02E-02	755	8.82E-04
445	1.30E-02	550	2.38E-02	655	1.81E-02	760	7.57E-04
450	2.44E-02	555	2.49E-02	660	1.60E-02	765	6.51E-04
455	3.37E-02	560	2.62E-02	665	1.41E-02	770	5.44E-04
460	2.70E-02	565	2.76E-02	670	1.23E-02	775	4.66E-04
465	1.89E-02	570	2.90E-02	675	1.07E-02	780	4.01E-04
470	1.63E-02	575	3.06E-02	680	9.32E-03		
475	1.29E-02	580	3.22E-02	685	8.04E-03		
480	1.04E-02	585	3.37E-02	690	6.96E-03		

Table 9: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4056, 0.3851)

Chart 9: 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

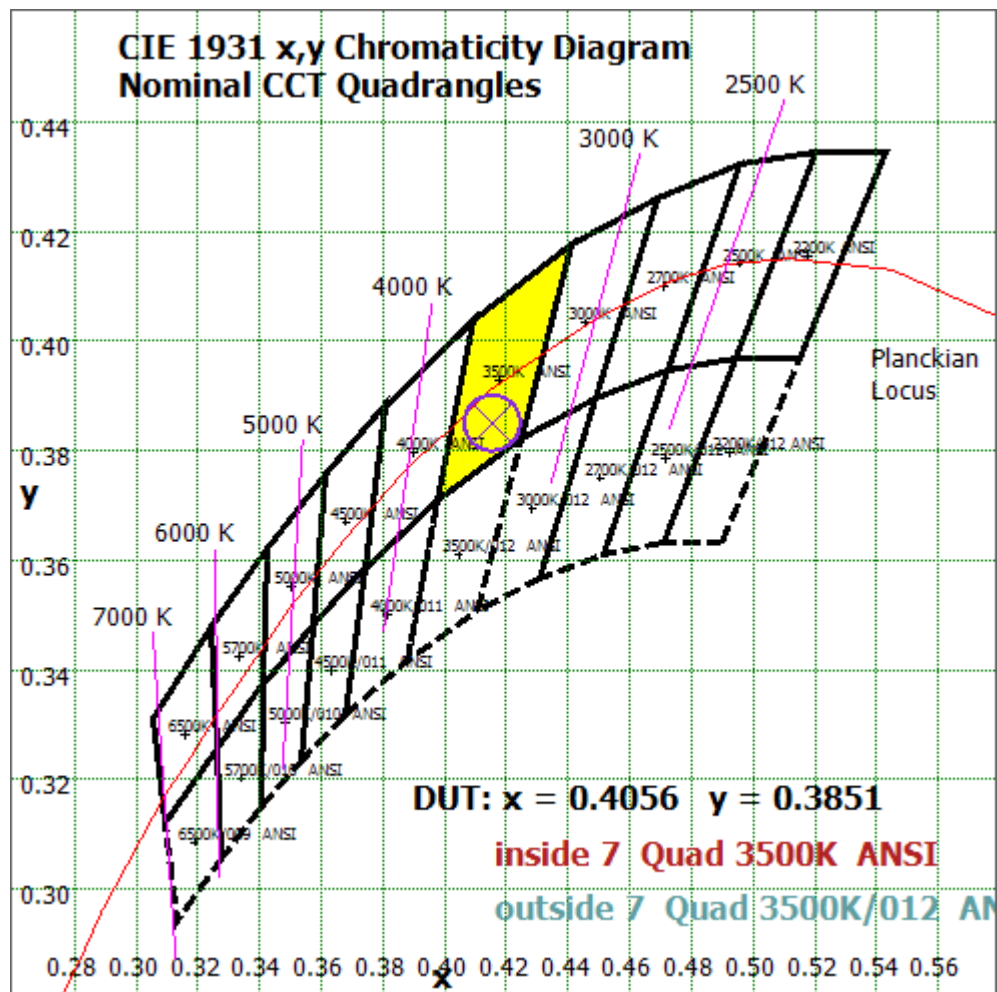


Chart 10: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

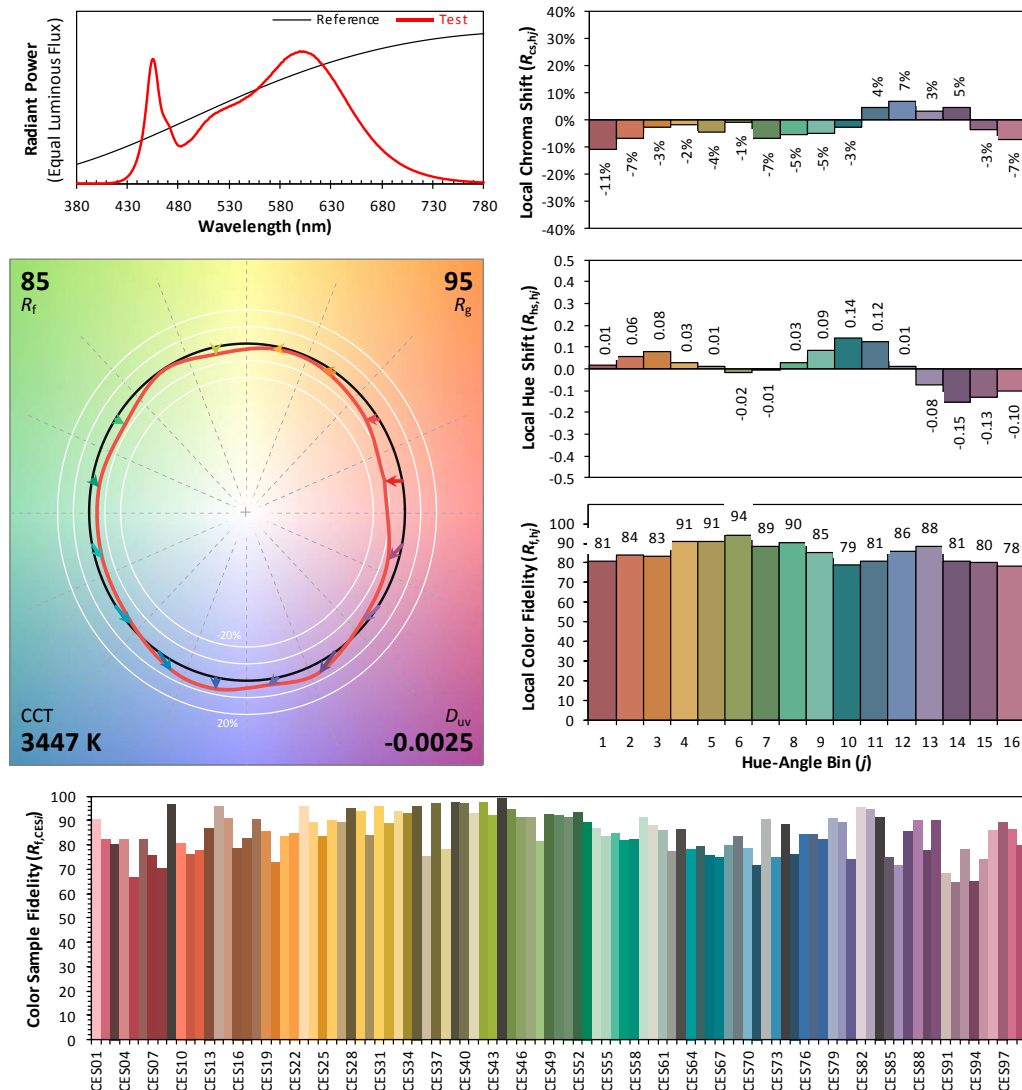
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: Espen Technology Inc.

Date: 2023/02/27

Model: L48T8/8F/12G-ID DE



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

x 0.4056
 y 0.3851
 u' 0.2382
 v' 0.5090

CIE 13.3-1995
(CRI)
 R_a 85
 R_g 19

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

Chart 11: 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 8 due to rounding.

TEST RESULTS (5000K Setting)

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	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.106	0.049
Power Factor	0.9790	0.9188
Test Power (W)	12.50	12.46
THD A%	18.43	18.76
Luminous Efficacy (lm/W)	150.2	148.8
Total Luminous Flux (lm)	1878.0	1853.7
Color Rendering Index (CRI)	83.8	
R9	8.6	
Correlated Color Temperature (CCT)(K)	5061	
Chromaticity Chroma x	0.3436	
Chromaticity Chroma y	0.3543	
Chromaticity Chroma u	0.2094	
Chromaticity Chroma v	0.3238	
Duv	0.0019	
Chromaticity Chroma u'	0.2094	
Chromaticity Chroma v'	0.4857	

Special Color Rendering Indices	
R1	82.4
R2	90.7
R3	94.6
R4	82
R5	82.6
R6	85.8
R7	86.2
R8	66.4
R9	8.6
R10	77.2
R11	81.4
R12	61
R13	85
R14	97.6

Table 10: Test data per Sphere-Spectroradiometer Method

Note: According to CIE 1976 (u', v') diagram, $u' = u / (-2x + 12y + 3)$, $v' = 3v / 2 = 9y / (-2x + 12y + 3)$.

Spectral Power Distribution - Sphere Spectroradiometer Method

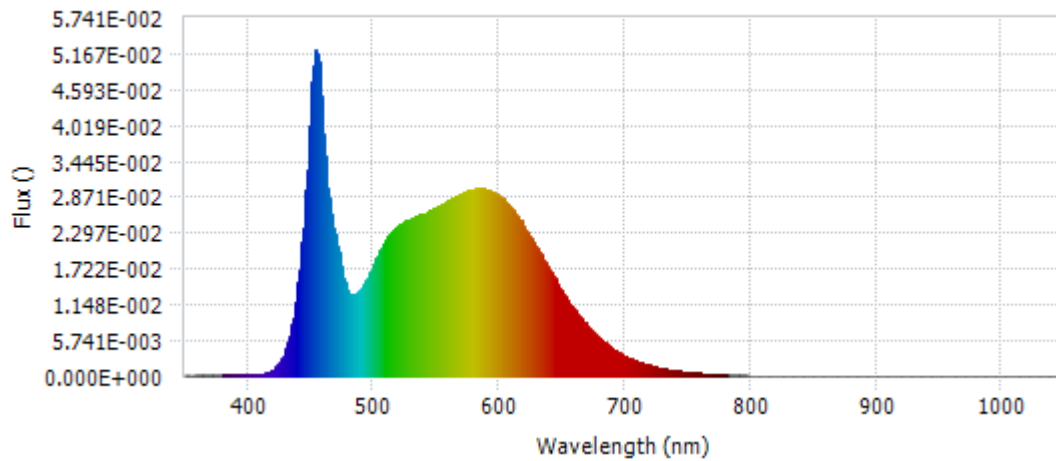
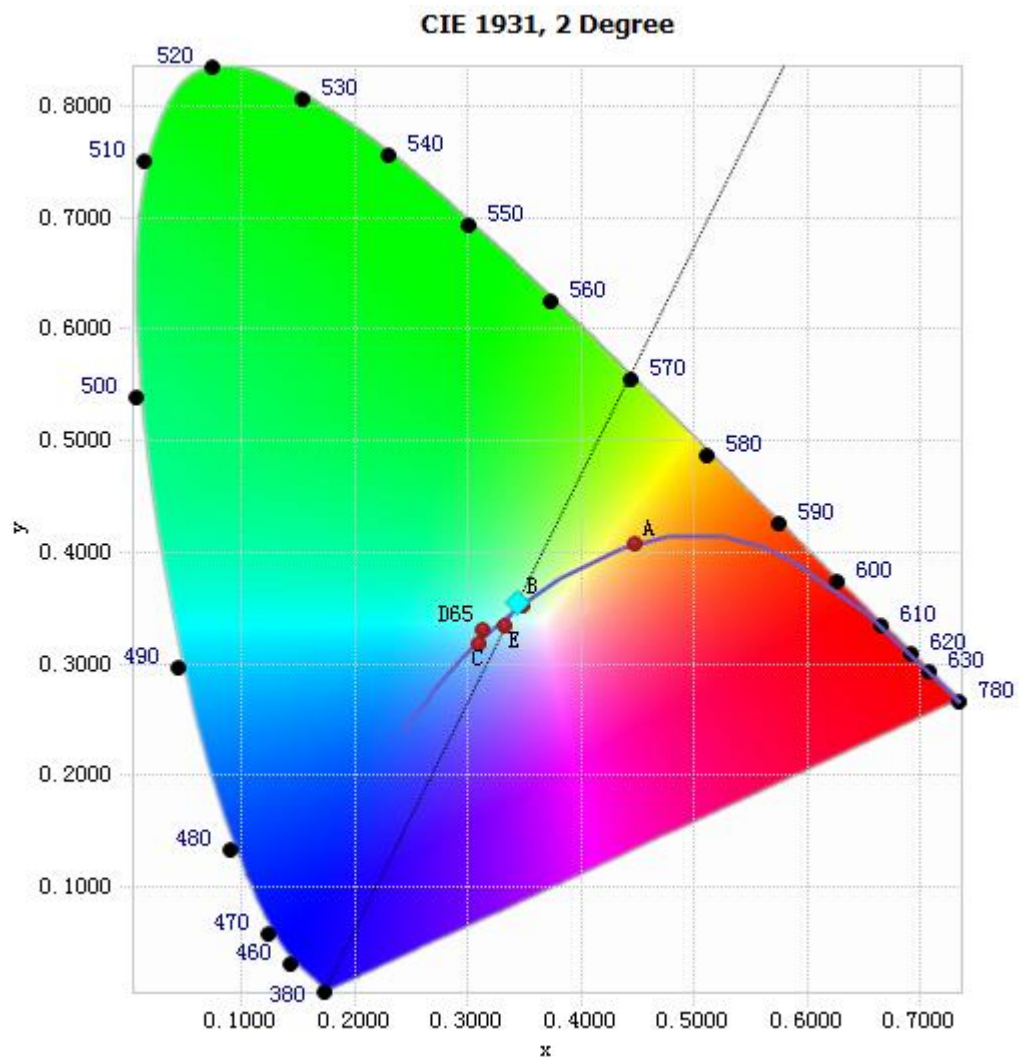


Chart 12: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.30E-04	485	1.31E-02	590	2.99E-02	695	3.80E-03
385	1.79E-04	490	1.41E-02	595	2.95E-02	700	3.26E-03
390	2.12E-04	495	1.58E-02	600	2.88E-02	705	2.77E-03
395	1.99E-04	500	1.79E-02	605	2.79E-02	710	2.38E-03
400	1.87E-04	505	2.01E-02	610	2.68E-02	715	2.02E-03
405	2.01E-04	510	2.18E-02	615	2.54E-02	720	1.72E-03
410	2.89E-04	515	2.33E-02	620	2.38E-02	725	1.47E-03
415	5.53E-04	520	2.40E-02	625	2.22E-02	730	1.25E-03
420	1.09E-03	525	2.48E-02	630	2.05E-02	735	1.06E-03
425	2.19E-03	530	2.54E-02	635	1.87E-02	740	9.15E-04
430	4.33E-03	535	2.57E-02	640	1.70E-02	745	7.75E-04
435	8.29E-03	540	2.60E-02	645	1.52E-02	750	6.66E-04
440	1.51E-02	545	2.66E-02	650	1.35E-02	755	5.68E-04
445	2.65E-02	550	2.69E-02	655	1.20E-02	760	4.90E-04
450	4.38E-02	555	2.76E-02	660	1.06E-02	765	4.18E-04
455	5.18E-02	560	2.82E-02	665	9.22E-03	770	3.58E-04
460	3.87E-02	565	2.87E-02	670	7.98E-03	775	3.05E-04
465	2.71E-02	570	2.92E-02	675	6.95E-03	780	2.64E-04
470	2.18E-02	575	2.97E-02	680	5.98E-03		
475	1.66E-02	580	2.99E-02	685	5.18E-03		
480	1.33E-02	585	3.01E-02	690	4.45E-03		

Table 11: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3436, 0.3543)

Chart 13: 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

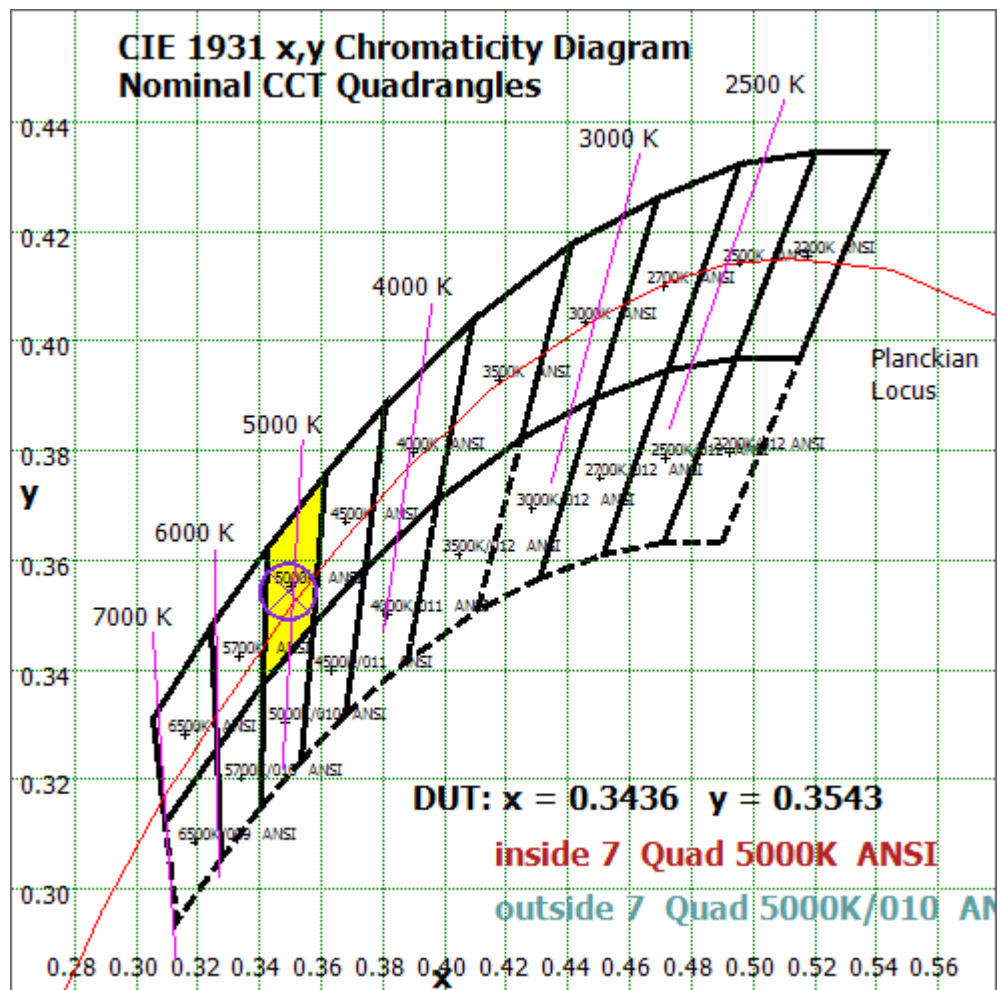


Chart 14: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

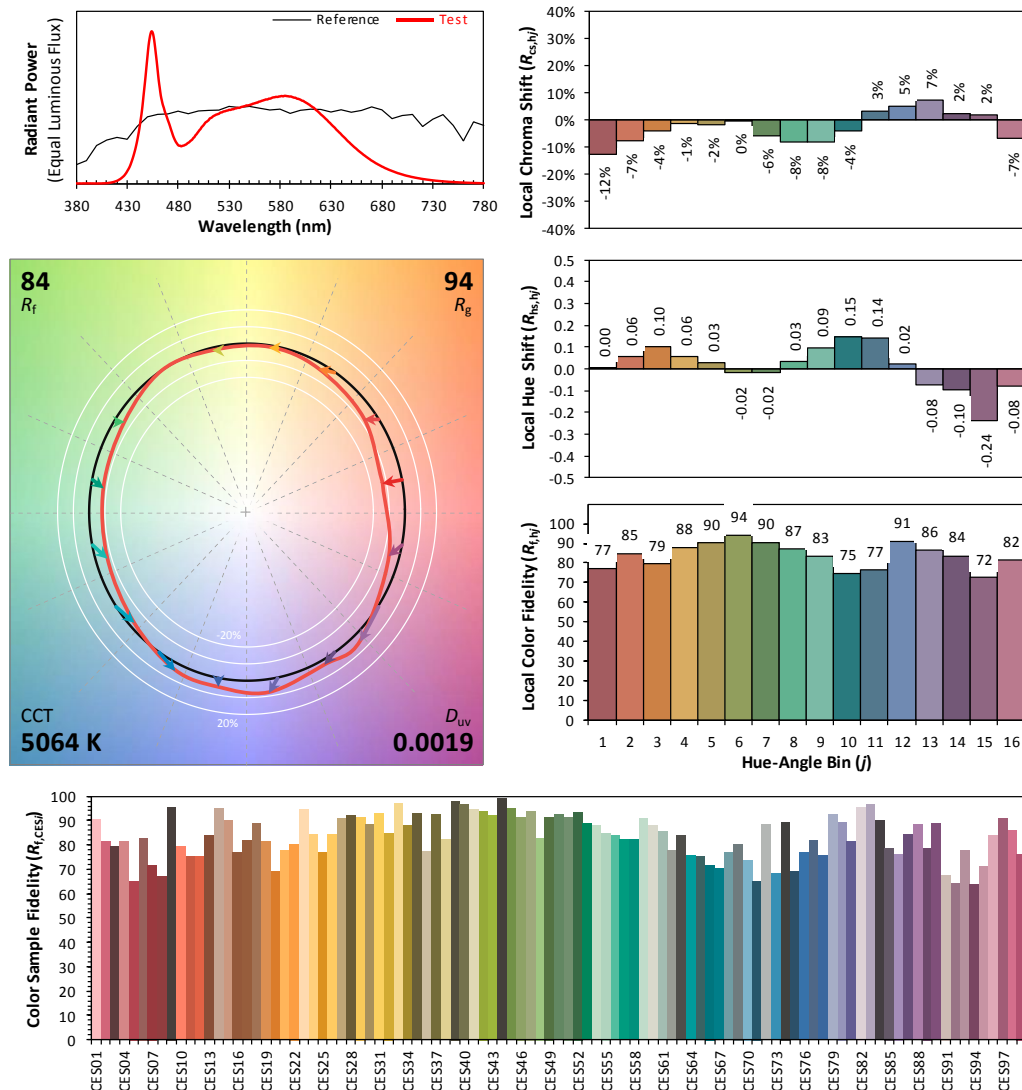
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: Espen Technology Inc.

Date: 2023/02/27

Model: L48T8/8F/12G-ID DE



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

x 0.3436
 y 0.3543
 u' 0.2094
 v' 0.4857

CIE 13.3-1995
(CRI)
 R_a 84
 R_g 9

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

Chart 15: 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 10 due to rounding.

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 12: 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 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 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 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 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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