

LM-79-08 TEST REPORT

for

ESPEN TECHNOLOGY, INC.

12257 FLORENCE AVE SANTA FE SPRINGS, CA. 90670-3805. LOS ANGELES US

LED Tube

Model: LB48T8U6/8T/13P-AB

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ24030021d

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
Mar. 18, 2024

Manager: April Zou
Mar. 18, 2024

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	LB48T8U6/8T/13P-AB 3500K Setting	LB48T8U6/8T/13P-AB 4000K Setting	LB48T8U6/8T/13P-AB 5000K Setting
Luminous Efficacy (Lumens /Watt)	125.5	132.8	128.8
Total Luminous Flux (Lumens)	1880.6	1949.3	1917.8
Power (Watts)/2	14.98	14.68	14.89
Power Factor	0.9956	0.9956	0.9956
CCT (K)	3430	4256	5107
CRI	84.5	86.1	85.6
Stabilization Time(Light & Power)	60	60	60
Note	3500K	4000K	5000K

Table 1: Executive Data Summary

Test specifications:

Date of Receipt : Sep. 16, 2021

Date of Test : Sep. 17, 2021

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

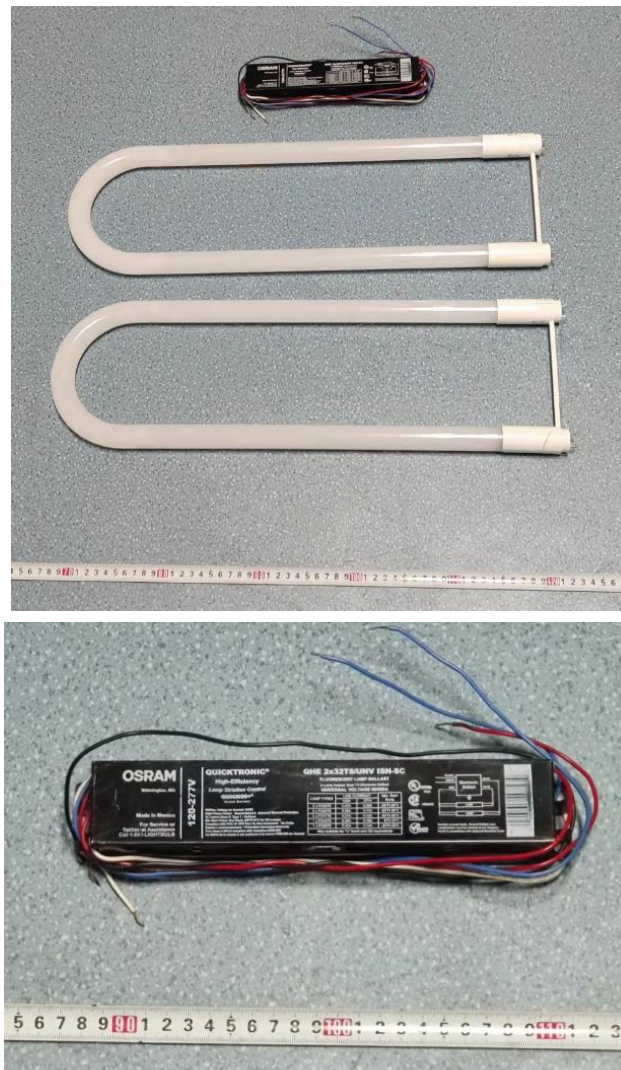


Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: LB48T8U6/8T/13P-AB
Electrical Ratings	: 120-277V, 50/60Hz, 16W
Product Description	: Color- Tunable 3500K/4000K/5000K LED Tubes supplied by a high frequency fluorescent lamp ballast: QHE 2x32T8/UNV ISN-SC

TEST RESULTS (3500K Setting)

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)	0.251	0.114
Power Factor	0.9956	0.9563
Test Power (W)/2	14.98	15.13
THD A%	5.77	13.81
Luminous Efficacy (lm/W)	125.5	124.3
Total Luminous Flux (lm)	1880.6	1879.5
Color Rendering Index (CRI)	84.5	
R9	13.4	
Correlated Color Temperature (CCT)(K)	3430	
Chromaticity Chroma x	0.4081	
Chromaticity Chroma y	0.3899	
Chromaticity Chroma u	0.2379	
Chromaticity Chroma v	0.3409	
Duv	-0.0010	
Chromaticity Chroma u'	0.2379	
Chromaticity Chroma v'	0.5113	

Special Color Rendering Indices	
R1	83.3
R2	91.8
R3	96.5
R4	83.3
R5	83.7
R6	89.5
R7	84.6
R8	63.5
R9	13.4
R10	81.2
R11	83.3
R12	71
R13	85.5
R14	98.7

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

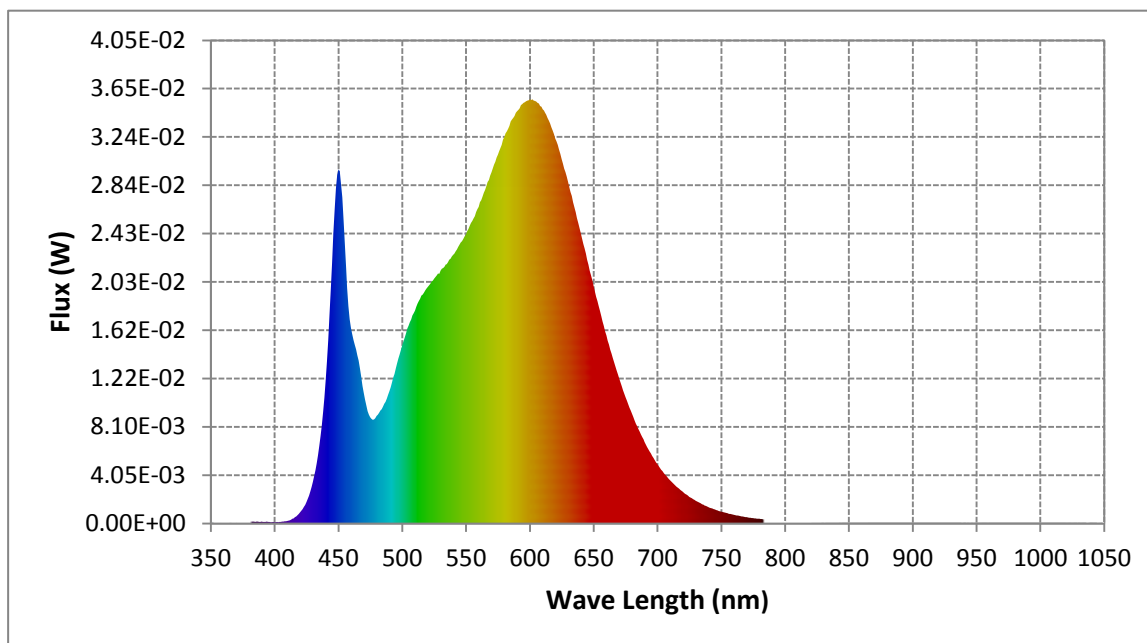
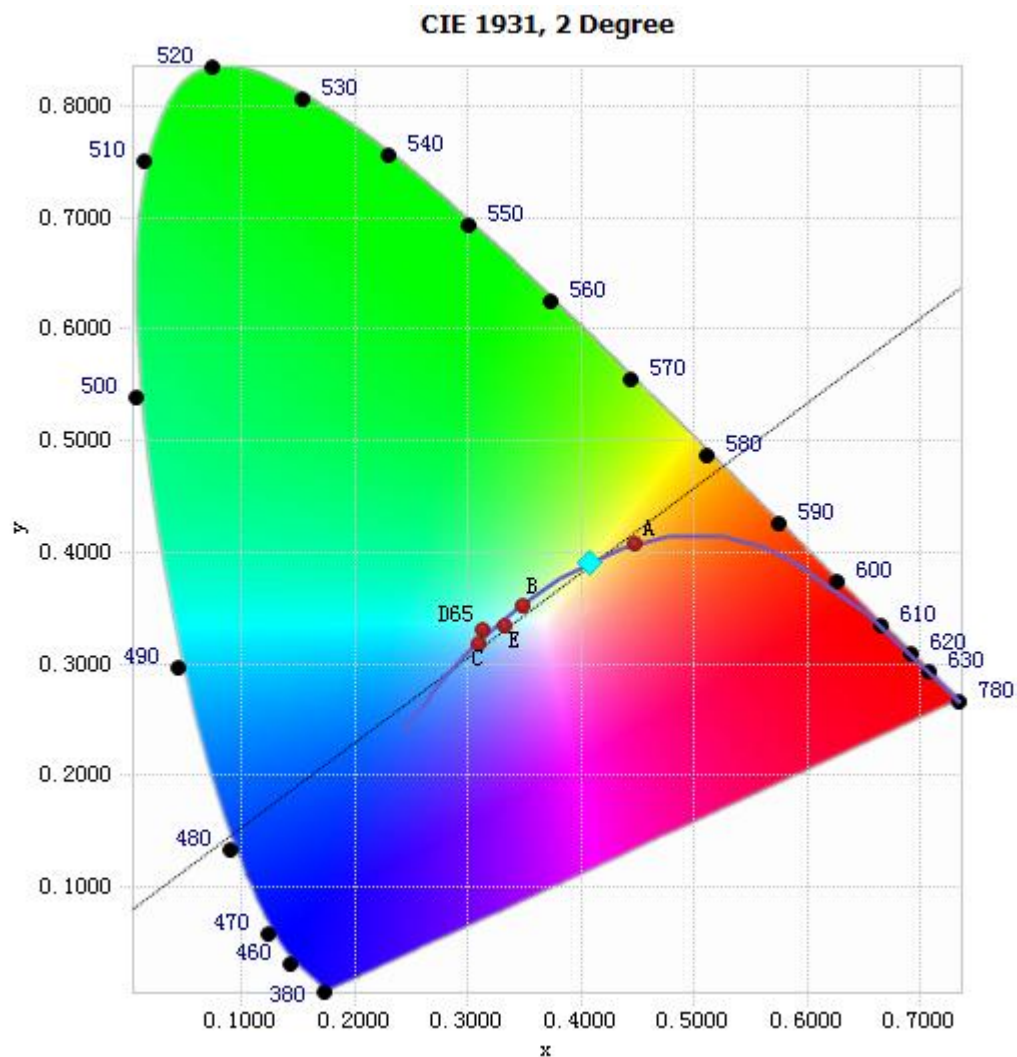


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.54E-04	485	9.80E-03	590	3.46E-02	695	5.87E-03
385	1.40E-04	490	1.11E-02	595	3.52E-02	700	4.99E-03
390	1.51E-04	495	1.30E-02	600	3.56E-02	705	4.25E-03
395	1.31E-04	500	1.49E-02	605	3.54E-02	710	3.62E-03
400	1.14E-04	505	1.66E-02	610	3.47E-02	715	3.08E-03
405	1.28E-04	510	1.78E-02	615	3.38E-02	720	2.65E-03
410	2.14E-04	515	1.91E-02	620	3.23E-02	725	2.24E-03
415	4.37E-04	520	1.98E-02	625	3.06E-02	730	1.90E-03
420	9.25E-04	525	2.05E-02	630	2.87E-02	735	1.61E-03
425	1.80E-03	530	2.12E-02	635	2.65E-02	740	1.37E-03
430	3.48E-03	535	2.17E-02	640	2.43E-02	745	1.17E-03
435	6.48E-03	540	2.25E-02	645	2.21E-02	750	9.99E-04
440	1.20E-02	545	2.34E-02	650	1.99E-02	755	8.50E-04
445	2.18E-02	550	2.42E-02	655	1.78E-02	760	7.19E-04
450	2.97E-02	555	2.53E-02	660	1.58E-02	765	6.09E-04
455	2.34E-02	560	2.65E-02	665	1.39E-02	770	5.27E-04
460	1.64E-02	565	2.80E-02	670	1.21E-02	775	4.47E-04
465	1.41E-02	570	2.94E-02	675	1.06E-02	780	3.85E-04
470	1.09E-02	575	3.09E-02	680	9.19E-03		
475	8.89E-03	580	3.24E-02	685	7.92E-03		
480	9.01E-03	585	3.37E-02	690	6.84E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4081, 0.3899)

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

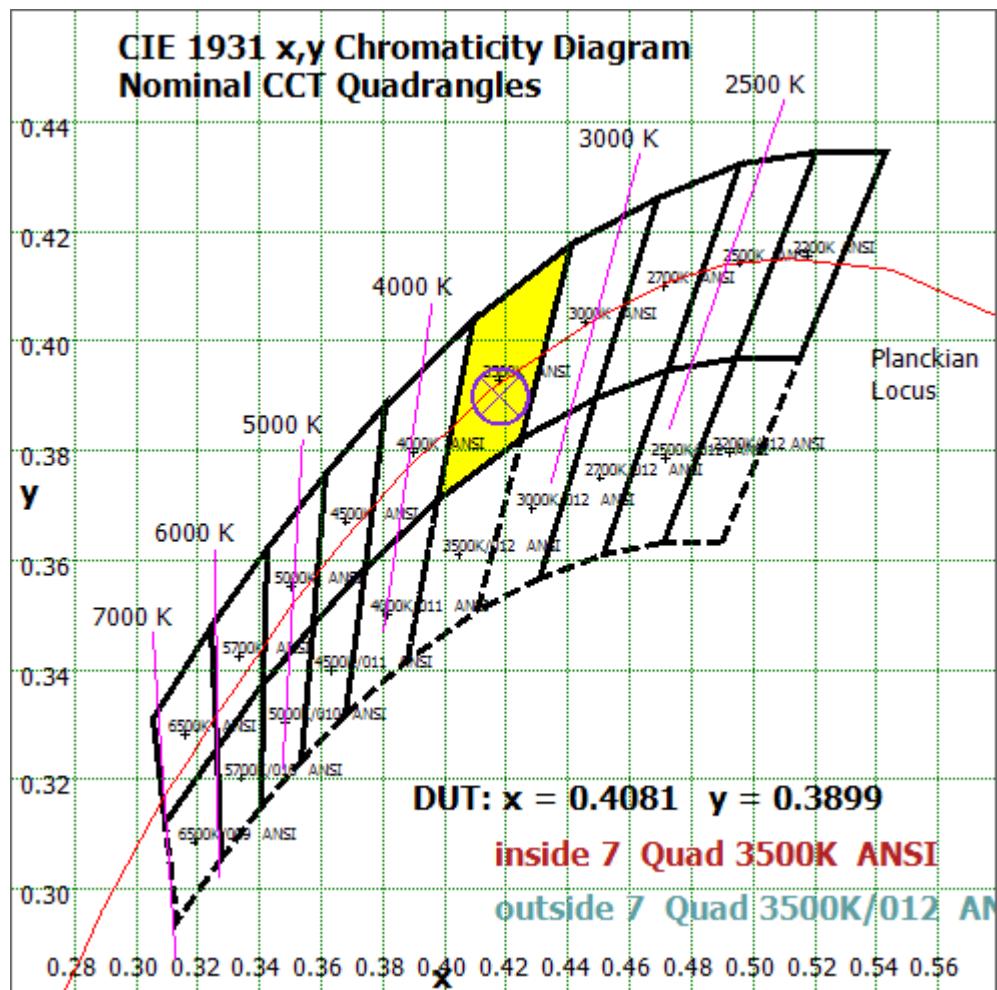


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

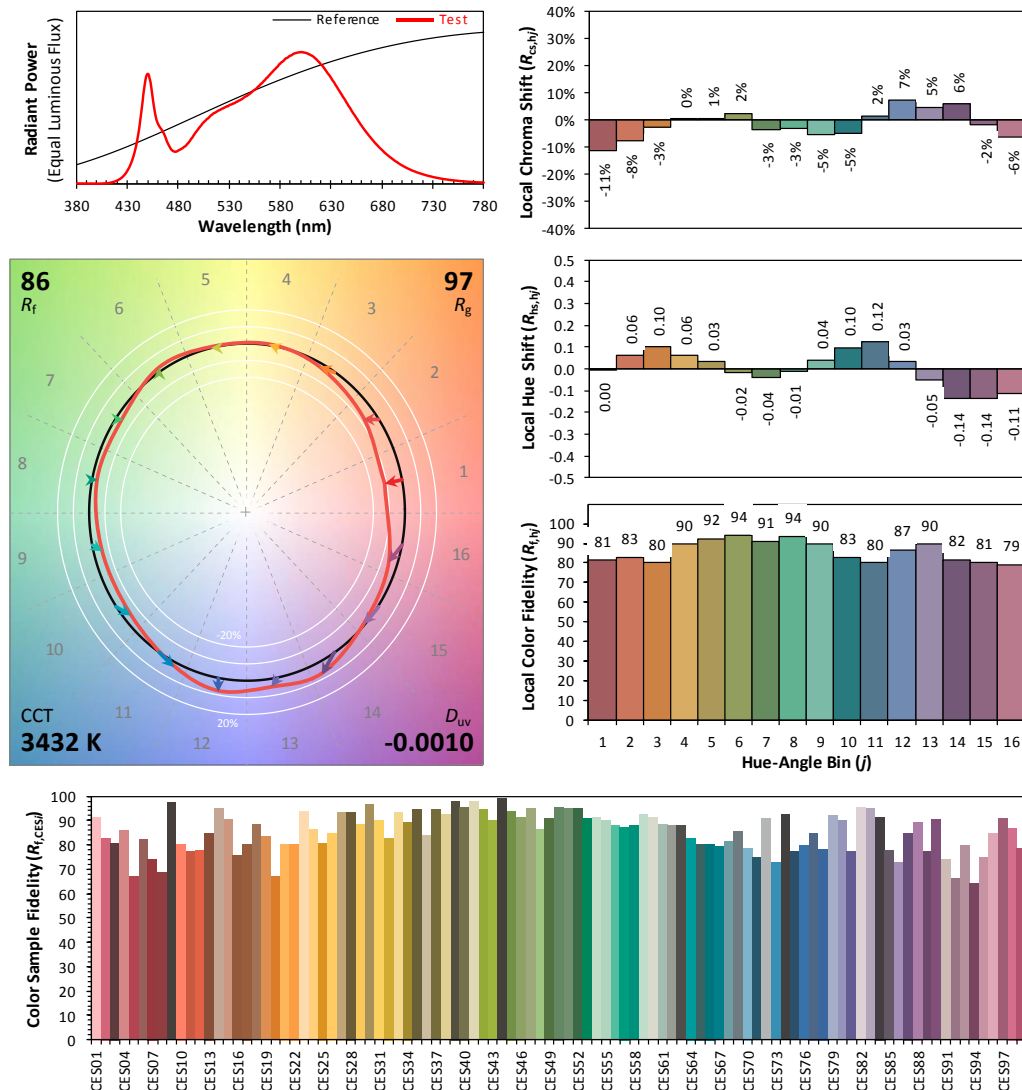
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: ESPEN TECHNOLOGY, INC.

Date: 2021/09/17

Model: LB48T8U6/8T/13P-AB



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

x 0.4081
 y 0.3899
 u' 0.2379
 v' 0.5113

CIE 13.3-1995
(CRI)
 R_a 85
 R_9 14

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 25.1 °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)	0.251
Power Factor	0.9953
Power (W)/2	14.97
Luminous Efficacy (lm/W)	123.9
Total Luminous Flux (lm)	1855.3
Beam Angle (°)	110.1 (0°-180°) / 162.0 (90°-270°)
Center Beam Candle Power (cd)	388
Maximum Beam Candle Power (cd)	388.9 (At: C=140.0, Gamma=3.5)
Spacing Criteria	1.27 (0°-180°) / 1.35 (90°-270°)
Zonal Lumens in the 0°-60° Zone	51.11%
Zonal Lumens in the 60°-90° Zone	26.60%
Zonal Lumens in the 90°-120° Zone	12.75%
Zonal Lumens in the 120°-180° Zone	9.54%

Table 4: Test data per Goniophotometer Method

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	36.736	1.98%
10- 20	105.88	5.71%
20- 30	162.881	8.78%
30- 40	202.116	10.89%
40- 50	220.888	11.91%
50- 60	219.762	11.84%
60- 70	202.084	10.89%
70- 80	172.586	9.30%
80- 90	118.784	6.40%
90-100	79.728	4.30%
100-110	84.888	4.58%
110-120	71.93	3.88%
120-130	58.5	3.15%
130-140	45.646	2.46%
140-150	33.819	1.82%
150-160	22.929	1.24%
160-170	12.775	0.69%
170-180	3.402	0.18%
Total	1855.3	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	948.263	51.11%
60- 90	493.454	26.60%
0-90	1441.72	77.71%
90- 180	413.617	22.29%
0- 180	1855.3	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

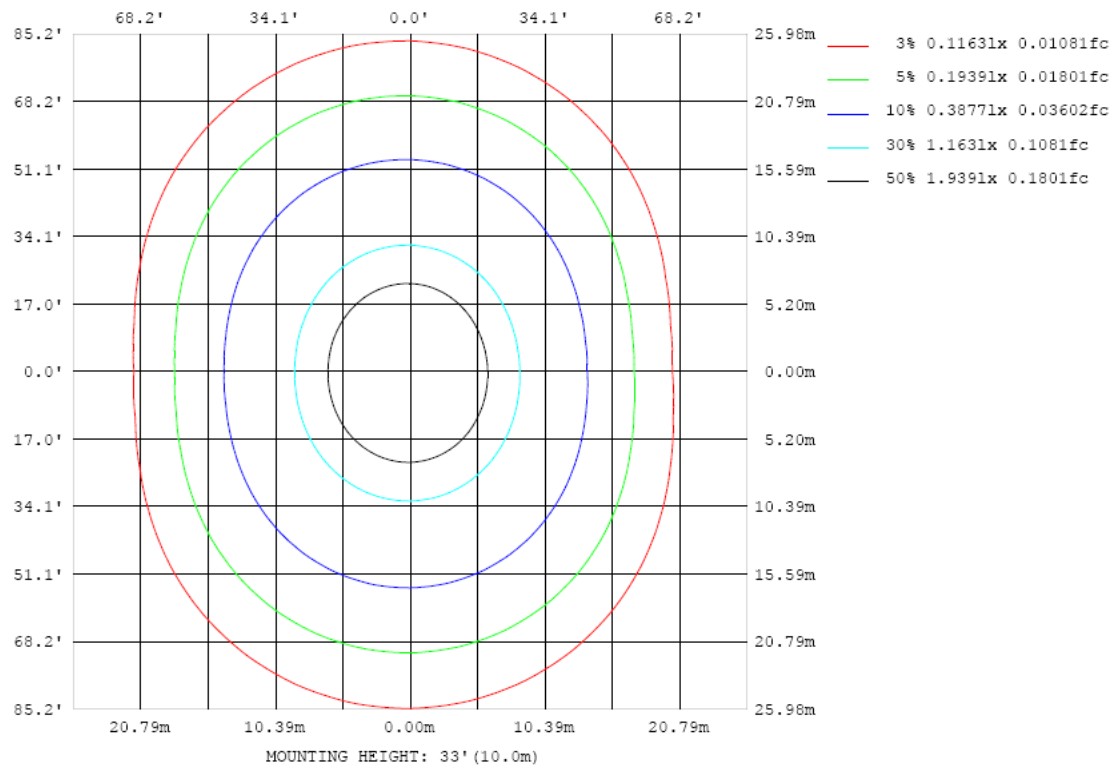


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

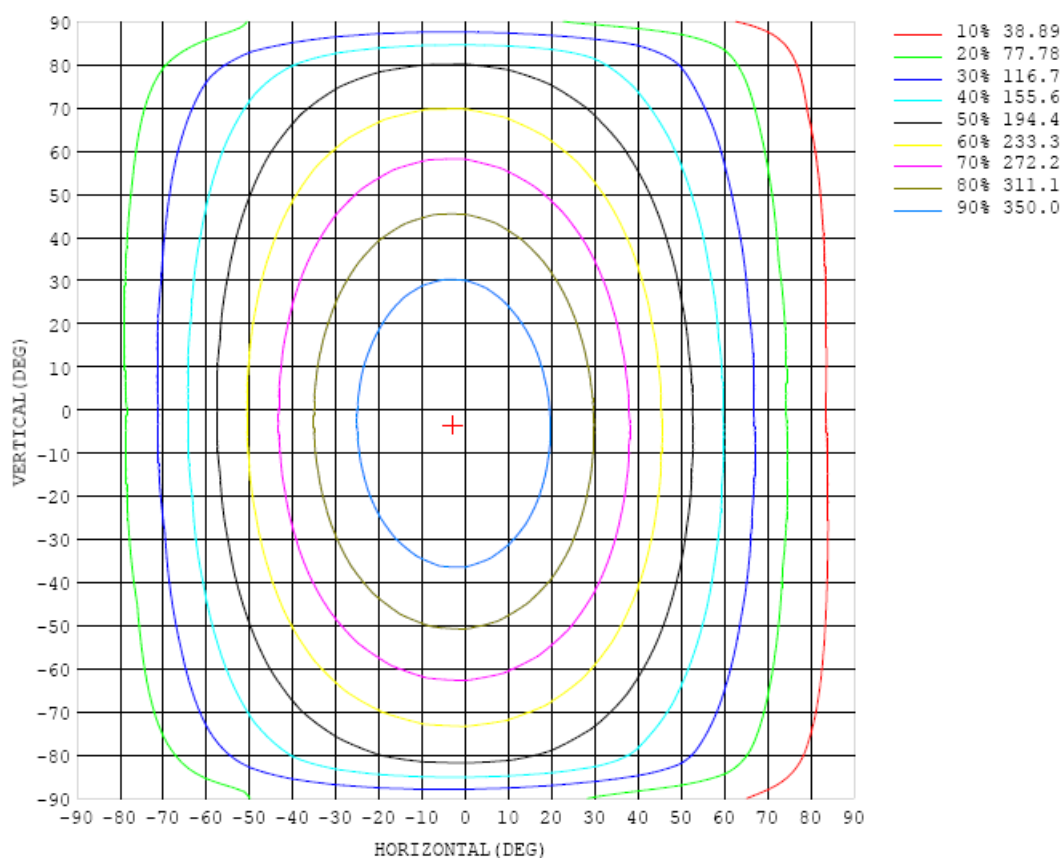


Chart 6: Isocandela Plot

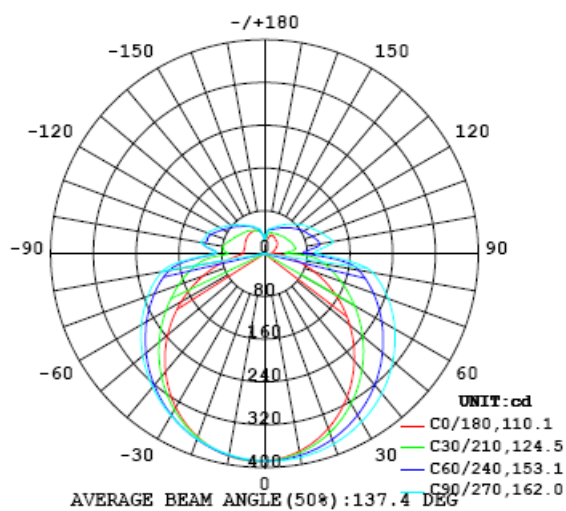


Chart 7: Polar Candela Distribution

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	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388
5	383	384	384	385	385	386	387	387	388	388	389	389	389	389	389	389	388	388	388
10	375	376	377	378	380	382	383	385	386	387	387	388	388	387	387	386	385	385	384
15	363	365	366	369	372	375	378	380	382	384	384	384	384	383	381	380	378	377	376
20	348	350	353	356	361	365	370	374	377	379	379	379	378	376	373	370	368	366	365
25	330	332	336	341	347	354	360	365	369	372	373	372	369	366	362	358	354	351	350
30	309	312	317	324	332	341	349	355	360	363	364	362	359	354	348	343	337	334	332
35	286	289	296	305	315	325	335	344	350	353	353	351	347	340	332	325	318	313	311
40	261	265	273	284	296	309	321	330	337	341	342	338	332	324	314	305	297	291	288
45	235	240	249	262	277	291	305	316	324	328	328	324	317	307	295	283	273	266	263
50	208	214	225	240	256	273	288	301	309	313	313	309	300	288	275	261	248	240	236
55	181	187	200	217	236	254	271	284	293	298	297	292	282	269	253	237	223	212	209
60	153	160	175	195	215	235	253	267	277	281	281	275	264	249	232	214	197	184	180
65	126	134	152	173	195	217	235	250	260	264	263	257	246	230	211	191	171	156	151
70	99.3	109	129	152	176	198	217	232	242	246	245	238	227	210	191	169	146	128	123
75	74.1	85.7	108	133	158	180	199	213	222	227	225	219	207	191	171	148	123	102	95.5
80	51.8	64.9	89.0	115	139	161	179	193	202	206	204	197	186	169	150	127	102	78.5	70.7
85	33.9	48.2	71.2	95.5	116	129	140	148	154	157	157	153	146	135	121	102	79.6	58.7	51.4
90	16.6	19.6	31.5	46.9	55.9	65.4	76.1	85.8	93.0	97.4	98.8	97.5	93.3	86.6	77.7	66.8	56.5	44.6	41.0
95	11.9	19.5	33.9	49.2	62.7	74.0	84.6	93.7	101	107	109	109	106	99.6	89.8	75.5	59.5	44.5	39.9
100	16.9	25.4	41.2	59.1	75.6	90.5	104	117	125	130	131	127	118	105	88.8	72.4	56.6	43.1	39.0
105	18.2	25.7	41.2	57.1	73.9	88.5	101	111	118	122	121	117	109	97.5	84.0	68.3	53.1	42.3	38.8
110	20.2	26.3	39.9	56.0	69.6	83.5	95.1	104	110	113	113	108	101	91.1	78.4	63.3	51.1	42.1	39.4
115	23.7	28.6	39.2	53.4	67.6	79.1	89.3	97.1	102	105	104	100	94.1	85.4	73.4	60.4	50.0	42.5	40.4
120	26.0	30.2	39.3	51.3	63.8	75.1	85.2	91.7	95.9	98.1	97.5	94.2	88.3	79.4	68.7	57.7	49.0	43.6	41.5
125	29.2	32.0	39.6	49.5	60.4	70.1	79.1	86.1	90.3	92.0	91.2	87.8	81.9	73.9	64.9	56.2	48.3	44.4	42.8
130	31.7	33.9	39.3	48.4	57.4	65.7	73.4	79.3	83.5	85.1	84.2	81.3	76.3	69.6	61.8	53.9	47.8	45.4	44.2
135	32.6	33.6	38.2	46.2	54.9	61.7	68.3	73.4	76.8	78.3	77.7	75.4	71.3	65.7	58.7	51.8	48.1	46.4	45.2
140	32.5	34.2	37.1	44.8	51.7	58.2	63.6	68.0	70.8	72.2	71.8	69.9	66.6	61.8	54.7	51.1	47.3	47.3	46.0
145	35.0	36.3	39.5	44.5	48.7	54.7	59.4	62.9	65.3	66.5	66.2	64.8	62.0	57.1	53.7	50.1	47.2	48.0	46.6
150	35.6	38.2	39.1	43.1	48.0	51.5	55.1	57.6	60.0	61.2	60.8	59.3	57.7	55.3	51.9	48.2	47.8	48.1	47.1
155	38.0	39.6	39.2	41.6	45.7	49.2	52.2	54.2	55.6	56.5	56.3	55.7	54.7	52.3	49.7	46.9	47.7	48.6	47.2
160	36.7	39.6	39.9	41.5	44.0	46.7	48.8	50.4	51.6	52.5	52.6	52.0	51.3	49.8	48.1	46.9	47.4	49.2	47.2
165	31.9	35.3	37.7	39.9	43.6	45.5	46.5	47.6	48.6	49.1	49.2	49.1	48.4	48.4	47.9	46.4	46.2	48.2	47.6
170	24.8	29.3	34.3	37.2	39.8	42.3	45.4	46.7	47.1	47.4	47.5	46.6	44.7	43.4	43.4	43.5	44.0	43.5	42.1
175	18.6	18.9	21.2	28.3	30.9	30.6	32.1	36.4	34.9	36.3	37.3	37.8	38.6	37.8	37.0	36.6	36.0	35.7	34.7
180	30.7	30.3	29.2	28.8	29.2	27.6	24.4	22.9	21.5	22.2	17.8	24.4	25.4	26.3	26.8	28.2	30.7	30.7	30.7

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	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388		
5	388	388	387	387	387	387	386	386	386	385	385	384	384	384	383	383	383		
10	384	384	384	384	383	383	383	382	382	381	380	378	377	376	376	375	375		
15	376	376	376	377	377	377	377	377	376	374	373	371	368	366	365	364	363		
20	365	365	366	367	369	370	370	370	369	367	364	361	357	354	351	349	348		
25	350	351	353	355	358	360	361	361	360	357	354	349	344	339	335	331	330		
30	332	334	337	341	345	349	351	351	350	347	342	336	329	322	316	312	309		
35	312	315	319	325	331	336	339	340	339	335	329	321	313	304	296	290	286		
40	289	293	300	307	315	321	325	327	326	322	315	306	295	284	275	266	262		
45	265	271	279	289	298	306	311	313	312	307	300	289	277	264	252	242	236		
50	239	247	257	269	280	289	296	298	297	292	284	272	258	244	229	217	210		
55	212	222	235	249	262	272	280	283	282	277	267	255	239	223	206	192	183		
60	185	197	213	229	243	255	263	267	266	260	251	237	220	202	184	167	156		
65	158	173	191	209	225	237	246	250	249	243	233	219	202	182	162	143	130		
70	132	150	171	190	206	219	228	233	232	227	216	202	184	164	142	121	105		
75	108	129	151	171	188	201	211	215	215	210	199	185	167	146	124	100	80.8		
80	86.0	110	132	151	168	181	190	195	195	190	181	167	149	129	106	81.4	59.4		
85	66.3	86.9	106	120	131	140	146	149	150	148	143	135	123	109	87.8	64.3	42.3		
90	47.5	58.4	69.2	78.4	85.7	90.9	94.0	94.6	92.5	87.6	80.3	71.0	61.9	52.6	42.1	30.0	18.3		
95	49.5	63.0	77.8	89.6	96.9	101	103	102	98.4	92.5	85.0	75.7	65.2	54.8	43.4	29.2	14.9		
100	48.0	63.1	78.5	90.4	104	114	121	123	121	116	109	97.1	82.7	67.6	52.9	34.4	20.8		
105	46.4	59.6	75.0	89.8	102	111	114	116	115	111	105	95.4	83.5	68.0	51.0	34.9	21.7		
110	45.4	56.7	69.9	83.5	96.0	106	112	114	113	109	103	92.2	78.3	64.1	49.6	34.5	23.4		
115	45.2	54.2	65.7	77.2	88.1	97.6	103	106	105	101	95.0	86.1	73.9	61.1	47.5	34.3	25.4		
120	45.6	52.3	62.7	72.6	81.5	89.4	95.1	97.8	97.3	93.9	88.4	80.0	69.7	57.9	45.5	34.8	27.3		
125	46.2	51.5	59.5	68.9	76.1	82.6	87.5	89.8	89.5	86.5	81.7	74.4	65.2	55.0	44.1	35.5	30.3		
130	46.3	50.6	57.3	64.4	71.7	77.0	80.7	82.5	82.3	79.7	75.5	69.3	61.3	52.0	43.9	36.7	32.6		
135	46.6	50.0	55.6	61.7	66.4	71.6	75.1	76.6	76.4	74.2	70.3	64.5	57.4	50.2	43.8	37.8	34.3		
140	47.3	49.6	54.1	59.1	63.6	66.9	68.9	70.0	70.1	68.3	64.9	60.4	54.9	49.1	43.1	39.5	35.4		
145	47.3	48.4	52.0	56.5	60.2	63.0	65.3	66.0	65.4	63.7	60.9	57.2	53.0	48.2	43.8	40.5	35.1		
150	47.1	47.3	49.9	53.8	57.2	59.3	60.8	61.4	60.7	59.6	57.9	55.0	51.4	47.5	43.6	39.9	35.5		
155	46.6	46.8	48.2	50.4	53.7	55.4	57.3	57.6	57.4	56.8	54.9	51.8	49.5	45.9	41.9	38.2	36.6		
160	47.5	45.5	46.2	47.8	49.6	51.3	52.5	52.4	53.7	53.0	51.4	49.3	46.9	45.0	42.5	38.9	37.4		
165	48.1	45.4	44.0	45.3	46.7	48.0	48.9	48.8	48.7	47.4	45.1	45.3	44.7	42.5	38.0	34.6	32.6		
170	42.1	42.4	41.7	41.8	41.7	41.0	41.9	43.1	45.9	46.8	46.1	43.8	41.4	38.8	35.6	32.3	25.6		
175	34.7	34.7	34.7	34.8	35.1	35.3	36.6	36.6	34.6	34.6	32.3	27.6	28.1	28.1	23.7	17.7	17.3		
180	30.7	30.2	29.3	29.1	28.9	27.9	25.4	23.3	21.3	19.2	20.2	24.5	27.4	27.6	27.5	28.8	30.0		

Table 7: Luminous Intensity Data

TEST RESULTS (4000K Setting)

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)	0.246	0.112
Power Factor	0.9956	0.9550
Test Power (W)/2	14.68	14.83
THD A%	5.65	14.18
Luminous Efficacy (lm/W)	132.8	131.3
Total Luminous Flux (lm)	1949.3	1947.5
Color Rendering Index (CRI)	86.1	
R9	21.2	
Correlated Color Temperature (CCT)(K)	4256	
Chromaticity Chroma x	0.3687	
Chromaticity Chroma y	0.3652	
Chromaticity Chroma u	0.2219	
Chromaticity Chroma v	0.3298	
Duv	-0.0019	
Chromaticity Chroma u'	0.2219	
Chromaticity Chroma v'	0.4946	

Special Color Rendering Indices	
R1	85.7
R2	93.9
R3	95.8
R4	83.8
R5	85.5
R6	89.6
R7	86
R8	68.3
R9	21.2
R10	84.6
R11	83.8
R12	64.7
R13	88.4
R14	98.5

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

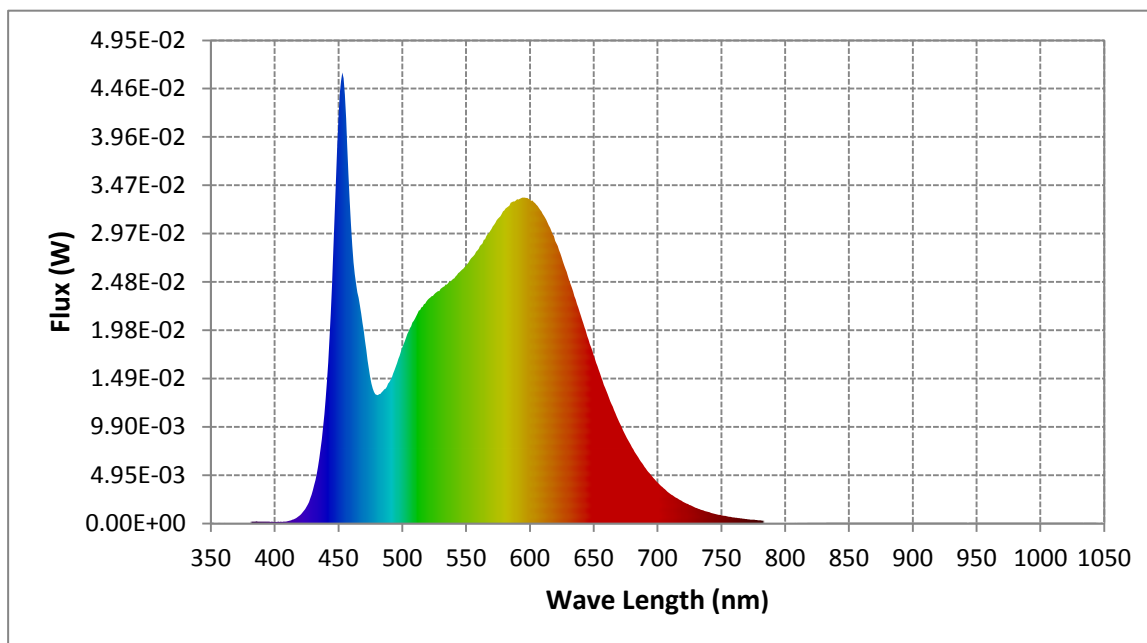
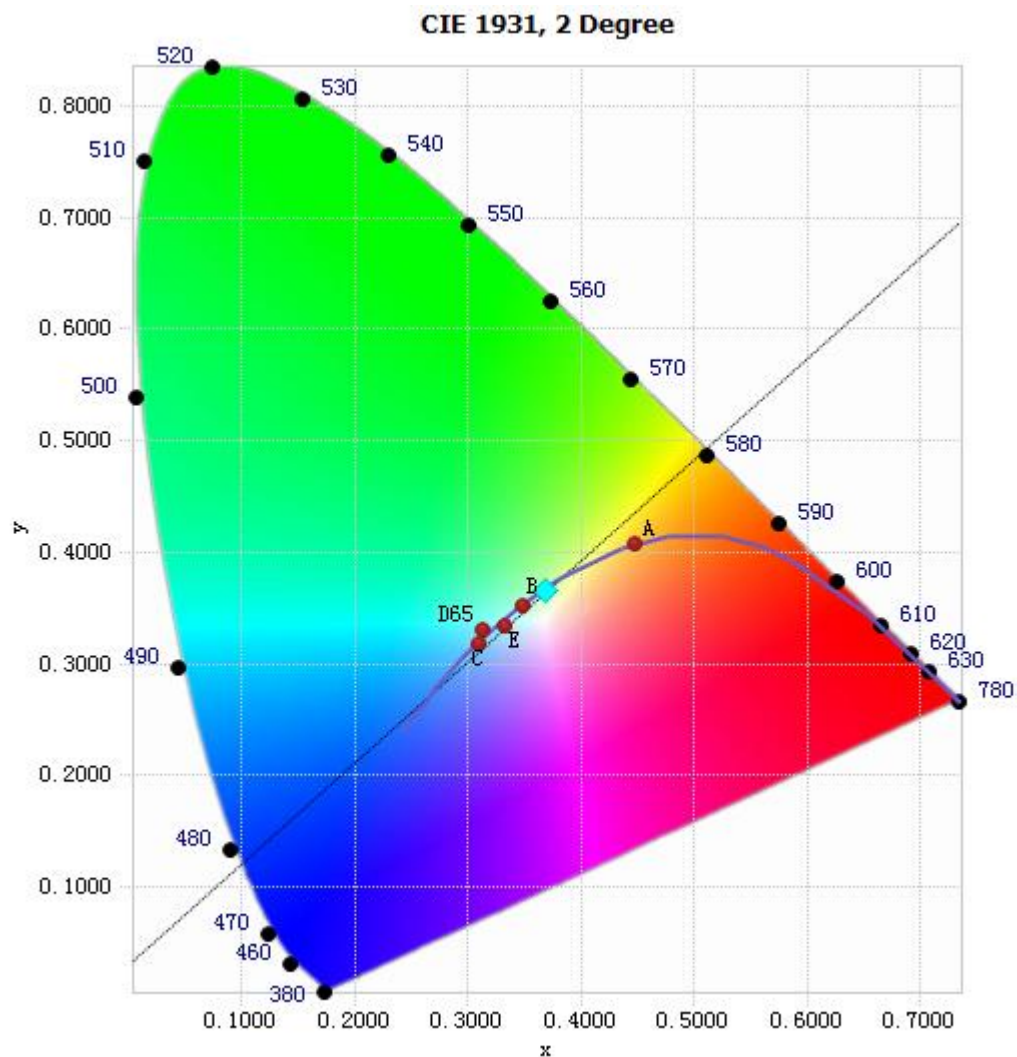


Chart 8: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.15E-04	485	1.36E-02	590	3.32E-02	695	4.97E-03
385	1.95E-04	490	1.45E-02	595	3.34E-02	700	4.22E-03
390	1.91E-04	495	1.61E-02	600	3.32E-02	705	3.60E-03
395	2.07E-04	500	1.80E-02	605	3.26E-02	710	3.06E-03
400	1.67E-04	505	1.97E-02	610	3.17E-02	715	2.62E-03
405	1.78E-04	510	2.10E-02	615	3.05E-02	720	2.23E-03
410	2.30E-04	515	2.21E-02	620	2.90E-02	725	1.90E-03
415	4.21E-04	520	2.29E-02	625	2.73E-02	730	1.61E-03
420	8.33E-04	525	2.35E-02	630	2.53E-02	735	1.37E-03
425	1.70E-03	530	2.40E-02	635	2.33E-02	740	1.16E-03
430	3.39E-03	535	2.45E-02	640	2.13E-02	745	9.81E-04
435	6.65E-03	540	2.51E-02	645	1.92E-02	750	8.39E-04
440	1.28E-02	545	2.58E-02	650	1.73E-02	755	7.25E-04
445	2.45E-02	550	2.64E-02	655	1.54E-02	760	6.20E-04
450	4.16E-02	555	2.73E-02	660	1.36E-02	765	5.24E-04
455	4.39E-02	560	2.81E-02	665	1.20E-02	770	4.43E-04
460	3.06E-02	565	2.91E-02	670	1.04E-02	775	3.79E-04
465	2.37E-02	570	3.02E-02	675	9.03E-03	780	3.28E-04
470	1.97E-02	575	3.12E-02	680	7.80E-03		
475	1.50E-02	580	3.21E-02	685	6.76E-03		
480	1.32E-02	585	3.29E-02	690	5.79E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3687, 0.3652)

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

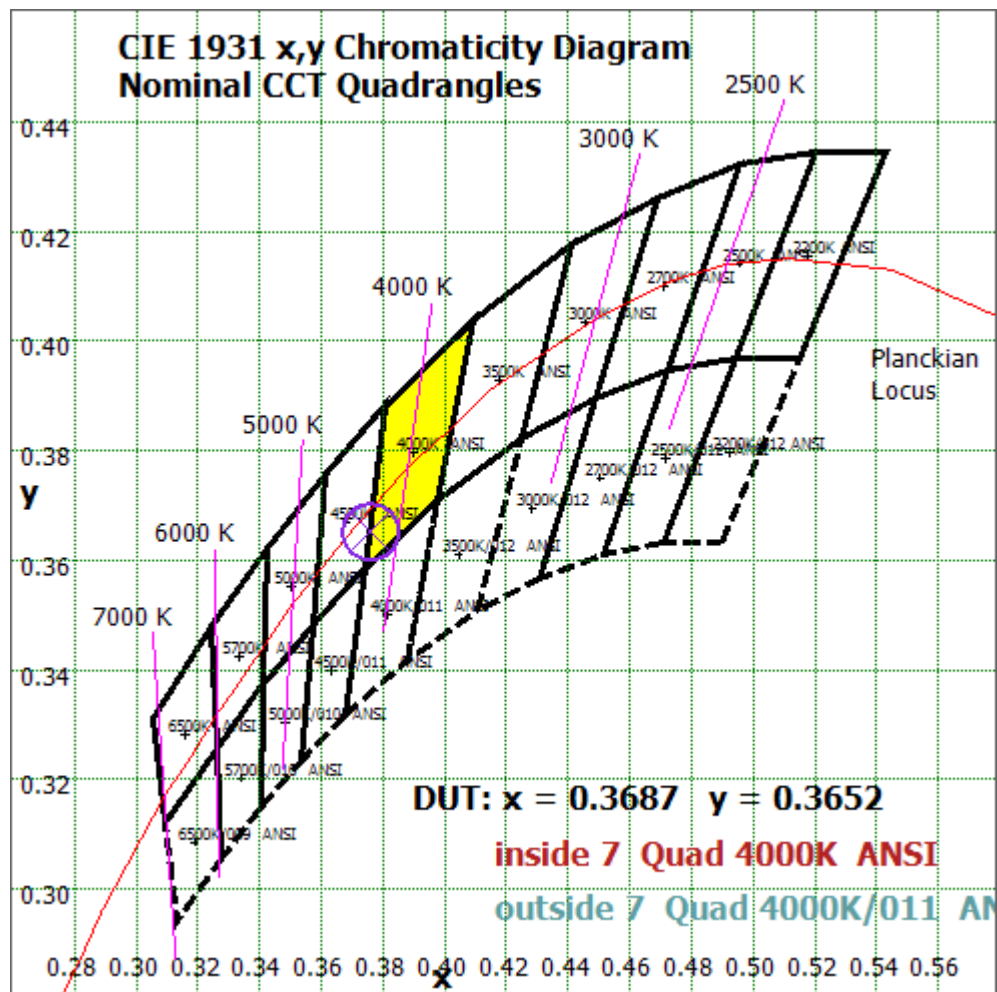


Chart 10: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

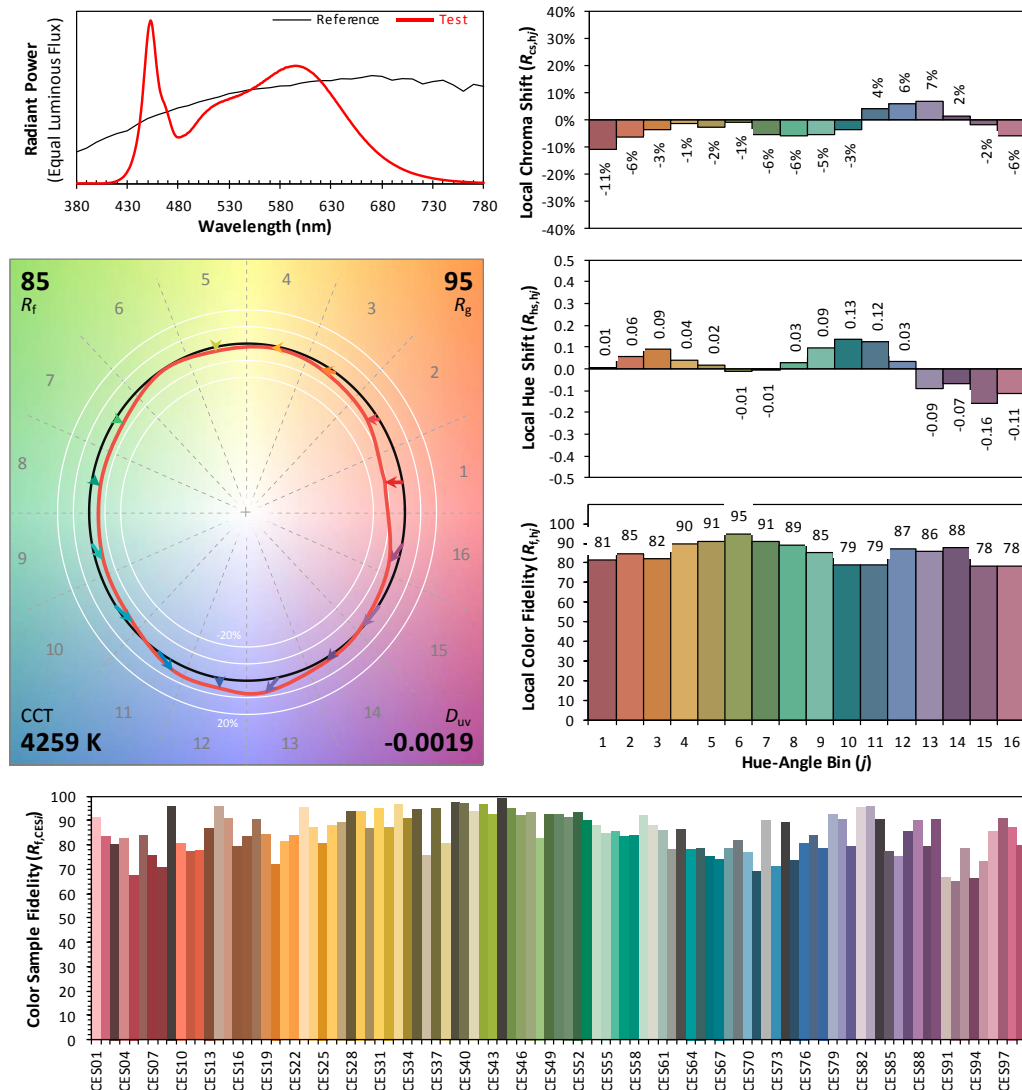
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: ESPEN TECHNOLOGY, INC.

Date: 2021/09/17

Model: LB48T8U6/8T/13P-AB



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

x 0.3687
 y 0.3652
 u' 0.2219
 v' 0.4946

CIE 13.3-1995
(CRI)
 R_a 86
 R_g 21

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 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)	0.249	0.114
Power Factor	0.9956	0.9559
Test Power (W)/2	14.89	15.04
THD A%	5.67	13.57
Luminous Efficacy (lm/W)	128.8	127.6
Total Luminous Flux (lm)	1917.8	1919.7
Color Rendering Index (CRI)	85.6	
R9	16.4	
Correlated Color Temperature (CCT)(K)	5107	
Chromaticity Chroma x	0.3421	
Chromaticity Chroma y	0.3495	
Chromaticity Chroma u	0.2102	
Chromaticity Chroma v	0.3221	
Duv	0.0002	
Chromaticity Chroma u'	0.2102	
Chromaticity Chroma v'	0.4832	

Special Color Rendering Indices	
R1	84.8
R2	92.7
R3	95.1
R4	84
R5	85.1
R6	87.9
R7	86.4
R8	68.7
R9	16.4
R10	81.9
R11	83.9
R12	64.7
R13	87.6
R14	98.1

Table 10: 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

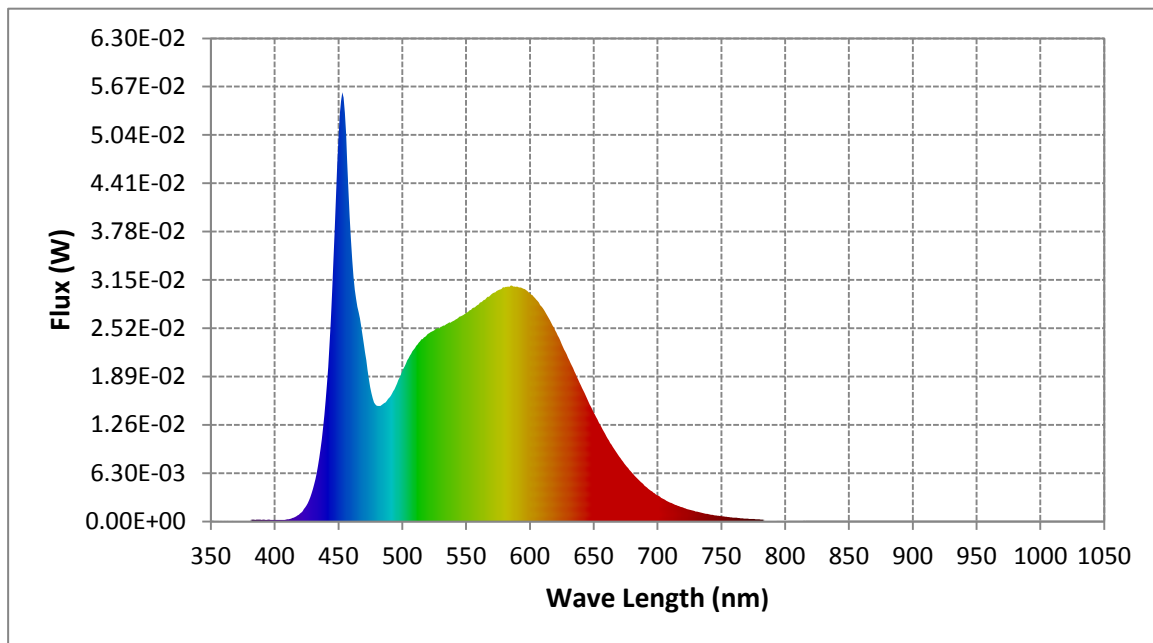
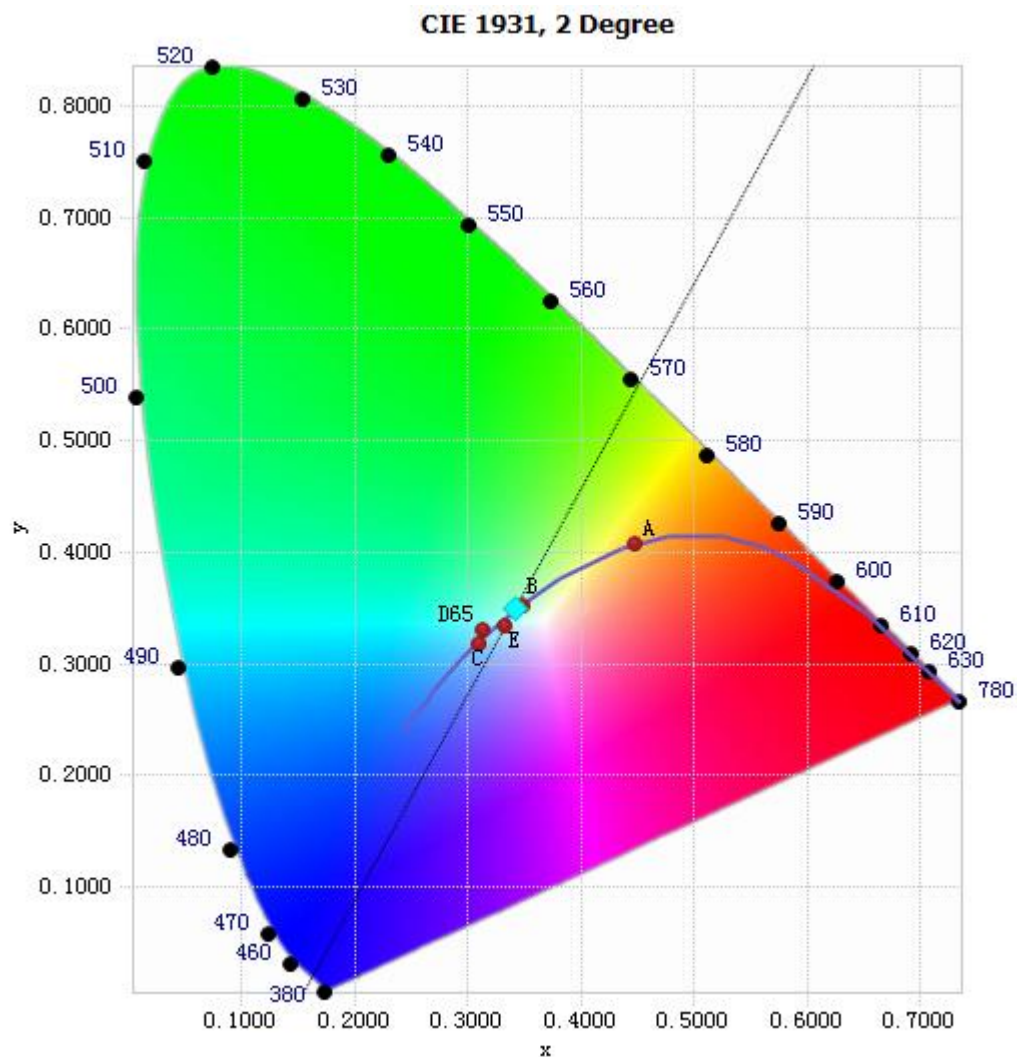


Chart 12: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.40E-04	485	1.53E-02	590	3.06E-02	695	4.00E-03
385	2.11E-04	490	1.62E-02	595	3.03E-02	700	3.42E-03
390	2.17E-04	495	1.76E-02	600	2.98E-02	705	2.91E-03
395	2.23E-04	500	1.96E-02	605	2.89E-02	710	2.48E-03
400	1.83E-04	505	2.13E-02	610	2.78E-02	715	2.12E-03
405	1.99E-04	510	2.26E-02	615	2.65E-02	720	1.81E-03
410	2.76E-04	515	2.37E-02	620	2.49E-02	725	1.53E-03
415	4.96E-04	520	2.45E-02	625	2.32E-02	730	1.30E-03
420	1.05E-03	525	2.49E-02	630	2.14E-02	735	1.11E-03
425	2.08E-03	530	2.54E-02	635	1.96E-02	740	9.50E-04
430	4.23E-03	535	2.57E-02	640	1.78E-02	745	7.97E-04
435	8.29E-03	540	2.61E-02	645	1.60E-02	750	6.91E-04
440	1.58E-02	545	2.67E-02	650	1.42E-02	755	5.88E-04
445	2.97E-02	550	2.71E-02	655	1.27E-02	760	5.03E-04
450	5.00E-02	555	2.78E-02	660	1.11E-02	765	4.29E-04
455	5.33E-02	560	2.83E-02	665	9.74E-03	770	3.64E-04
460	3.67E-02	565	2.89E-02	670	8.46E-03	775	3.17E-04
465	2.80E-02	570	2.96E-02	675	7.34E-03	780	2.69E-04
470	2.32E-02	575	3.01E-02	680	6.35E-03		
475	1.75E-02	580	3.05E-02	685	5.47E-03		
480	1.51E-02	585	3.08E-02	690	4.68E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3421, 0.3495)

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

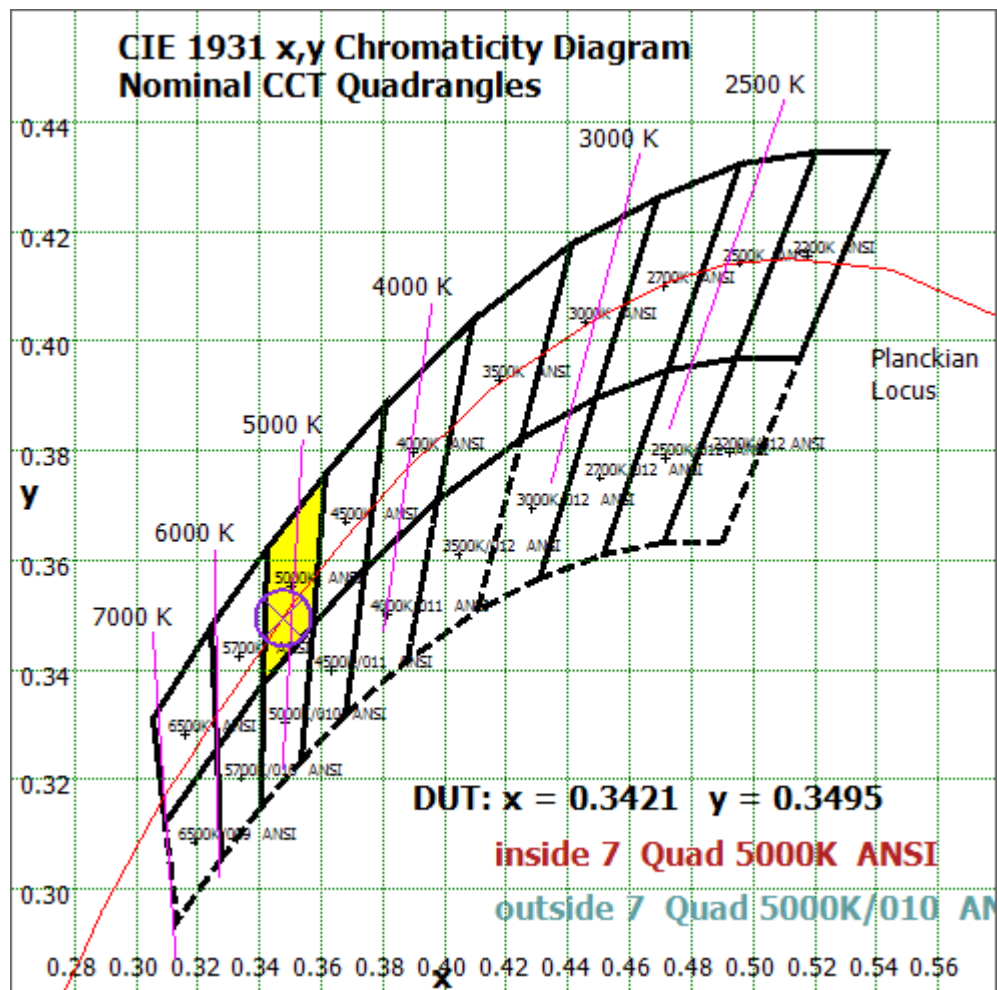


Chart 14: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

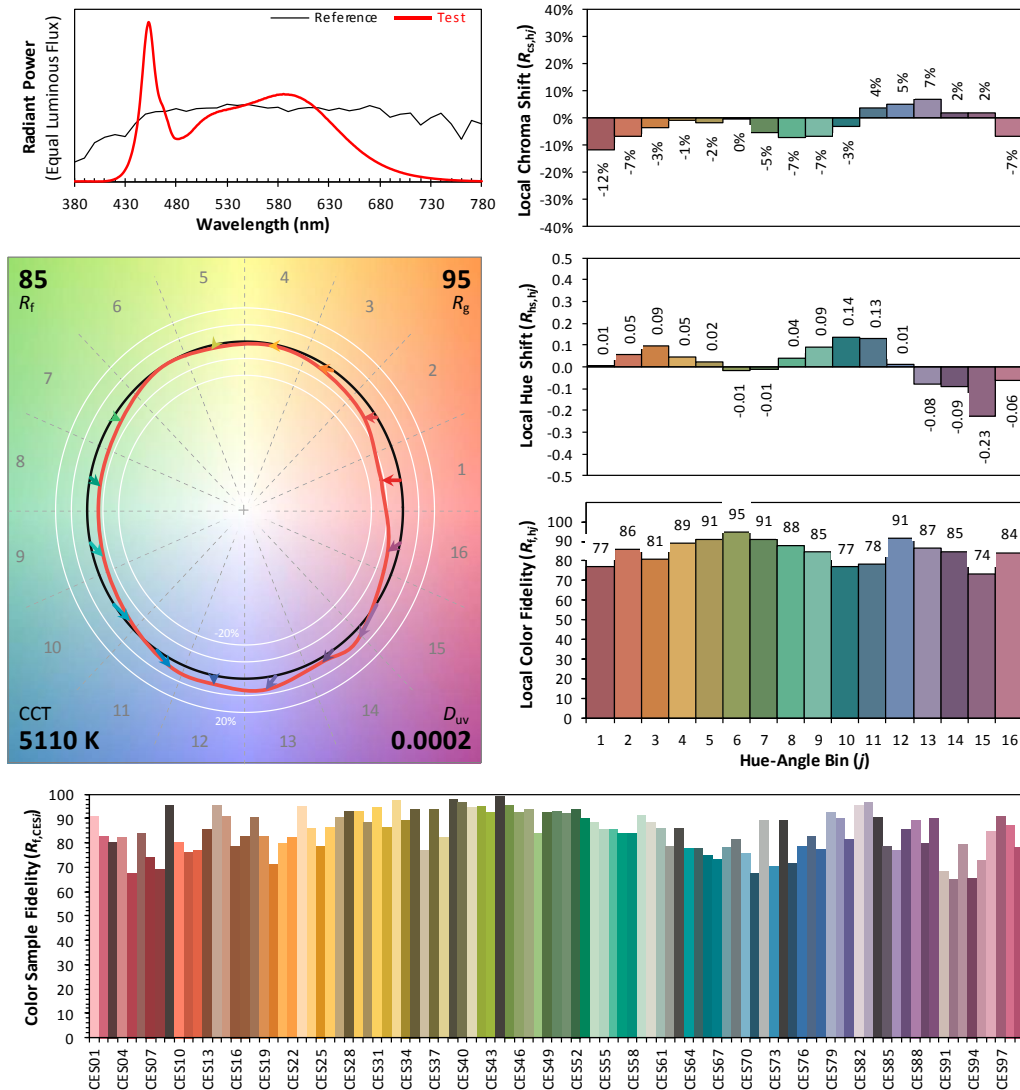
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: ESPEN TECHNOLOGY, INC.

Date: 2021/09/17

Model: LB48T8U6/8T/13P-AB



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

x 0.3421
 y 0.3495
 u' 0.2102
 v' 0.4832

CIE 13.3-1995
(CRI)
 R_a 86
 R_g 16

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, 2021	Aug. 04, 2022
Digital Power Meter	PF2010A	HZTE028-01	Aug. 05, 2021	Aug. 04, 2022
AC Power Supply	DPS1060	HZTE001-06	Aug. 05, 2021	Aug. 04, 2022
DC Power Supply	WY12010	HZTE004-03	Aug. 05, 2021	Aug. 04, 2022
Temperature recorder	JM624U	HZTE018-08	Aug. 05, 2021	Aug. 04, 2022
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 05, 2021	Aug. 04, 2022
Standard source	D908	HZTE012-01	Aug. 05, 2021	Aug. 04, 2022
Integrate Sphere system	3M	HZTE015-04	Aug. 05, 2021	Aug. 04, 2022
Digital Power Meter	WT210	HZTE008-01	Aug. 05, 2021	Aug. 04, 2022
AC Power Supply	PCR 500L	HZTE001-07	Aug. 05, 2021	Aug. 04, 2022
DC Power Supply	IT6154	HZTE004-04	Aug. 05, 2021	Aug. 04, 2022
Standard source	SCL-1400	HZTE012-02	Aug. 05, 2021	Aug. 04, 2022
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 05, 2021	Aug. 04, 2022
Temperature Meter	TES1310	HZTE017-01	Aug. 05, 2021	Aug. 04, 2022

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 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

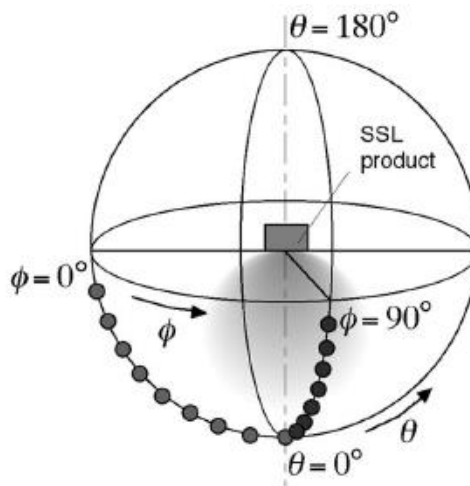
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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