LM-79-19 TEST REPORT

for

P.Q.L., Inc.

2285 Ward Avenue / Simi Valley, CA 93065

LED Tube

91496, 91497, 91498

All measurements are the same except CCT.

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ22100009d

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

Review by:

Engineer: April Zou
Nov. 17, 2022

Approved by:

Manager: Jim Zhang
Nov. 17, 2022

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	91502	91496	91497	91498
Luminous Efficacy (Lumens /Watt)	124.2	129.9	131.8	131.7
Total Luminous Flux (Lumens)	2095.9	2189.1	2228.3	2187.4
Power (Watts)/2	16.88	16.86	16.91	16.61
Power Factor	0.9956	0.9956	0.9955	0.9955
CCT (K)	3084	3513	3994	5141
CRI	81.8	81.2	80.9	83.3
Stabilization Time (Light & Power)	50 mins	50 mins	50 mins	50 mins
Note	3000K	3500K	4000K	5000K

Table 1: Executive Data Summary

Test specifications:

Date of Receipt : Oct. 17, 2022

Date of Test : Oct. 21, 2022 & Nov. 09, 2022

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

ANSI/UL 8750 Light Emitting Diode (LED) Equipment for Use in Lighting Products

UL 1993 Self-Ballasted Lamps and Lamp Adapters

TABLE OF CONTENT

LM-79-19 TEST REPORT 1

TEST SUMMARY 2

SAMPLE PHOTO 5

TEST RESULTS of 91502 6

Sphere-Spectroradiometer Method 6

Spectral Power Distribution - Sphere Spectroradiometer Method 7

Chromaticity Diagram - Sphere Spectroradiometer Method 8

Nominal CCT Quadrangles – Sphere Spectroradiometer Method 9

Color Rendition Report – Sphere Spectroradiometer Method 10

Goniophotometer Method 11

Zonal Lumen Tabulation- Goniophotometer Method 12

Illuminance Plots- Goniophotometer Method 13

Luminous Intensity Distribution Plots- Goniophotometer Method 14

Luminous Intensity Data- Goniophotometer Method 15

TEST RESULTS of 91496 17

Sphere-Spectroradiometer Method 17

Spectral Power Distribution - Sphere Spectroradiometer Method 18

Chromaticity Diagram - Sphere Spectroradiometer Method 19

Nominal CCT Quadrangles – Sphere Spectroradiometer Method 20

Color Rendition Report – Sphere Spectroradiometer Method 21

Goniophotometer Method 22

Zonal Lumen Tabulation- Goniophotometer Method 23

Illuminance Plots- Goniophotometer Method 24

Luminous Intensity Distribution Plots- Goniophotometer Method 25

Luminous Intensity Data- Goniophotometer Method 26

TEST RESULTS of 91497 28

Sphere-Spectroradiometer Method 28

Spectral Power Distribution - Sphere Spectroradiometer Method 29

Chromaticity Diagram - Sphere Spectroradiometer Method 30
Nominal CCT Quadrangles – Sphere Spectroradiometer Method 31
Color Rendition Report – Sphere Spectroradiometer Method 32
Goniophotometer Method 33
Zonal Lumen Tabulation- Goniophotometer Method 34
Illuminance Plots- Goniophotometer Method 35
Luminous Intensity Distribution Plots- Goniophotometer Method 36
Luminous Intensity Data- Goniophotometer Method 37
TEST RESULTS of 91498 39
Sphere-Spectroradiometer Method 39
Spectral Power Distribution - Sphere Spectroradiometer Method 40
Chromaticity Diagram - Sphere Spectroradiometer Method 41
Nominal CCT Quadrangles – Sphere Spectroradiometer Method 42
Color Rendition Report – Sphere Spectroradiometer Method 43
Goniophotometer Method 44
Zonal Lumen Tabulation- Goniophotometer Method 45
Illuminance Plots- Goniophotometer Method 46
Luminous Intensity Distribution Plots- Goniophotometer Method 47
Luminous Intensity Data- Goniophotometer Method 48
ISTMT Test Results 50
EQUIPMENT LIST 51
TEST METHODS 51
Seasoning of SSL Product 51
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements 51
Goniophotometer Method 52
Photometric and Electrical Measurements 52
Color Characteristics Measurements 52
ISTMT Measurements 52

SAMPLE PHOTO

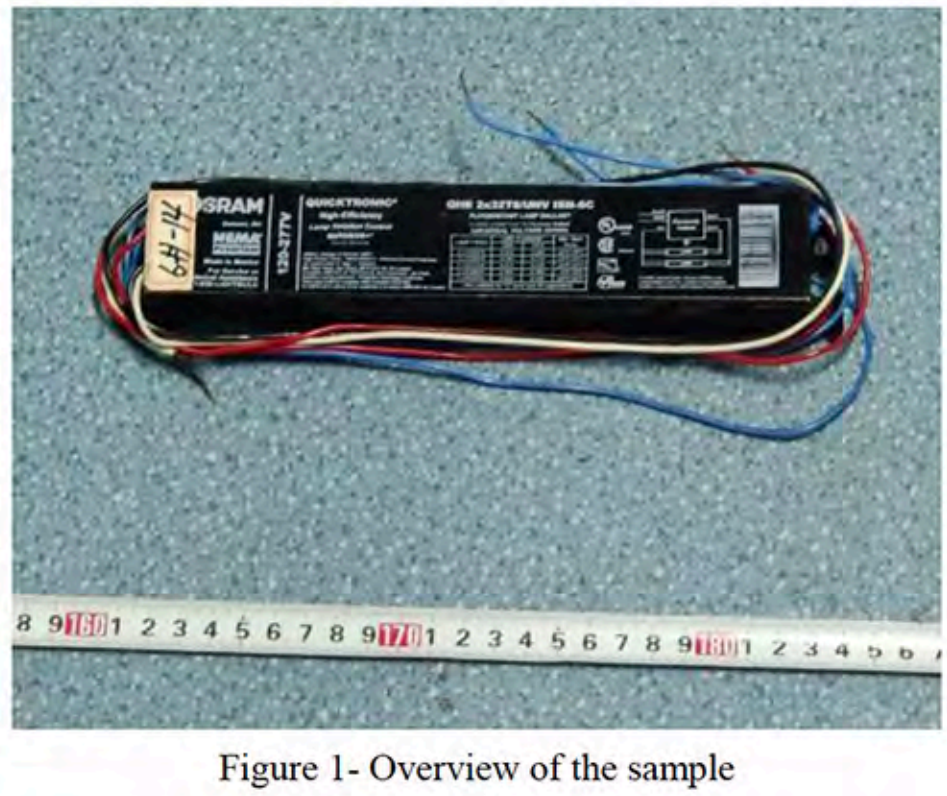


Figure 1- Overview of the sample

Equipment Under Test(EUT)	
Name	: LED Tube
Model	: 91502 - 3000K 91496 - 3500K 91497 - 4000K 91498 - 5000K
Electrical Ratings	: 120-277V, 50/60Hz, 15W LED Tubes supplied by a high frequency fluorescent lamp ballast: QHE 2x32T8/UNV ISN-SC
Product Description	: Manufacturer of light source: Bridgelux Inc. Model of LED light source: BXVN-30E-11L-3EJ-000-00-00-0 (3000K) BXVN-35E-11L-3EJ-000-00-00-0 (3500K) BXVN-40E-11L-3EJ-000-00-00-0 (4000K) BXVN-50E-11L-3EJ-000-00-00-0 (5000K)
Manufacturer	: P.Q.L., Inc.
Address	: 2285 Ward Avenue / Simi Valley, CA 93065

TEST RESULTS of 91502

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)	0.282	0.127
Power Factor	0.9956	0.9643
Test Power (W)/2	16.88	16.95
THD A%	5.92	11.53
Luminous Efficacy (lm/W)	124.2	123.6
Total Luminous Flux (lm)	2095.9	2095.7
Color Rendering Index (CRI)	81.8	
R9	3	
Correlated Color Temperature (CCT)(K)	3084	
Chromaticity Chroma x	0.4306	
Chromaticity Chroma y	0.4013	
Chromaticity Chroma u	0.2477	
Chromaticity Chroma v	0.3462	
Duv	-0.0002	
Chromaticity Chroma u '	0.2477	
Chromaticity Chroma v'	0.5193	

Special Color Rendering Indices	
R1	80.5
R2	91.7
R3	94.8
R4	78.7
R5	80.6
R6	89.8
R7	81.3
R8	56.9
R9	3
R10	81.1
R11	77.9
R12	68.7
R13	83.4
R14	97.9

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

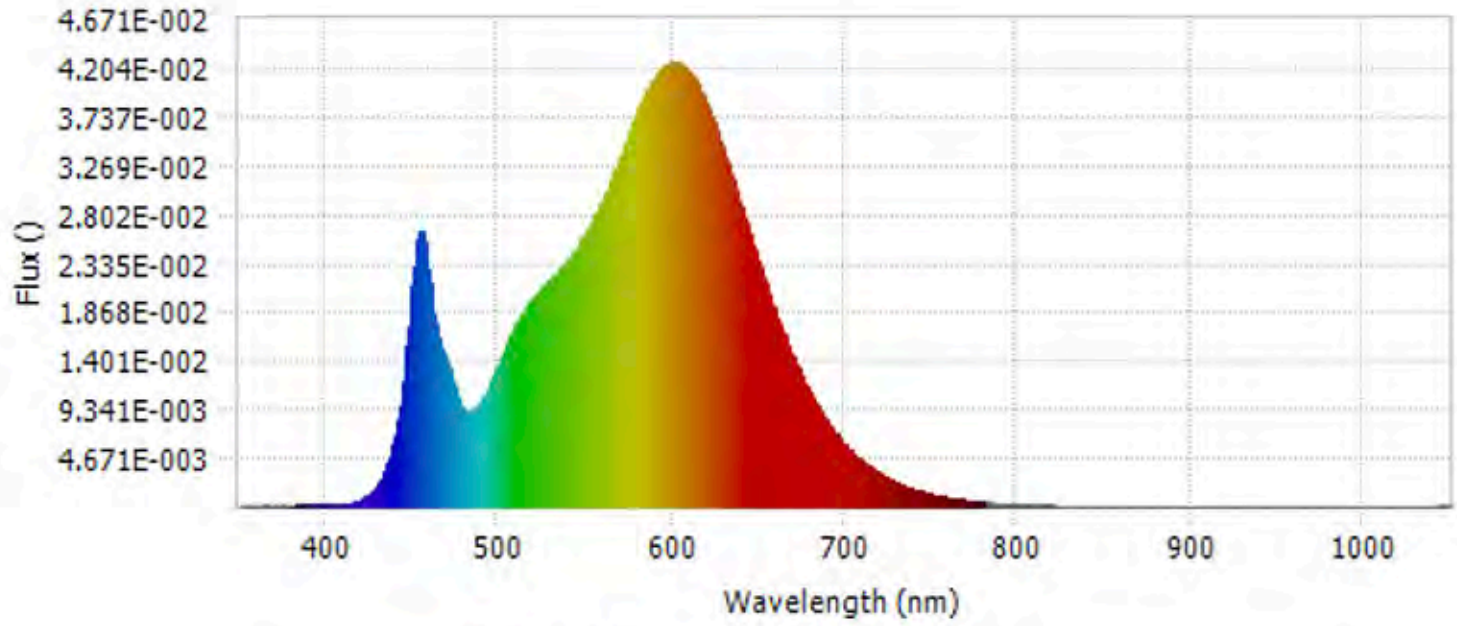
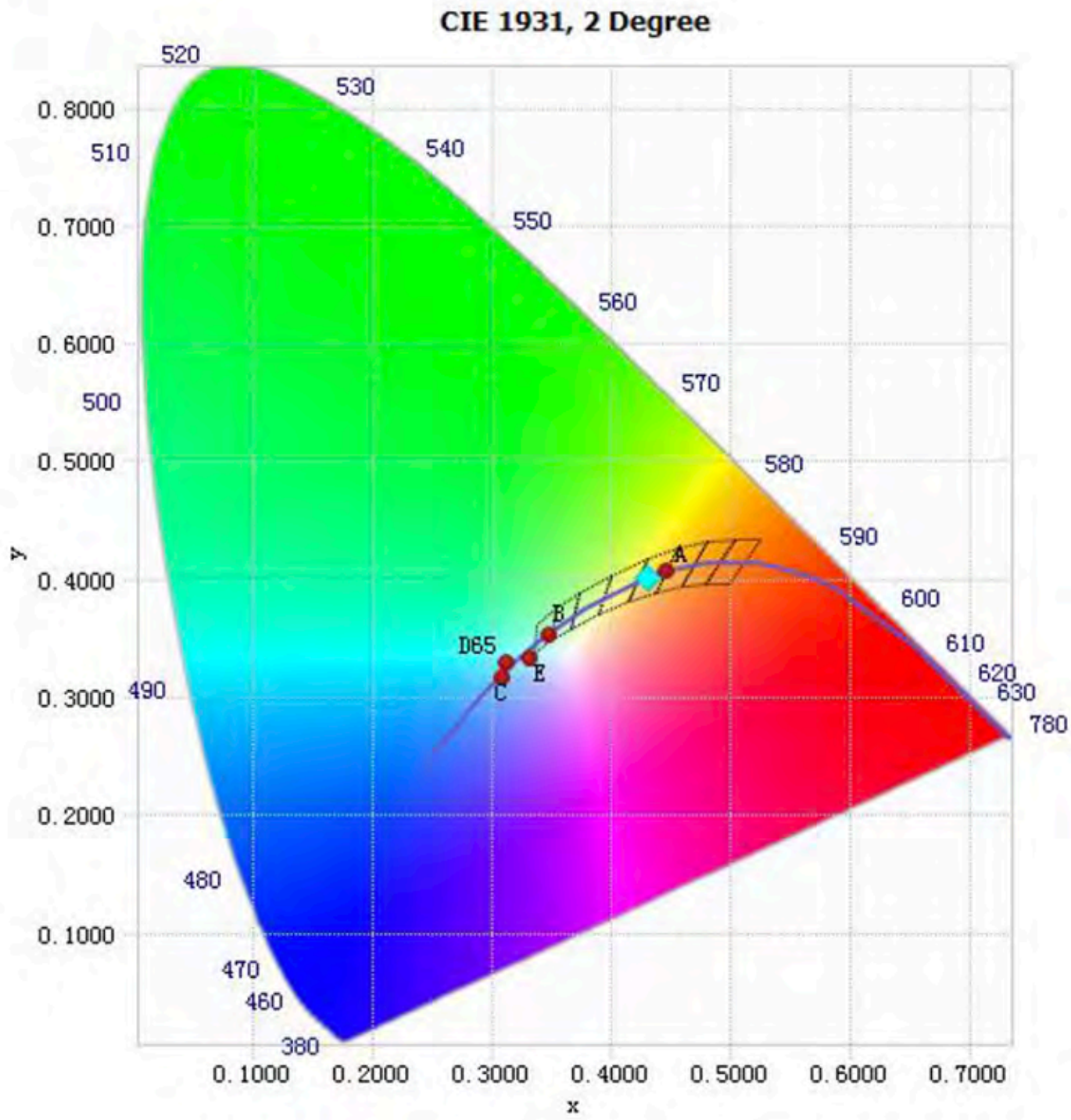


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.30E-04	485	9.24E-03	590	4.10E-02	695	6.94E-03
385	1.40E-04	490	1.01E-02	595	4.20E-02	700	5.94E-03
390	1.32E-04	495	1.16E-02	600	4.25E-02	705	5.08E-03
395	1.54E-04	500	1.36E-02	605	4.23E-02	710	4.33E-03
400	1.50E-04	505	1.57E-02	610	4.16E-02	715	3.69E-03
405	1.59E-04	510	1.74E-02	615	4.04E-02	720	3.18E-03
410	2.07E-04	515	1.88E-02	620	3.86E-02	725	2.71E-03
415	3.63E-04	520	2.00E-02	625	3.64E-02	730	2.30E-03
420	6.28E-04	525	2.09E-02	630	3.40E-02	735	1.95E-03
425	1.15E-03	530	2.17E-02	635	3.14E-02	740	1.67E-03
430	2.09E-03	535	2.26E-02	640	2.87E-02	745	1.41E-03
435	3.73E-03	540	2.35E-02	645	2.60E-02	750	1.22E-03
440	6.76E-03	545	2.47E-02	650	2.35E-02	755	1.03E-03
445	1.21E-02	550	2.60E-02	655	2.09E-02	760	8.95E-04
450	2.11E-02	555	2.75E-02	660	1.86E-02	765	7.51E-04
455	2.65E-02	560	2.92E-02	665	1.63E-02	770	6.45E-04
460	2.14E-02	565	3.12E-02	670	1.43E-02	775	5.54E-04
465	1.61E-02	570	3.34E-02	675	1.25E-02	780	4.74E-04
470	1.37E-02	575	3.55E-02	680	1.08E-02		
475	1.09E-02	580	3.77E-02	685	9.37E-03		
480	9.12E-03	585	3.96E-02	690	8.08E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4306, 0.4013)

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

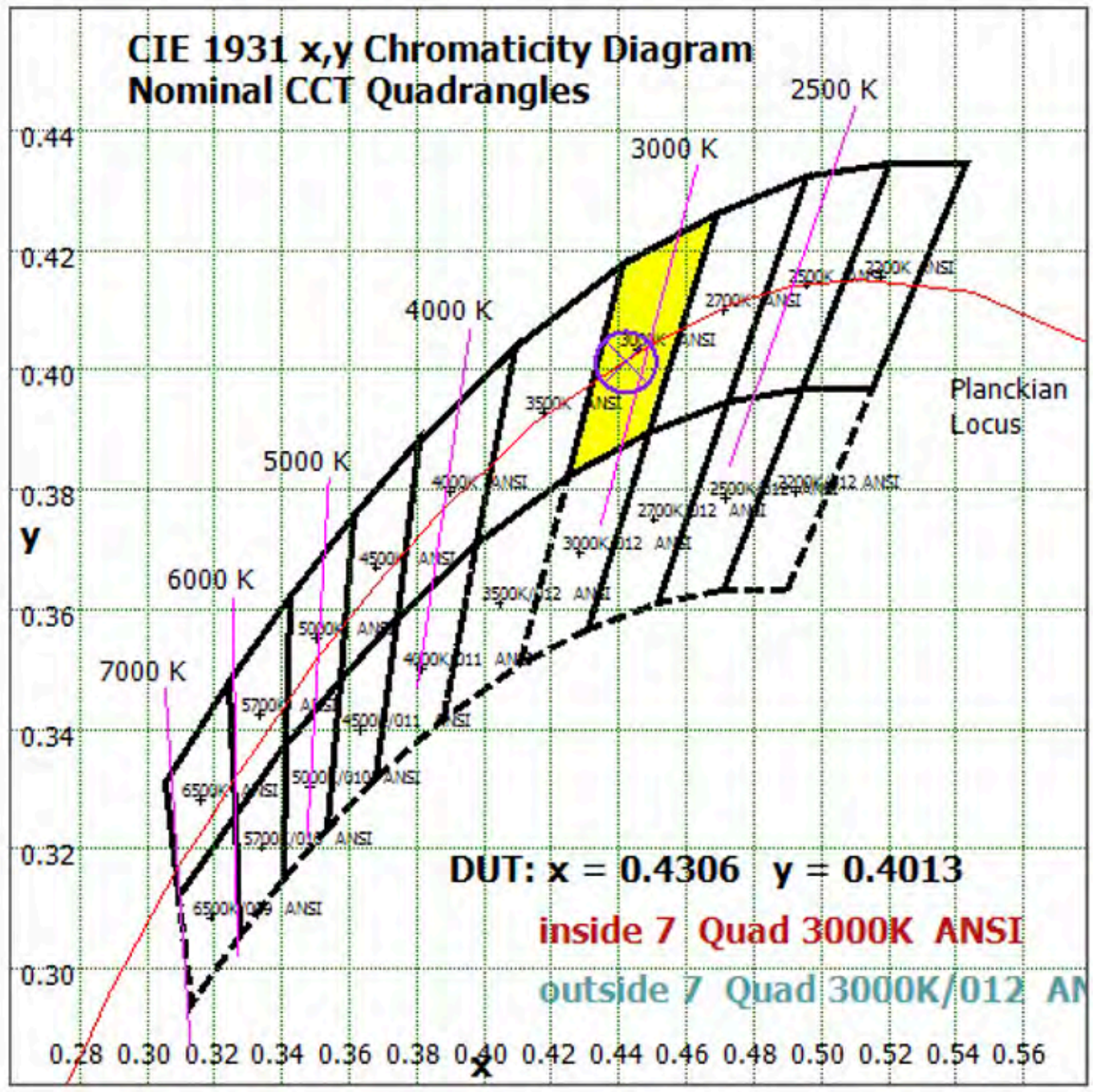


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Quality Assured

Color Rendition Report – Sphere Spectroradiometer Method

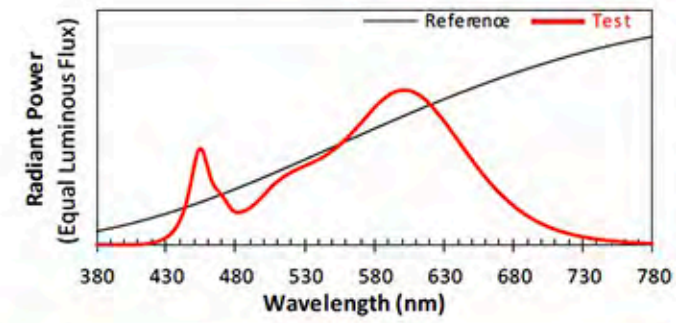
ANSI/IES TM-30-18 Color Rendition Report

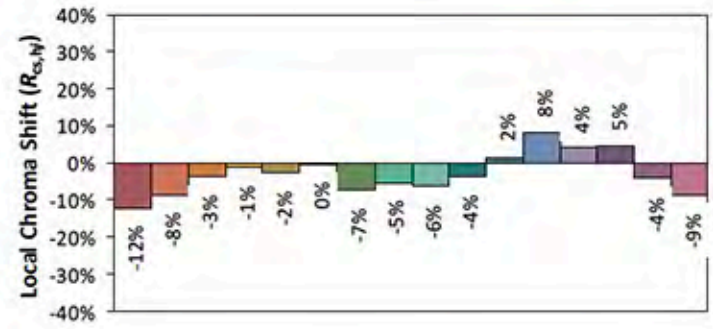
Source: LED

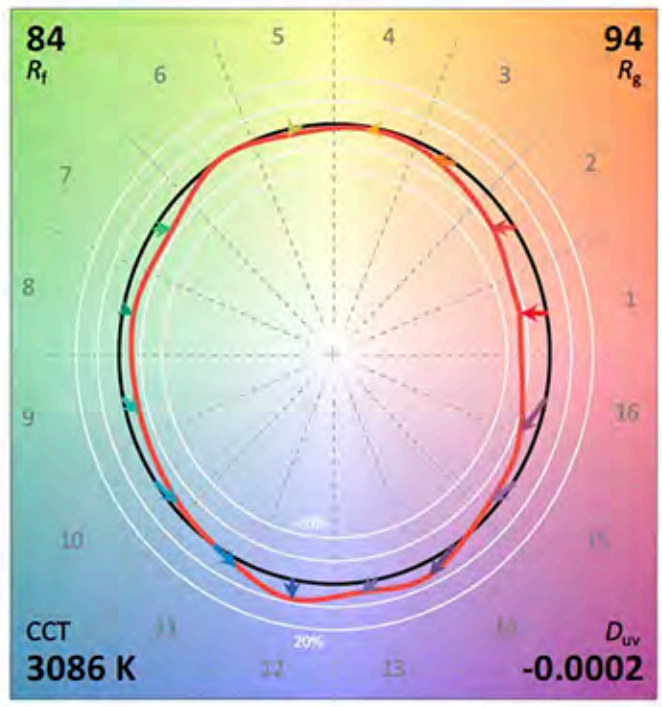
Manufacturer: P.Q.L., Inc.

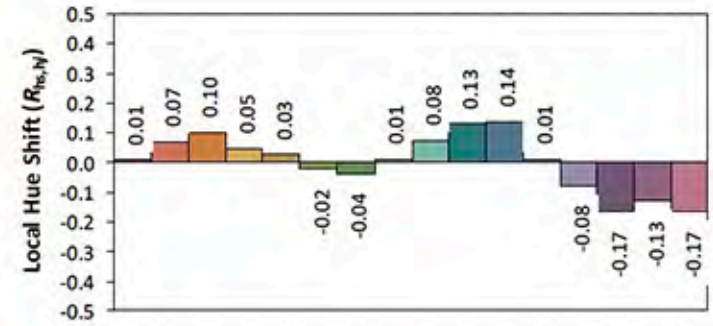
Date: 2022/10/21

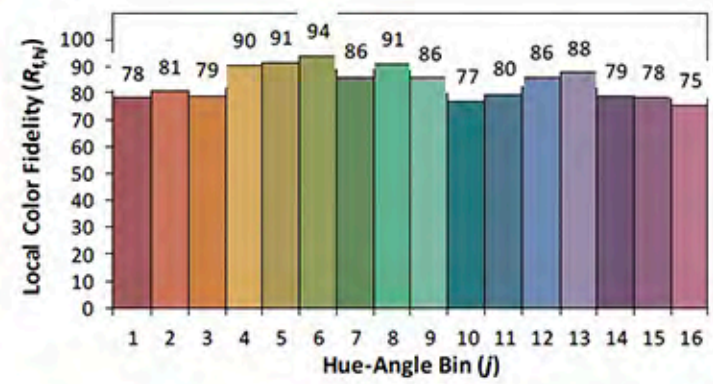
Model: 91502

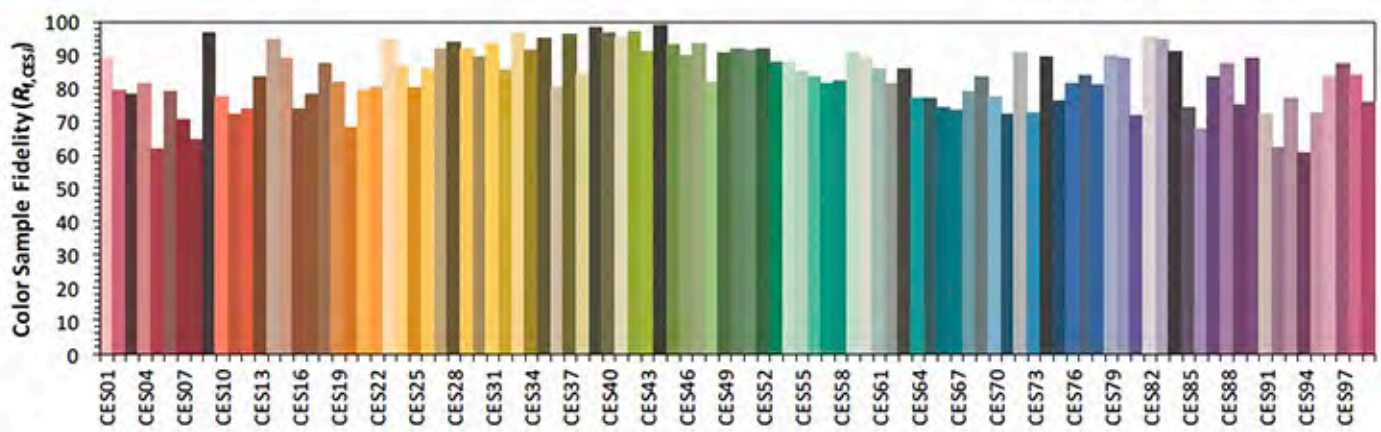












Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x	0.4306
y	0.4013
u'	0.2477
v'	0.5193

CIE 13.3-1995 (CRI)

R_a	82
R_9	3

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)	0.282
Power Factor	0.9962
Power (W)/2	16.88
Luminous Efficacy (lm/W)	124.9
Total Luminous Flux (lm)	2109.1
Beam Angle (°)	113.4 (0°-180°) / 206.2 (90°-270°)
Center Beam Candle Power (cd)	372
Maximum Beam Candle Power (cd)	372.7 (At: C=20.0, Gamma=3.0)
Spacing Criteria	1.25 (0°-180°) / 1.41 (90°-270°)
Zonal Lumens in the 0°-60°Zone	44.84%
Zonal Lumens in the 60°-90°Zone	26.84%
Zonal Lumens in the 90°-120°Zone	17.02%
Zonal Lumens in the 120°-180°Zone	11.29%

Table 4: Test data per Goniophotometer Method

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	35.287	1.67%
10- 20	102.243	4.85%
20- 30	158.848	7.53%
30- 40	200.041	9.48%
40- 50	222.768	10.56%
50- 60	226.61	10.74%
60- 70	213.997	10.15%
70- 80	189.91	9.00%
80- 90	162.271	7.69%
90-100	138.998	6.59%
100-110	119.093	5.65%
110-120	100.834	4.78%
120-130	83.012	3.94%
130-140	65.459	3.10%
140-150	47.132	2.23%
150-160	29.42	1.39%
160-170	11.949	0.57%
170-180	1.208	0.06%
Total	2109.1	100%

γ(°)	Lumens	% Total
0- 60	945.797	44.84%
60- 90	566.178	26.84%
0-90	1511.98	71.69%
90- 180	597.105	28.31%
0- 180	2109.1	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

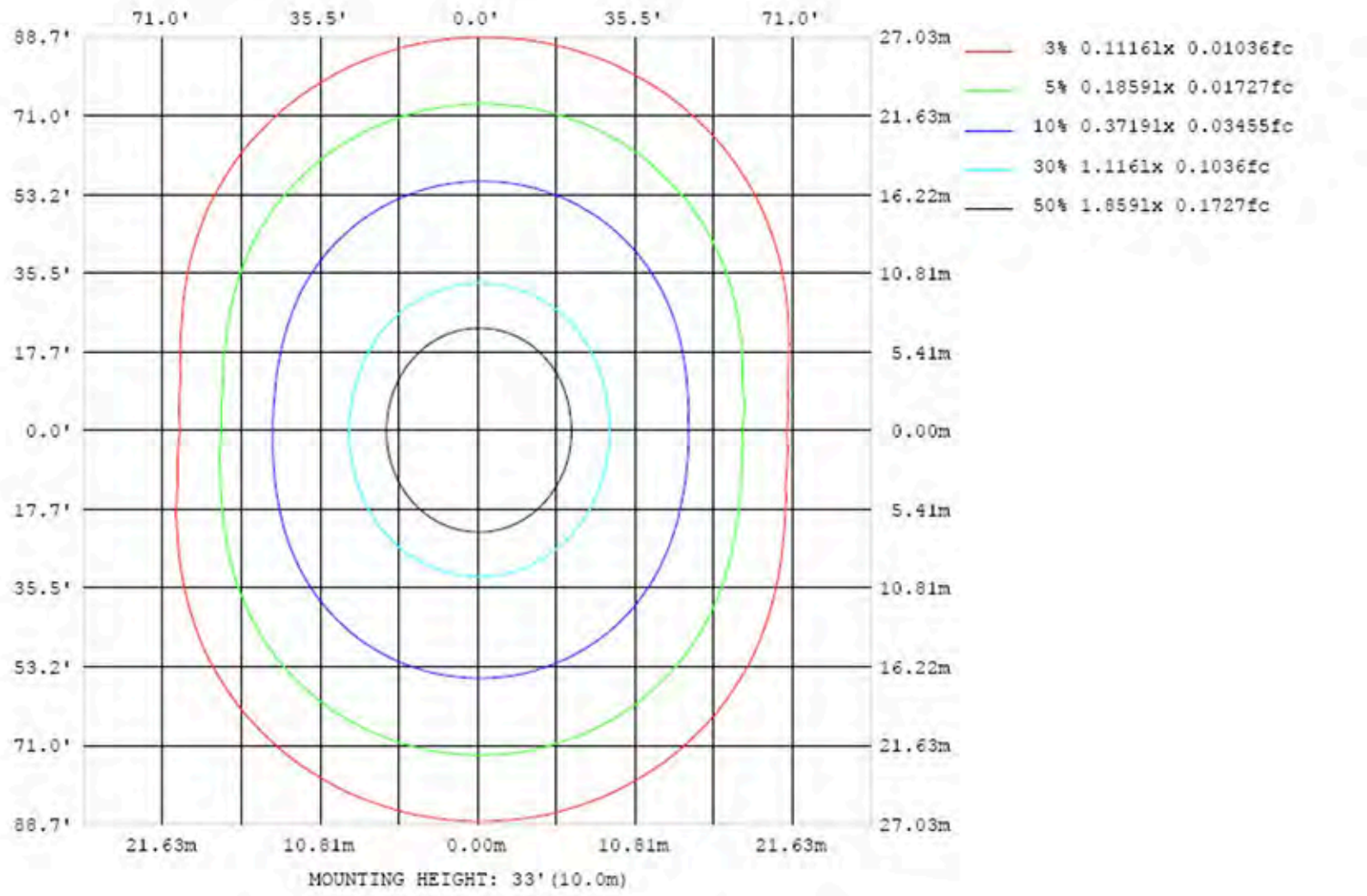


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

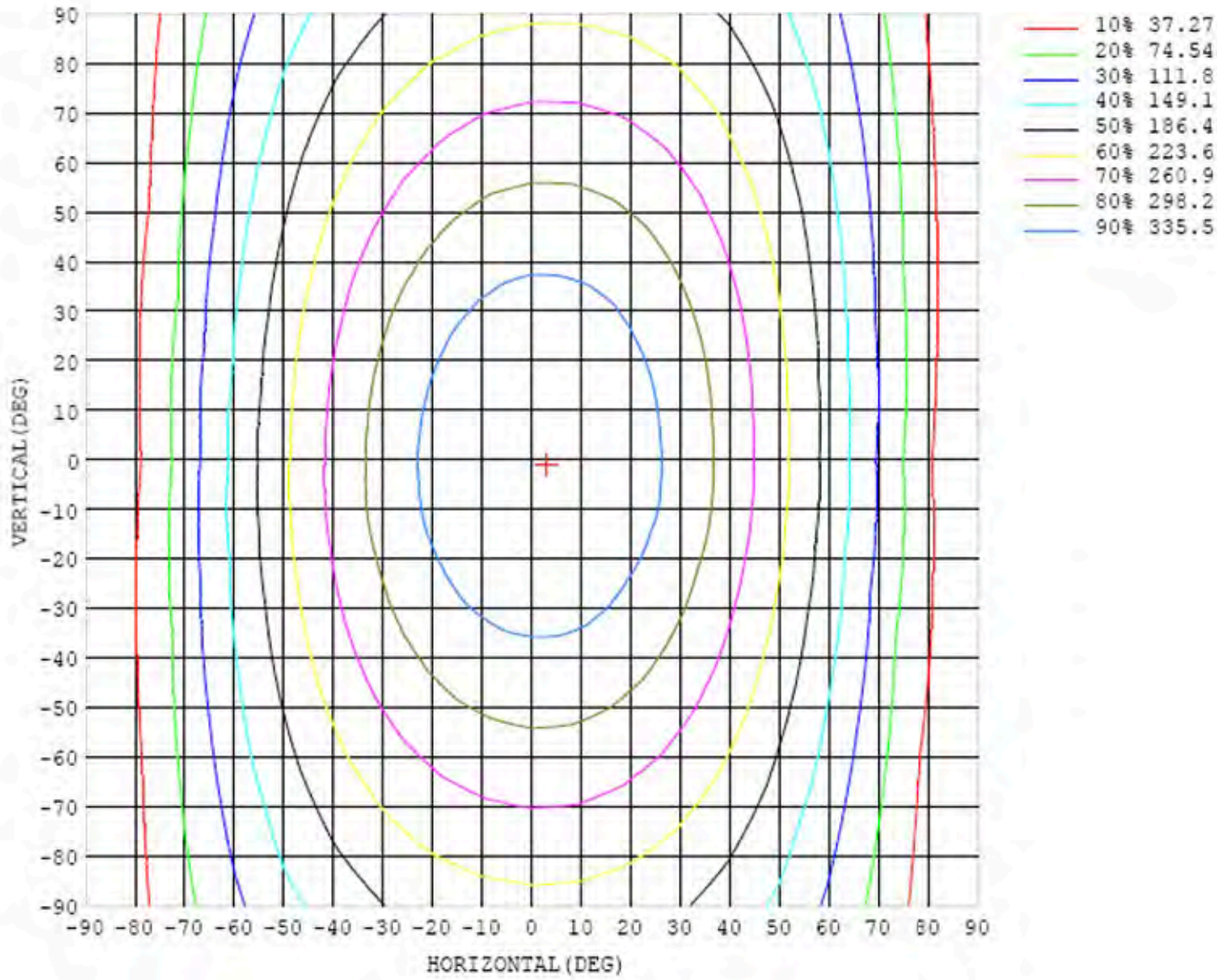


Chart 6: Isocandela Plot

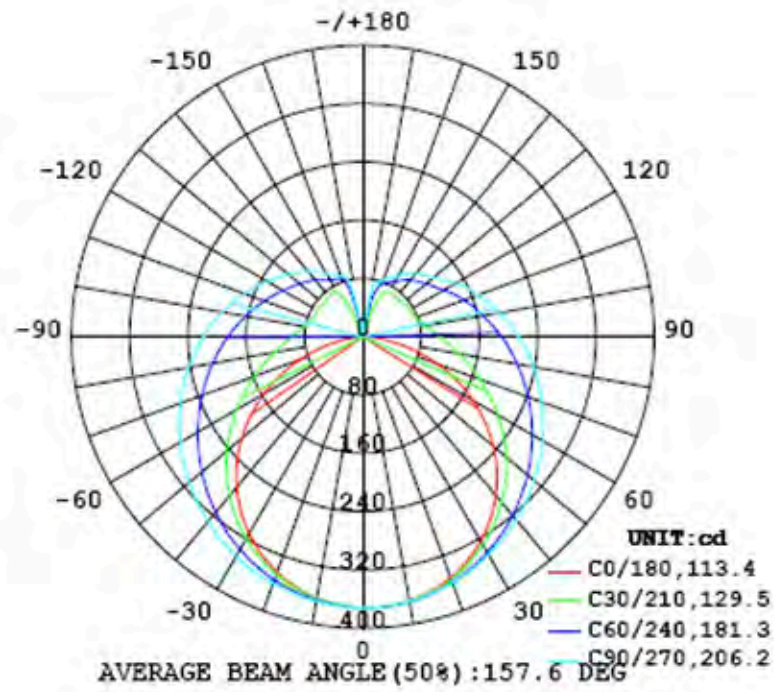


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

γ (DEG) \ C(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	371	372	372	371	372	372	372	372	372	372	371	371	371	371	370	370	369	370	369
10	368	369	369	368	369	369	370	370	370	369	369	368	368	367	366	365	364	364	365
15	361	362	362	363	364	364	365	365	366	365	364	363	362	361	359	357	356	355	355
20	352	352	354	355	356	356	359	360	360	359	358	357	355	353	350	348	346	344	344
25	339	340	342	344	346	348	351	353	353	353	352	350	346	343	339	336	333	330	329
30	324	324	327	330	334	337	342	344	346	346	344	341	337	331	326	321	317	313	312
35	305	306	310	314	320	326	332	335	337	337	335	331	326	319	312	304	299	294	292
40	284	286	290	296	305	313	320	325	328	328	326	321	314	306	296	286	278	272	269
45	260	263	268	277	289	299	308	314	318	318	316	310	302	291	279	267	255	248	244
50	234	237	245	257	271	284	295	303	307	307	305	298	289	276	262	246	232	221	217
55	205	209	220	236	253	269	282	291	296	296	293	286	276	261	244	225	207	194	187
60	175	179	194	214	235	254	269	278	285	285	281	274	262	245	226	204	182	165	156
65	143	149	168	192	217	238	255	266	272	273	270	262	249	231	209	183	158	136	124
70	109	116	142	171	200	223	241	254	261	262	258	249	235	216	192	164	134	106	91.3
75	74.6	85.0	117	152	183	209	228	241	249	250	246	237	222	202	176	146	111	78.1	60.2
80	42.1	56.4	94.4	134	167	195	215	229	236	238	234	225	210	189	162	130	92.1	53.8	30.8
85	15.7	33.7	76.4	119	155	182	203	217	224	226	222	213	198	176	150	116	76.9	35.8	8.57
90	1.48	20.7	63.5	106	142	169	191	205	212	214	210	201	186	165	138	105	65.8	25.8	0.76
95	0.46	17.0	55.6	95.9	131	159	179	193	200	202	198	189	174	155	128	95.1	57.7	20.2	0.38
100	0.34	17.9	51.5	88.3	121	148	167	181	189	190	187	178	164	144	118	86.9	51.5	18.1	0.40
105	0.36	21.8	49.1	82.7	113	138	158	170	177	179	176	167	154	135	110	80.0	46.7	20.8	1.29
110	0.47	25.1	50.2	77.3	106	130	148	161	166	168	165	158	144	126	102	73.8	47.0	24.5	2.16
115	0.71	30.3	52.4	75.8	98.7	121	138	150	157	158	155	147	134	117	94.7	71.2	48.6	28.3	2.66
120	1.61	36.8	53.6	74.9	95.0	112	128	140	146	148	145	137	125	109	90.3	70.5	50.3	30.9	2.56
125	4.42	43.5	55.8	74.6	91.8	107	120	129	135	136	134	126	116	103	87.5	70.5	51.5	33.8	2.78
130	7.31	41.5	59.0	72.7	89.2	102	114	122	126	127	125	120	111	98.8	85.3	70.1	52.1	36.8	3.89
135	8.91	33.1	61.0	71.4	86.0	98.0	108	114	119	120	118	113	105	95.0	83.6	68.6	54.5	28.5	5.38
140	9.14	17.6	63.7	69.9	80.7	92.9	102	108	111	113	111	107	100	91.6	79.9	68.0	56.4	24.3	6.29
145	8.33	13.4	66.0	72.7	78.4	86.2	95.0	101	105	106	104	101	94.2	85.6	76.7	67.5	57.5	6.72	6.09
150	7.27	5.98	53.9	71.4	76.5	82.1	88.8	91.8	95.4	96.8	95.7	92.0	86.9	81.5	74.9	67.2	54.0	10.8	5.43
155	5.79	11.7	32.1	68.2	70.7	78.9	81.9	86.2	88.5	89.1	88.2	86.0	82.7	78.8	73.0	67.6	39.0	3.43	4.85
160	4.15	12.2	14.3	36.9	64.8	69.3	78.0	80.0	80.9	82.7	82.7	81.4	78.5	75.3	70.3	55.9	20.3	7.11	4.39
165	2.96	5.60	11.1	12.0	32.2	47.7	62.1	72.6	76.9	76.6	75.8	75.7	74.5	71.3	51.5	35.0	14.4	13.2	4.05
170	4.01	3.16	9.82	12.0	7.39	11.4	23.1	31.9	40.3	47.6	47.8	46.2	41.1	30.9	13.7	10.7	7.76	14.9	4.41
175	5.18	4.83	6.69	9.61	12.4	13.1	10.9	6.04	3.43	3.42	5.03	2.08	7.49	12.3	14.3	16.4	11.7	9.30	4.69
180	4.97	4.90	4.32	6.56	7.67	9.52	6.29	6.83	7.18	6.56	2.06	7.37	6.46	12.1	12.9	13.6	14.3	14.8	4.86

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	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372
5	369	370	369	369	370	370	371	371	371	371	371	371	371	371	371	371	371
10	364	365	365	365	366	367	367	369	369	369	369	369	369	368	368	368	368
15	355	356	357	359	360	362	363	365	365	366	366	365	365	363	362	362	361
20	344	345	347	349	352	355	358	359	360	360	361	360	358	357	354	353	352
25	330	332	335	338	342	347	350	353	354	355	354	353	350	347	344	341	339
30	313	316	320	326	331	337	342	346	348	348	347	345	340	336	332	327	324
35	292	297	304	311	319	326	332	337	340	340	339	335	330	324	317	311	307
40	270	276	285	295	305	314	322	328	331	331	329	325	317	309	301	292	287
45	246	254	265	278	290	302	311	318	321	321	319	313	305	294	283	271	263
50	219	229	244	260	275	289	300	307	311	311	308	301	291	278	263	249	238
55	191	204	222	241	259	275	288	296	300	300	297	289	277	261	243	226	211
60	161	178	200	223	244	262	275	285	289	289	285	276	262	244	223	201	182
65	130	151	178	205	229	248	263	273	278	278	273	263	248	228	203	176	153
70	99.7	126	158	188	214	235	250	261	266	266	261	251	234	211	183	152	123
75	70.9	103	139	172	200	222	238	249	254	254	250	238	220	196	165	129	93.9
80	45.7	82.7	123	158	186	209	226	237	242	242	237	225	207	181	148	109	68.3
85	26.8	68.0	109	144	174	197	214	225	231	231	225	213	194	168	134	92.1	48.0
90	17.3	57.3	97.2	133	162	185	202	213	219	219	213	201	182	155	121	79.8	35.4
95	15.3	50.8	88.4	123	152	174	191	202	207	207	201	189	170	144	111	71.6	29.9
100	17.0	47.6	81.7	114	142	164	180	190	196	195	189	178	159	134	103	66.6	29.3
105	20.6	46.9	77.1	107	133	154	169	179	184	184	178	167	149	126	96.3	63.9	31.5
110	25.1	47.9	74.1	101	125	144	158	168	173	173	167	156	140	118	91.5	63.2	35.6
115	29.7	49.9	72.8	96.1	117	135	149	158	162	162	157	147	132	112	88.1	64.0	40.4
120	28.9	52.7	72.5	92.2	111	127	139	148	152	152	147	138	124	106	85.8	65.6	45.5
125	15.8	54.3	72.5	89.3	106	120	131	139	142	142	138	129	117	102	84.4	67.7	50.6
130	8.01	57.0	70.4	87.1	101	113	123	130	133	133	129	122	111	98.1	83.5	69.9	54.8
135	11.6	59.5	71.7	84.3	97.1	108	116	122	124	124	121	115	106	95.2	80.1	70.3	43.8
140	11.5	54.3	72.8	80.9	92.8	102	109	114	117	117	114	109	101	89.6	80.7	71.5	29.5
145	7.54	37.9	73.6	80.6	87.5	94.9	103	108	109	109	107	102	94.0	87.2	80.5	72.3	10.6
150	3.72	15.0	71.2	80.1	85.4	90.5	94.7	98.0	99.6	99.5	97.8	94.4	90.8	85.2	77.5	56.4	9.43
155	11.9	13.6	47.0	79.6	83.7	87.4	90.6	92.8	93.9	93.9	93.0	90.8	87.6	81.8	69.9	30.8	17.2
160	11.2	15.0	13.4	53.2	78.9	84.7	86.9	88.5	89.3	89.3	88.6	86.9	81.2	66.0	41.2	9.09	11.7
165	10.1	5.96	19.7	11.4	36.4	57.7	72.1	80.8	83.9	83.8	80.1	66.5	48.5	30.6	10.1	16.1	5.16
170	15.7	12.5	8.67	17.5	18.9	11.2	13.3	22.1	26.3	26.2	20.4	12.9	8.51	11.2	17.0	8.79	6.29
175	14.8	18.7	13.5	12.2	12.3	8.97	7.93	8.52	11.6	9.37	9.78	9.71	8.79	10.2	9.60	9.86	15.8
180	4.77	5.54	7.11	8.87	14.8	20.8	23.1	21.2	6.51	0.00	7.21	11.2	18.8	26.4	26.5	22.0	19.3

Table 7: Luminous Intensity Data

Quality Assured

TEST RESULTS of 91496

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)	0.282	0.127
Power Factor	0.9956	0.9641
Test Power (W)/2	16.86	16.93
THD A%	5.92	11.58
Luminous Efficacy (lm/W)	129.9	129.3
Total Luminous Flux (lm)	2189.1	2188.8
Color Rendering Index (CRI)	81.2	
R9	2.2	
Correlated Color Temperature (CCT)(K)	3513	
Chromaticity Chroma x	0.4055	
Chromaticity Chroma y	0.3933	
Chromaticity Chroma u	0.2348	
Chromaticity Chroma v	0.3416	
Duv	0.0011	
Chromaticity Chroma u '	0.2348	
Chromaticity Chroma v'	0.5124	

Special Color Rendering Indices	
R1	79.1
R2	87.3
R3	94.5
R4	80.6
R5	79.1
R6	83.2
R7	84.7
R8	60.8
R9	2.2
R10	70.7
R11	79.6
R12	62.2
R13	80.8
R14	96.9

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

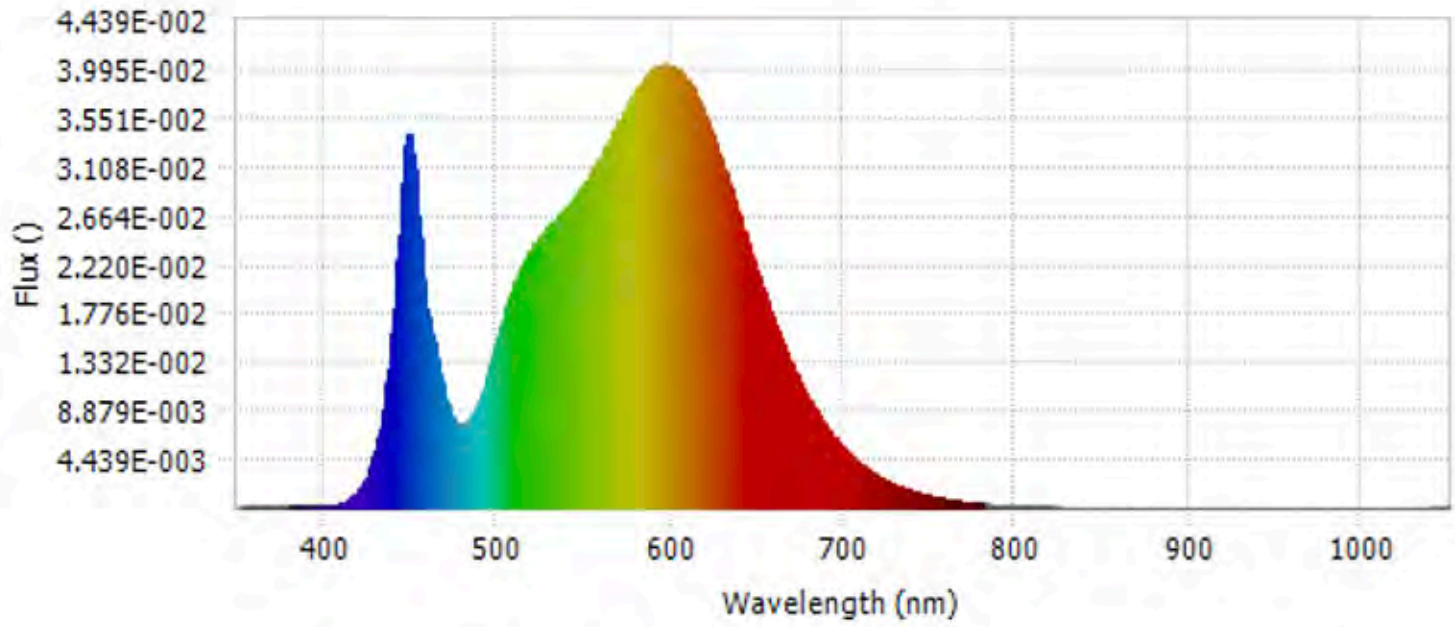
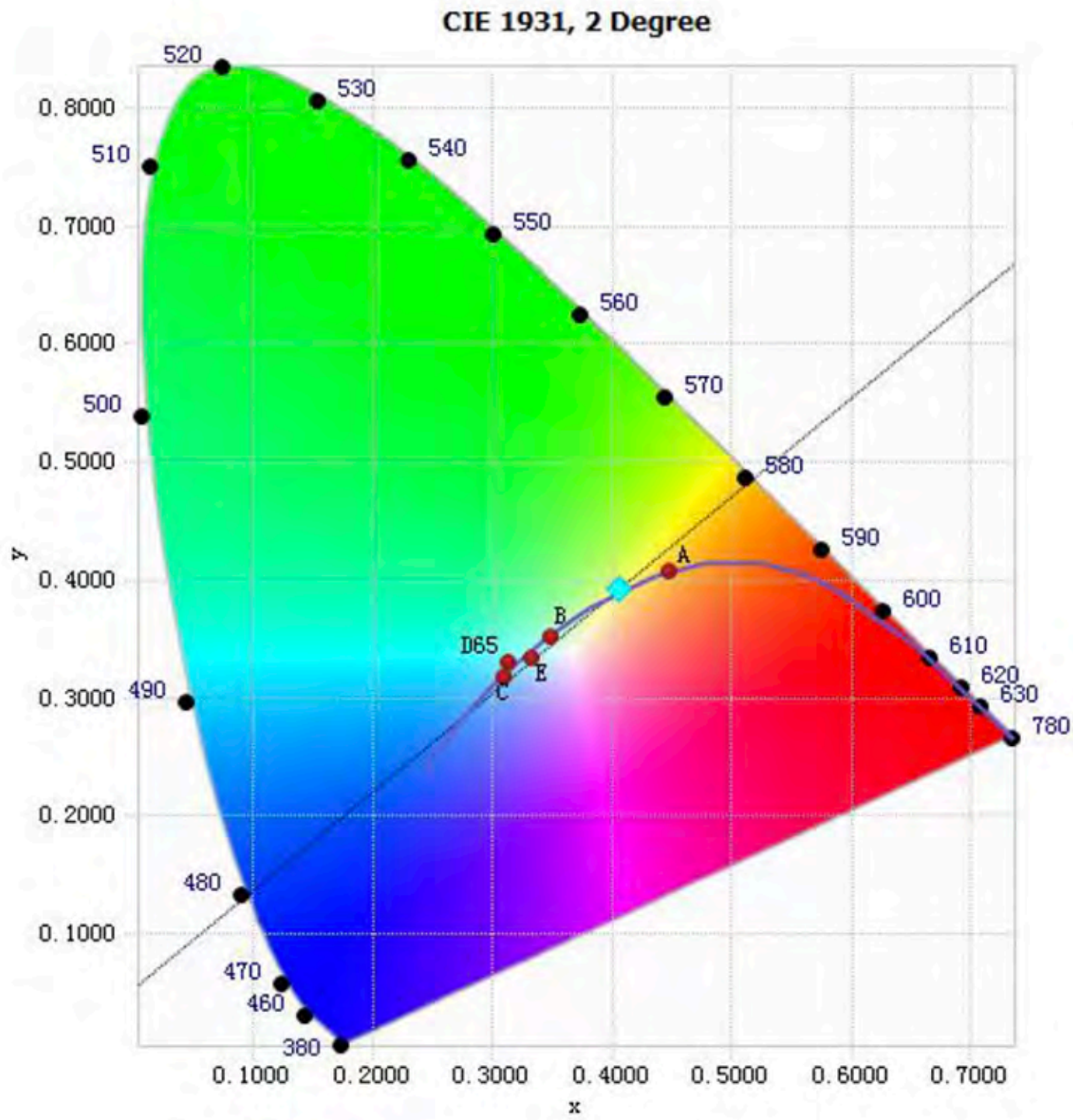


Chart 8: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.15E-04	485	8.41E-03	590	3.98E-02	695	6.35E-03
385	1.57E-04	490	1.00E-02	595	4.02E-02	700	5.43E-03
390	1.52E-04	495	1.27E-02	600	4.02E-02	705	4.64E-03
395	1.31E-04	500	1.55E-02	605	3.98E-02	710	3.96E-03
400	1.43E-04	505	1.82E-02	610	3.89E-02	715	3.40E-03
405	2.05E-04	510	2.05E-02	615	3.75E-02	720	2.89E-03
410	4.37E-04	515	2.23E-02	620	3.56E-02	725	2.47E-03
415	8.79E-04	520	2.37E-02	625	3.35E-02	730	2.10E-03
420	1.66E-03	525	2.48E-02	630	3.13E-02	735	1.78E-03
425	3.17E-03	530	2.57E-02	635	2.89E-02	740	1.52E-03
430	5.79E-03	535	2.64E-02	640	2.65E-02	745	1.29E-03
435	1.01E-02	540	2.74E-02	645	2.39E-02	750	1.11E-03
440	1.80E-02	545	2.85E-02	650	2.15E-02	755	9.48E-04
445	2.96E-02	550	2.94E-02	655	1.92E-02	760	8.04E-04
450	3.34E-02	555	3.07E-02	660	1.70E-02	765	6.81E-04
455	2.44E-02	560	3.21E-02	665	1.50E-02	770	5.82E-04
460	1.75E-02	565	3.36E-02	670	1.31E-02	775	5.03E-04
465	1.38E-02	570	3.51E-02	675	1.14E-02	780	4.30E-04
470	1.00E-02	575	3.65E-02	680	9.92E-03		
475	7.90E-03	580	3.80E-02	685	8.59E-03		
480	7.74E-03	585	3.92E-02	690	7.39E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4055, 0.3933)

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

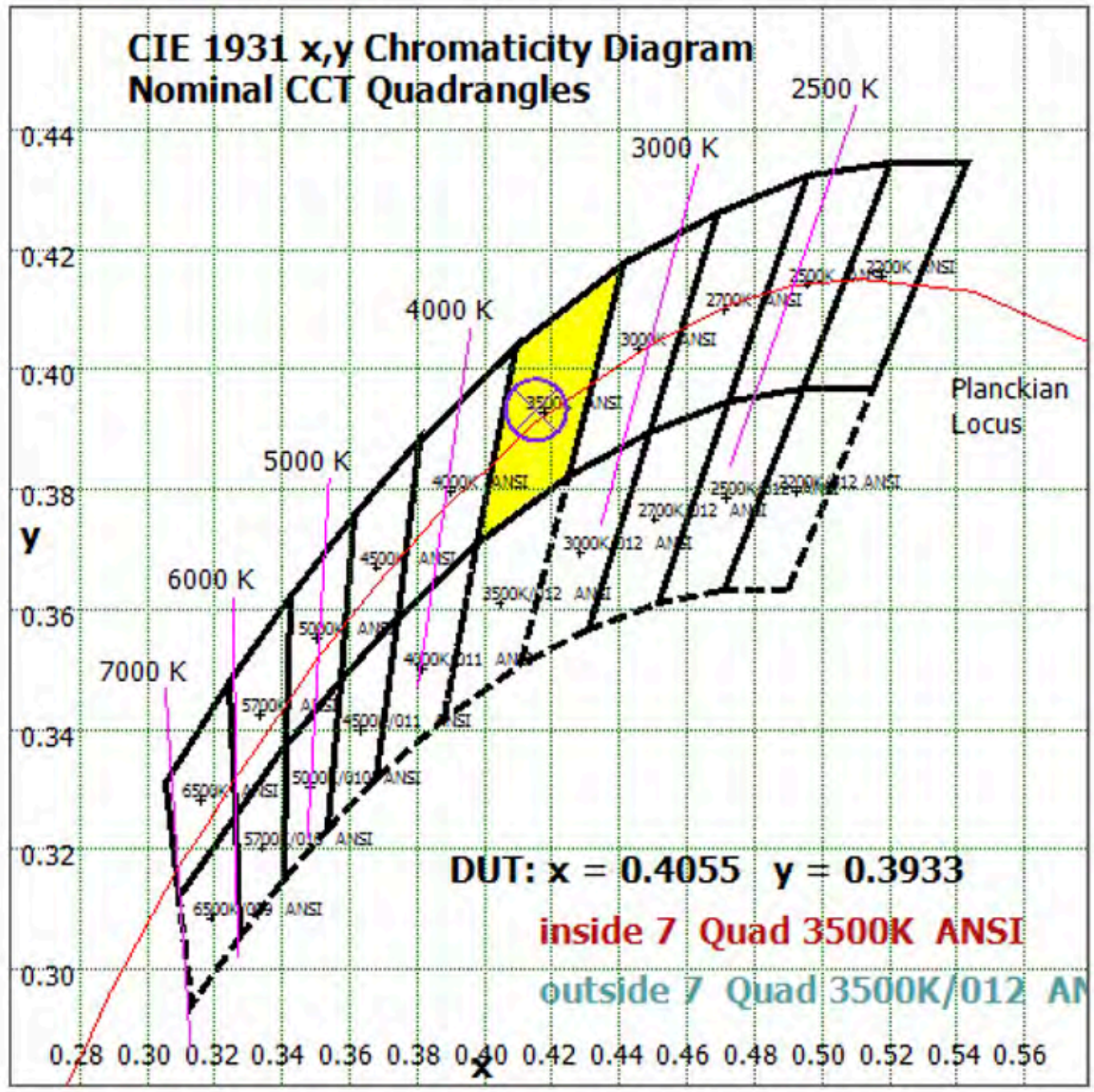


Chart 10: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Quality Assured

Color Rendition Report – Sphere Spectroradiometer Method

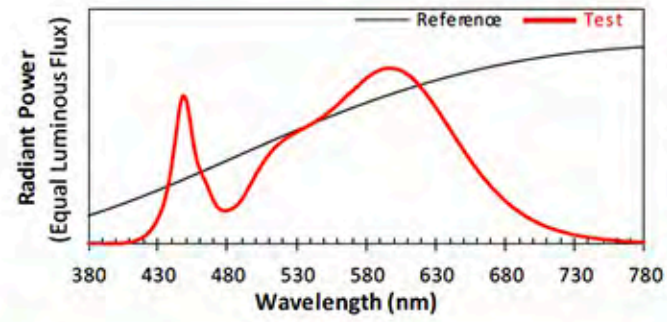
ANSI/IES TM-30-18 Color Rendition Report

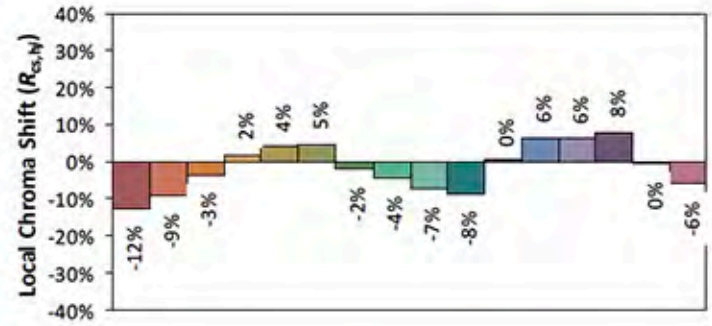
Source: LED

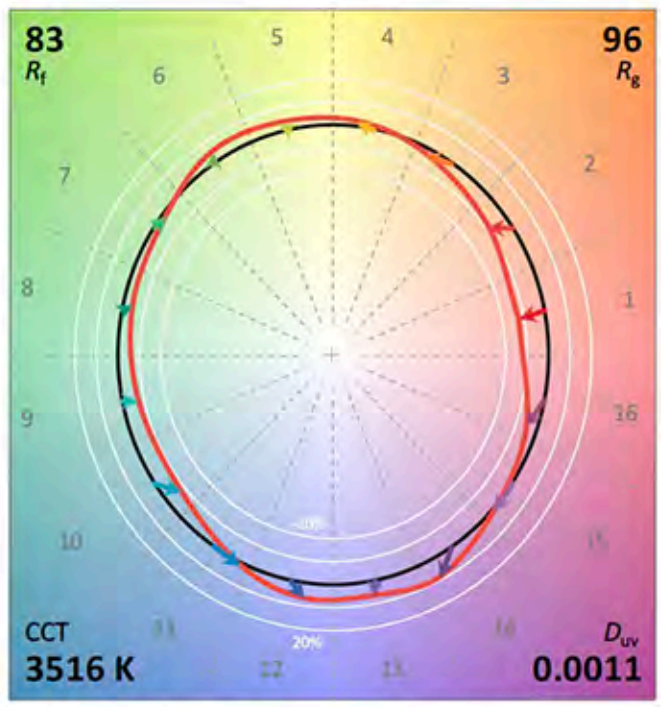
Manufacturer: P.Q.L., Inc.

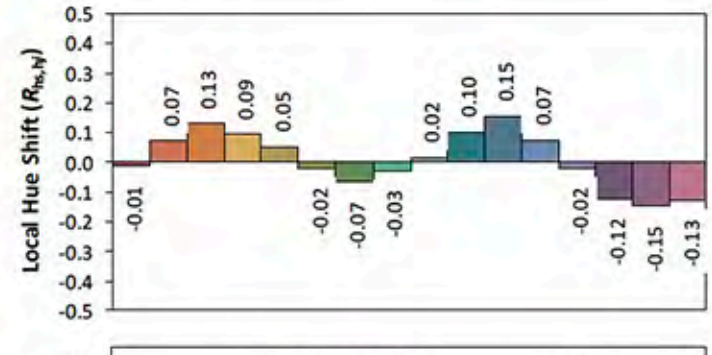
Date: 2022/10/21

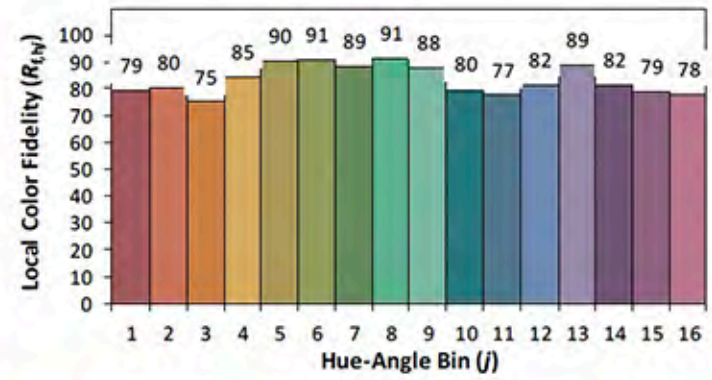
Model: 91496

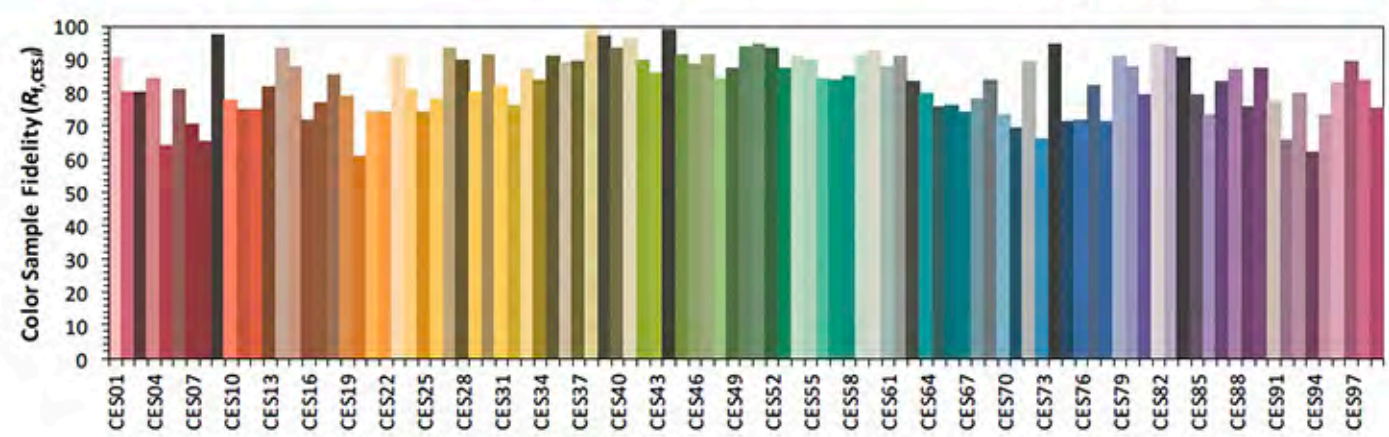












Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x	0.4055
y	0.3933
u'	0.2348
v'	0.5124

CIE 13.3-1995 (CRI)	
R_a	81
R_9	2

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.

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)	0.282
Power Factor	0.9961
Power (W)/2	16.86
Luminous Efficacy (lm/W)	130.6
Total Luminous Flux (lm)	2201.7
Beam Angle (°)	113.3 (0°-180°) / 207.7 (90°-270°)
Center Beam Candle Power (cd)	387
Maximum Beam Candle Power (cd)	387.4 (At: C=70.0, Gamma=4.0)
Spacing Criteria	1.25 (0°-180°) / 1.41 (90°-270°)
Zonal Lumens in the 0°-60°Zone	44.65%
Zonal Lumens in the 60°-90°Zone	26.81%
Zonal Lumens in the 90°-120°Zone	17.12%
Zonal Lumens in the 120°-180°Zone	11.42%

Table 10: Test data per Goniophotometer Method

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	36.673	1.67%
10- 20	106.273	4.83%
20- 30	165.108	7.50%
30- 40	207.86	9.44%
40- 50	231.479	10.51%
50- 60	235.644	10.70%
60- 70	222.699	10.11%
70- 80	198.011	8.99%
80- 90	169.648	7.71%
90-100	145.692	6.62%
100-110	125.11	5.68%
110-120	106.067	4.82%
120-130	87.646	3.98%
130-140	69.028	3.14%
140-150	49.663	2.26%
150-160	31.051	1.41%
160-170	12.548	0.57%
170-180	1.474	0.07%
Total	2201.7	100%

γ(°)	Lumens	% Total
0- 60	983.037	44.65%
60- 90	590.358	26.81%
0-90	1573.4	71.46%
90- 180	628.279	28.54%
0- 180	2201.7	100%

Table 11: Zonal Lumen

Illuminance Plots- Goniophotometer Method

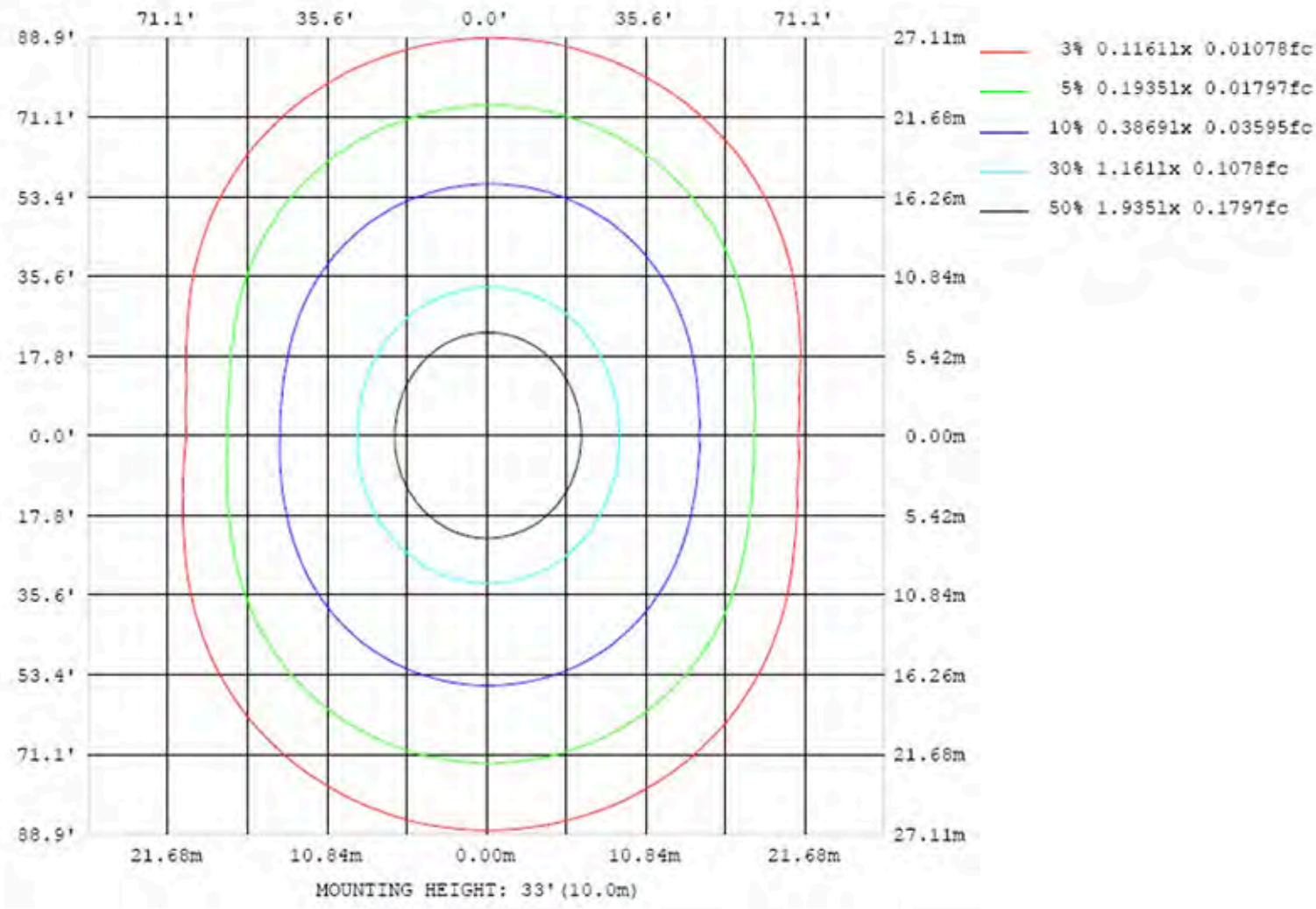


Chart 12: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

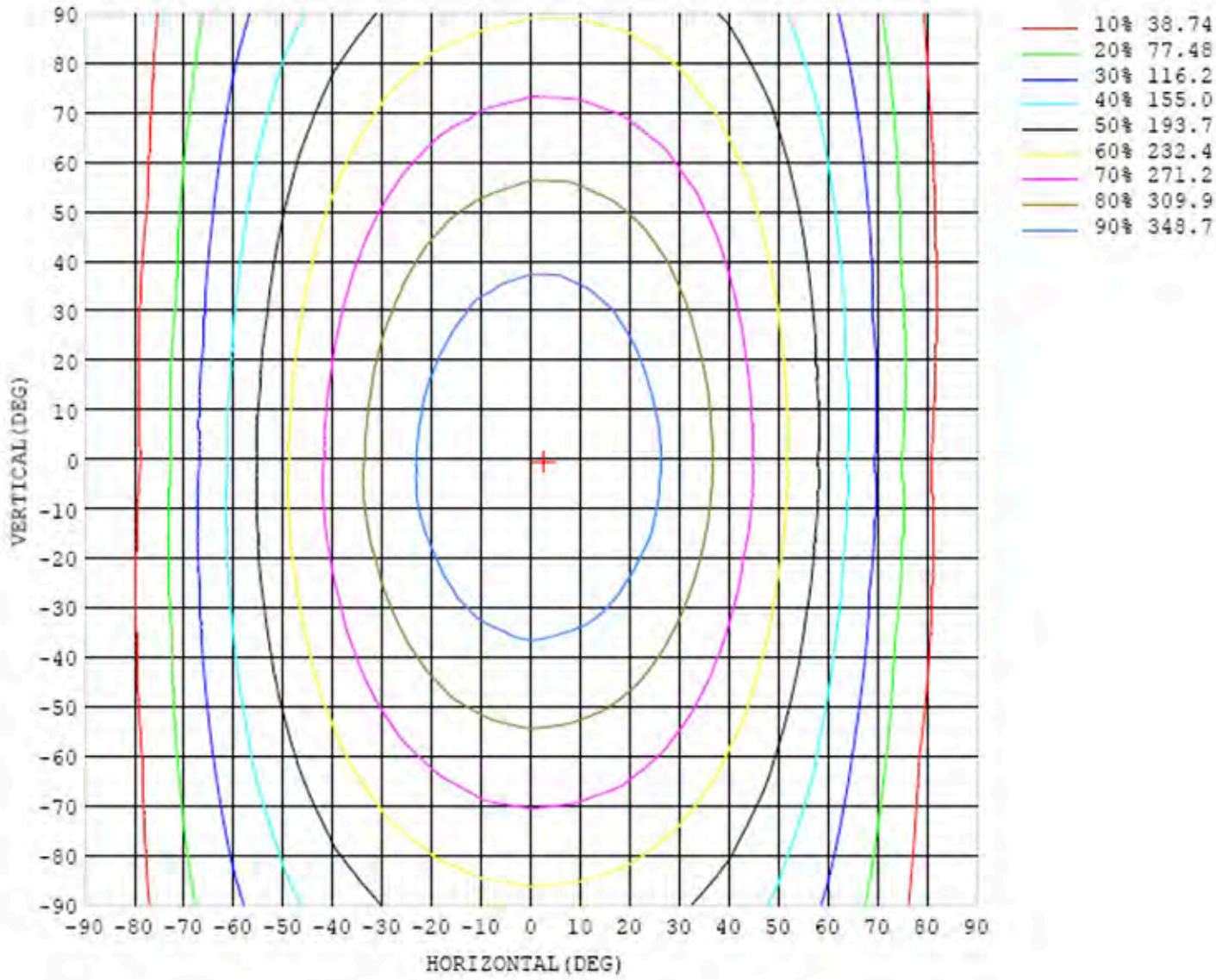


Chart 13: Isocandela Plot

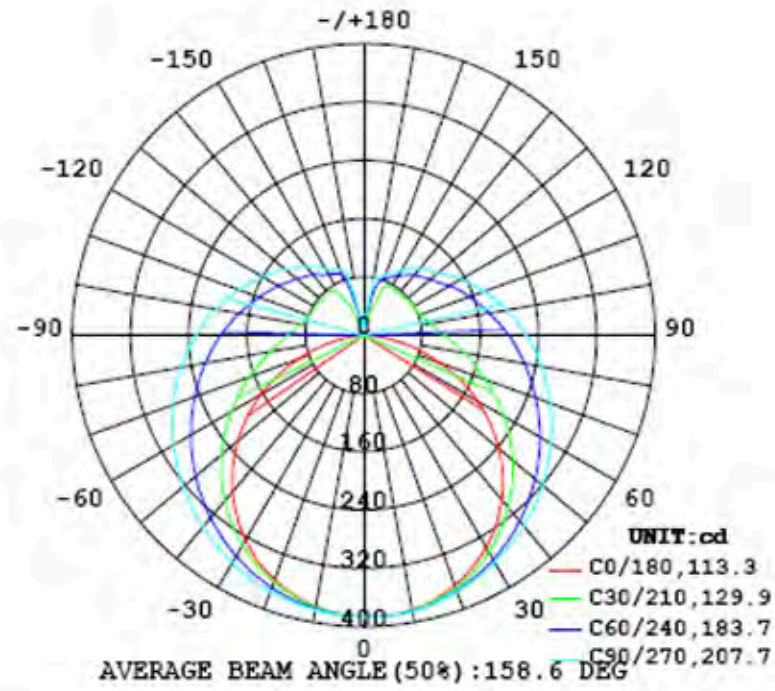


Chart 14: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

γ (DEG) \ C(DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387
5	386	386	386	386	386	387	386	387	386	386	386	386	386	386	384	385	385	384	384
10	382	383	383	383	384	384	384	385	384	385	384	384	383	381	380	380	380	379	378
15	376	376	376	377	378	379	380	381	380	381	380	380	378	375	373	372	372	370	369
20	365	366	367	370	370	372	373	375	374	375	373	372	371	368	365	362	361	359	357
25	352	353	355	358	360	362	365	367	367	367	366	365	361	357	352	350	347	344	343
30	336	337	340	343	347	352	356	359	359	360	358	356	351	345	340	334	331	327	324
35	317	318	322	327	333	339	345	349	350	351	349	346	339	332	324	317	311	307	304
40	294	297	301	309	317	325	333	338	340	342	339	334	327	318	308	298	290	284	280
45	270	273	279	289	300	311	320	327	330	332	328	323	314	303	291	277	266	259	254
50	242	246	254	267	282	295	307	315	320	320	317	311	301	287	272	256	241	232	225
55	212	217	228	245	264	280	294	303	307	308	306	298	287	272	253	234	216	202	195
60	180	186	201	223	244	264	280	290	295	297	293	285	273	255	235	212	189	172	163
65	148	154	173	200	226	248	265	277	283	285	281	272	259	240	217	190	163	141	129
70	112	121	147	178	207	232	251	264	271	273	269	260	245	225	199	170	139	110	94.8
75	77.3	88.7	121	158	190	217	238	251	258	260	256	247	232	210	183	152	116	81.1	62.1
80	43.8	59.2	98.3	140	174	203	224	239	246	248	244	234	219	197	168	135	95.6	55.6	31.8
85	16.4	35.6	79.9	124	160	190	211	226	233	236	232	222	206	184	156	121	79.5	36.6	8.65
90	1.47	22.2	66.7	111	149	177	199	214	221	223	219	210	194	172	144	109	68.1	26.2	0.61
95	0.39	18.4	58.7	101	137	165	187	201	209	211	208	198	182	161	134	99.3	60.1	20.1	0.43
100	0.40	19.6	54.6	93.2	127	155	175	190	197	200	195	187	171	151	124	90.7	53.1	18.6	0.43
105	0.63	24.2	52.0	87.5	119	145	165	178	185	187	184	175	160	141	115	82.7	48.9	21.6	0.95
110	0.92	28.6	53.3	82.5	112	137	155	167	174	176	173	164	151	131	106	76.6	48.9	25.6	1.72
115	1.64	33.7	55.6	80.1	105	128	146	157	163	165	161	154	141	122	98.6	74.6	51.0	29.8	1.96
120	4.35	40.8	57.1	79.3	100	119	136	147	153	155	151	143	131	114	94.7	73.7	53.0	33.0	2.71
125	7.62	47.7	59.1	79.2	97.0	113	126	137	142	144	140	133	122	108	91.6	74.0	54.3	36.7	4.81
130	9.30	52.2	62.5	77.3	94.3	108	120	128	132	134	131	125	116	104	89.5	73.9	55.1	39.9	7.33
135	8.45	39.8	65.0	75.4	91.6	104	113	120	125	126	124	119	110	100.0	87.8	72.7	57.9	32.0	7.65
140	6.56	31.3	68.7	74.0	86.3	99.2	108	114	117	119	117	112	105	96.4	85.0	71.7	60.9	27.6	7.08
145	3.52	19.9	72.9	76.3	83.5	92.1	101	108	111	112	110	106	100	91.3	81.5	71.1	64.2	14.5	4.20
150	2.30	18.6	69.1	75.8	80.7	88.3	93.5	98.6	102	104	102	98.5	92.9	86.7	79.2	71.4	61.1	17.2	4.07
155	1.98	12.6	45.7	75.4	77.3	82.7	87.5	92.3	95.0	96.0	94.8	91.8	87.6	83.3	77.2	74.3	48.6	9.36	2.24
160	5.29	14.4	18.7	50.0	72.0	78.3	83.4	83.4	87.4	88.7	88.2	86.9	83.7	80.0	76.4	68.4	32.8	9.80	4.11
165	3.83	7.39	8.87	21.1	44.4	64.5	71.5	80.4	81.5	81.7	80.4	80.5	79.9	78.5	67.9	48.0	21.4	12.6	8.05
170	3.07	8.82	10.3	8.95	16.9	27.1	35.6	43.1	57.3	67.9	68.4	62.7	51.6	45.3	30.5	15.9	8.94	11.6	13.6
175	5.39	8.80	12.3	15.5	11.4	9.50	10.5	9.97	9.53	11.5	17.0	16.0	10.8	6.97	7.70	13.7	18.6	15.2	11.3
180	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68

Table 12: Luminous Intensity Data

Table--2 UNIT: cd

γ (DEG) \ C(DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350
0	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387
5	383	384	384	384	384	385	385	384	385	385	386	386	385	385	385	385	386
10	378	378	379	379	380	381	382	382	383	383	383	383	383	382	381	382	383
15	369	369	371	372	374	376	377	377	379	380	380	379	378	377	376	376	376
20	357	358	361	363	365	369	371	372	374	375	374	373	371	369	367	366	366
25	343	344	348	352	357	360	364	365	368	368	367	366	362	359	356	354	353
30	324	328	333	338	344	350	355	358	361	362	360	357	352	348	343	339	336
35	304	308	316	323	331	339	346	350	352	353	351	346	342	335	327	322	318
40	281	287	296	306	317	327	335	340	343	343	341	336	329	319	310	303	297
45	256	264	276	290	303	314	324	330	333	333	330	324	315	304	292	281	273
50	228	239	255	271	287	301	312	318	324	324	320	312	301	287	272	258	247
55	199	212	232	252	271	288	300	307	312	312	308	299	286	270	251	233	218
60	168	185	209	233	255	274	288	296	301	301	296	286	271	252	230	207	188
65	136	158	187	215	240	260	276	285	290	290	284	273	257	235	209	182	158
70	104	132	166	198	225	247	263	273	278	278	272	260	242	218	189	156	126
75	74.2	108	147	181	211	234	250	261	267	266	260	247	228	202	170	133	96.2
80	48.5	87.9	130	167	197	221	238	248	255	254	247	234	215	187	153	112	69.2
85	28.9	72.0	116	154	184	208	226	236	242	242	235	222	202	174	138	94.8	48.9
90	19.2	61.6	104	141	172	196	214	224	230	230	223	210	189	161	125	82.1	35.9
95	17.1	54.9	94.9	131	161	185	202	212	218	217	211	197	177	150	115	73.3	30.4
100	18.9	51.5	88.0	122	151	174	190	200	206	205	199	186	166	140	106	68.7	29.7
105	22.5	50.8	83.1	114	141	163	179	189	194	193	187	175	156	131	99.6	66.1	32.2
110	27.2	51.7	79.8	108	133	153	168	177	182	182	176	164	146	123	95.0	65.6	36.2
115	31.9	53.9	77.8	103	125	144	158	166	171	170	165	154	137	116	91.5	66.6	40.8
120	30.9	56.5	77.2	98.7	118	135	148	156	160	160	155	144	130	111	89.4	68.6	45.7
125	17.9	57.1	77.2	95.4	113	127	139	146	150	150	145	136	123	107	88.1	71.0	50.3
130	7.19	58.5	74.6	92.7	108	121	131	137	140	140	136	128	117	103	87.3	73.0	52.9
135	9.19	60.4	76.4	88.7	103	114	123	128	132	131	128	121	111	99.5	83.6	72.4	39.3
140	10.7	54.2	76.7	86.4	97.4	109	116	121	123	123	120	115	106	93.6	85.4	71.1	20.0
145	5.60	35.5	75.1	86.5	93.5	100	109	113	116	116	113	106	98.3	92.2	85.3	69.1	5.50
150	3.40	9.88	66.1	85.5	91.1	96.4	101	103	105	105	103	99.5	95.6	90.0	79.5	47.8	8.54
155	11.1	13.0	40.4	80.1	89.5	93.2	96.2	98.1	99.8	99.4	98.2	95.9	91.6	82.6	61.4	21.7	15.1
160	10.6	15.1	9.40	42.5	74.4	89.4	92.5	93.5	94.6	94.7	93.9	90.8	80.7	59.6	29.8	7.13	8.50
165	10.0	6.06	17.6	12.8	21.8	46.2	63.0	74.0	79.3	79.1	71.5	56.5	39.2	16.1	11.3	14.4	1.95
170	11.1	15.8	10.7	11.4	20.1	20.9	12.6	11.9	13.0	12.7	9.32	7.55	13.0	17.5	11.2	8.34	6.04
175	5.77	12.5	18.7	17.5	14.1	12.9	11.9	10.3	8.11	6.42	8.41	9.58	9.81	10.9	15.0	16.5	4.78
180	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68	6.68

Table 13: Luminous Intensity Data

TEST RESULTS of 91497

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)	0.283	0.127
Power Factor	0.9955	0.9642
Test Power (W)/2	16.91	16.97
THD A%	6.04	11.56
Luminous Efficacy (lm/W)	131.8	131.4
Total Luminous Flux (lm)	2228.3	2229.4
Color Rendering Index (CRI)	80.9	
R9	0.6	
Correlated Color Temperature (CCT)(K)	3994	
Chromaticity Chroma x	0.3814	
Chromaticity Chroma y	0.3796	
Chromaticity Chroma u	0.2246	
Chromaticity Chroma v	0.3353	
Duv	0.0011	
Chromaticity Chroma u '	0.2246	
Chromaticity Chroma v'	0.5030	

Special Color Rendering Indices	
R1	78.8
R2	86.6
R3	93.1
R4	80.5
R5	79
R6	81.7
R7	85.4
R8	62.3
R9	0.6
R10	68.7
R11	79.3
R12	58.9
R13	80.5
R14	96.2

Table 14: 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

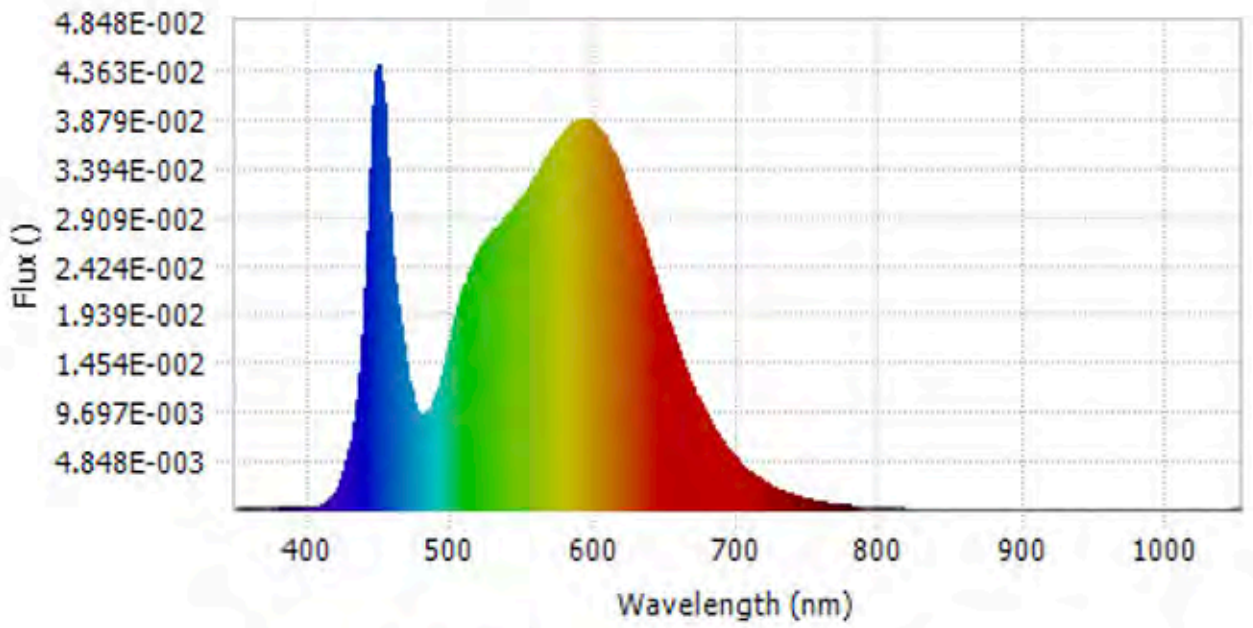
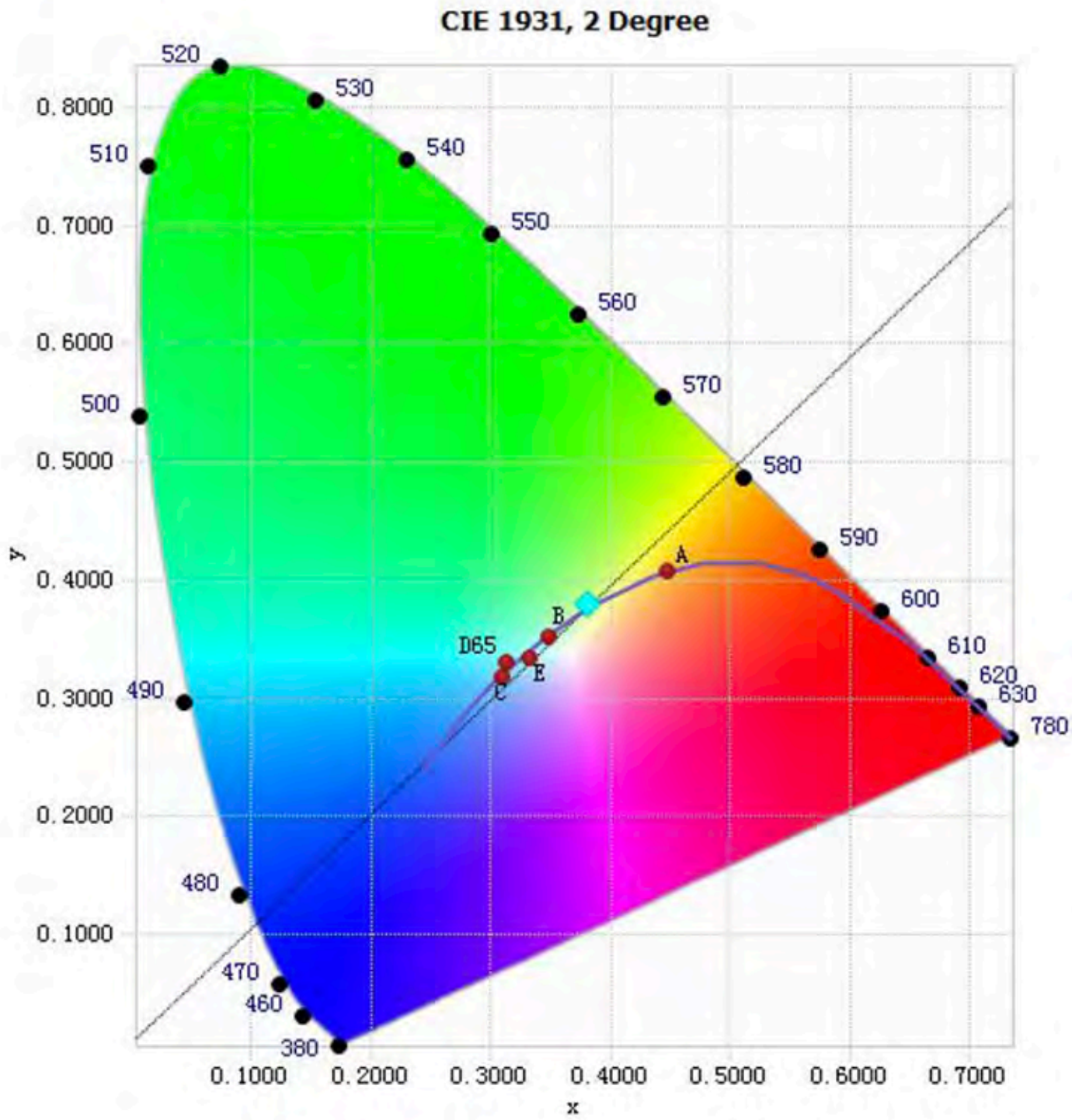


Chart 15: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.16E-04	485	9.93E-03	590	3.87E-02	695	5.55E-03
385	1.90E-04	490	1.16E-02	595	3.86E-02	700	4.73E-03
390	2.03E-04	495	1.44E-02	600	3.83E-02	705	4.04E-03
395	1.76E-04	500	1.75E-02	605	3.73E-02	710	3.42E-03
400	1.67E-04	505	2.04E-02	610	3.61E-02	715	2.95E-03
405	2.50E-04	510	2.26E-02	615	3.46E-02	720	2.51E-03
410	4.76E-04	515	2.46E-02	620	3.26E-02	725	2.15E-03
415	9.88E-04	520	2.59E-02	625	3.06E-02	730	1.81E-03
420	1.92E-03	525	2.70E-02	630	2.83E-02	735	1.55E-03
425	3.68E-03	530	2.78E-02	635	2.60E-02	740	1.32E-03
430	6.90E-03	535	2.85E-02	640	2.36E-02	745	1.12E-03
435	1.21E-02	540	2.93E-02	645	2.13E-02	750	9.54E-04
440	2.21E-02	545	3.03E-02	650	1.91E-02	755	8.14E-04
445	3.73E-02	550	3.12E-02	655	1.70E-02	760	7.07E-04
450	4.37E-02	555	3.23E-02	660	1.50E-02	765	5.97E-04
455	3.20E-02	560	3.34E-02	665	1.31E-02	770	5.16E-04
460	2.24E-02	565	3.46E-02	670	1.15E-02	775	4.39E-04
465	1.75E-02	570	3.58E-02	675	1.00E-02	780	3.81E-04
470	1.26E-02	575	3.68E-02	680	8.63E-03		
475	9.73E-03	580	3.77E-02	685	7.47E-03		
480	9.23E-03	585	3.85E-02	690	6.45E-03		

Table 15: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3814, 0.3796)

Chart 16: 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

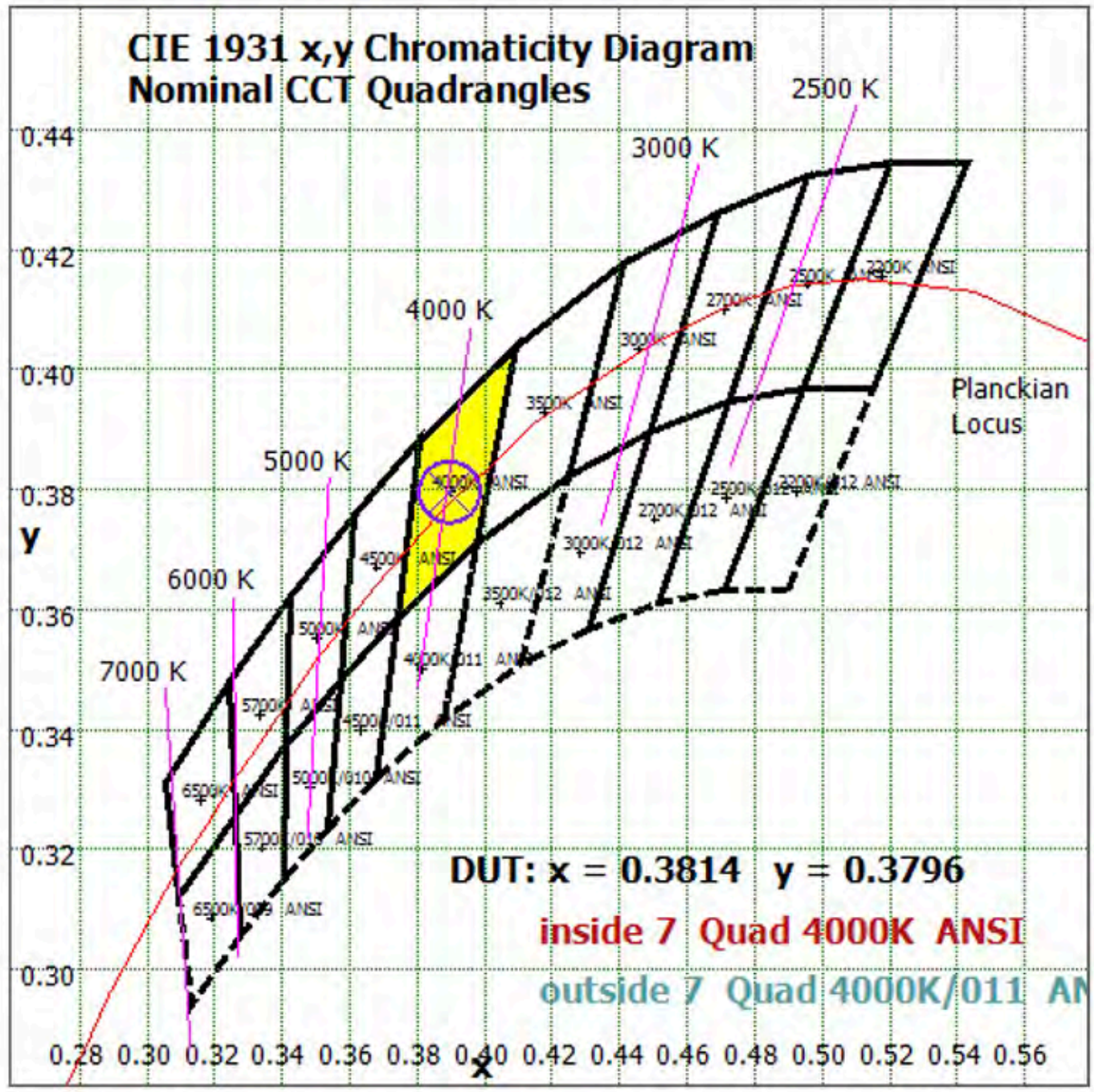


Chart17: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Quality Assured

Color Rendition Report – Sphere Spectroradiometer Method

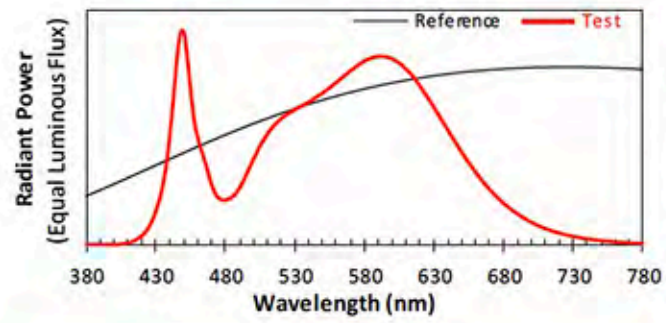
ANSI/IES TM-30-18 Color Rendition Report

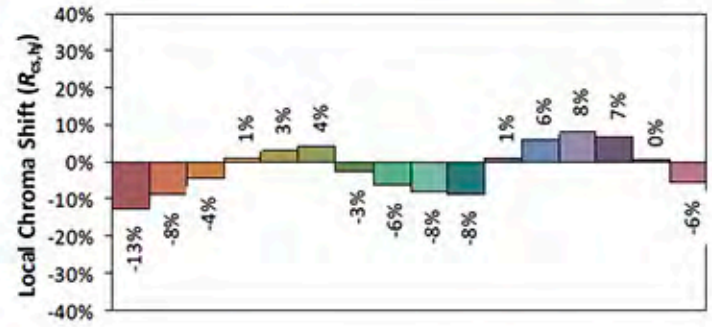
Source: LED

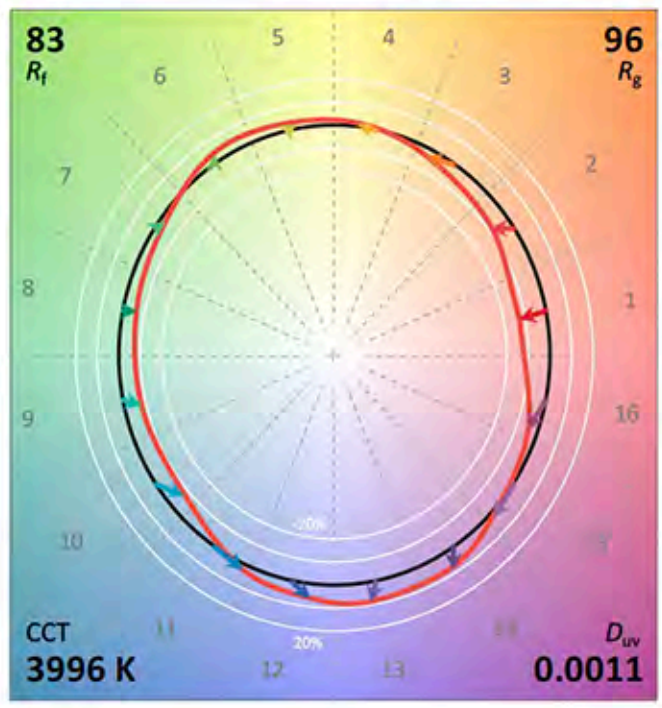
Manufacturer: P.Q.L., Inc.

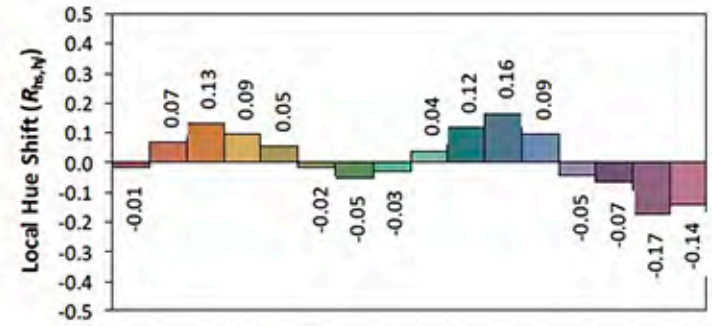
Date: 2022/10/21

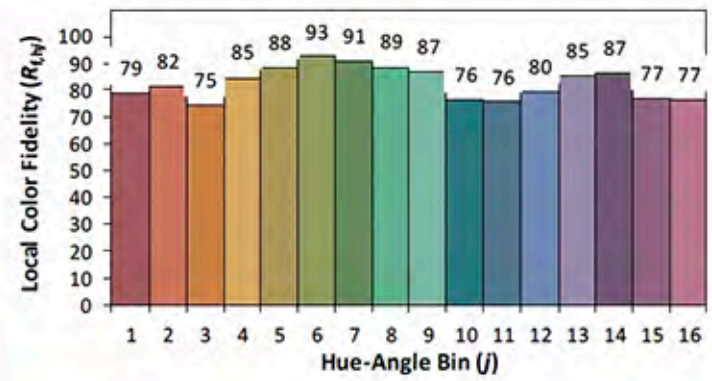
Model: 91497

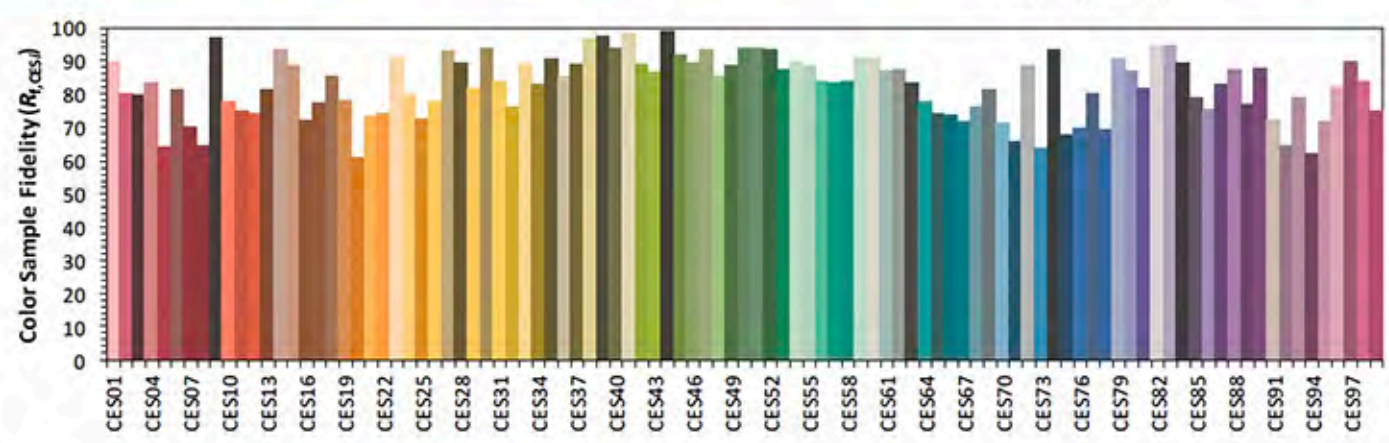












Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x	0.3814
y	0.3796
u'	0.2246
v'	0.5030

CIE 13.3-1995 (CRI)

R_a	81
R_9	1

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

Chart 18: 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 14 due to rounding.

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)	0.283
Power Factor	0.9961
Power (W)/2	16.94
Luminous Efficacy (lm/W)	132.4
Total Luminous Flux (lm)	2242.7
Beam Angle (°)	112.6 (0°-180°) / 199.9 (90°-270°)
Center Beam Candle Power (cd)	404
Maximum Beam Candle Power (cd)	404.8 (At: C=270.0, Gamma=3.5)
Spacing Criteria	1.29 (0°-180°) / 1.41 (90°-270°)
Zonal Lumens in the 0°-60°Zone	45.38%
Zonal Lumens in the 60°-90°Zone	26.74%
Zonal Lumens in the 90°-120°Zone	16.78%
Zonal Lumens in the 120°-180°Zone	11.10%

Table 16: Test data per Goniophotometer Method

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	38.308	1.71%
10- 20	110.794	4.94%
20- 30	171.747	7.66%
30- 40	215.58	9.61%
40- 50	239.131	10.66%
50- 60	242.181	10.80%
60- 70	227.608	10.15%
70- 80	201.084	8.97%
80- 90	170.994	7.62%
90-100	146.007	6.51%
100-110	124.777	5.56%
110-120	105.479	4.70%
120-130	86.976	3.88%
130-140	68.305	3.05%
140-150	49.002	2.18%
150-160	30.592	1.36%
160-170	12.762	0.57%
170-180	1.358	0.06%
Total	2242.7	100%

γ(°)	Lumens	% Total
0- 60	1017.74	45.38%
60- 90	599.686	26.74%
0-90	1617.43	72.12%
90- 180	625.258	27.88%
0- 180	2242.7	100%

Table 17: Zonal Lumen

Illuminance Plots- Goniophotometer Method

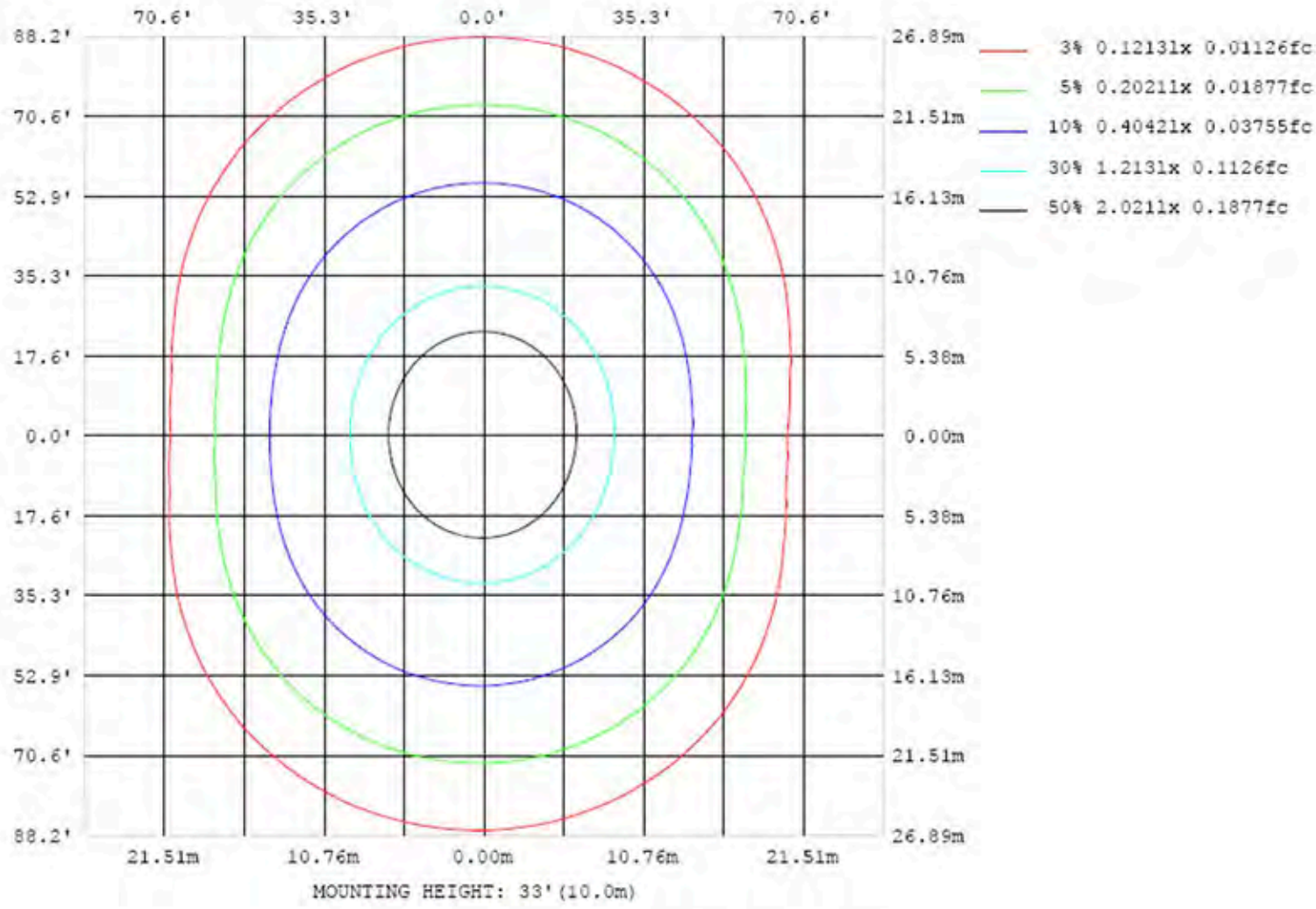


Chart 19: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

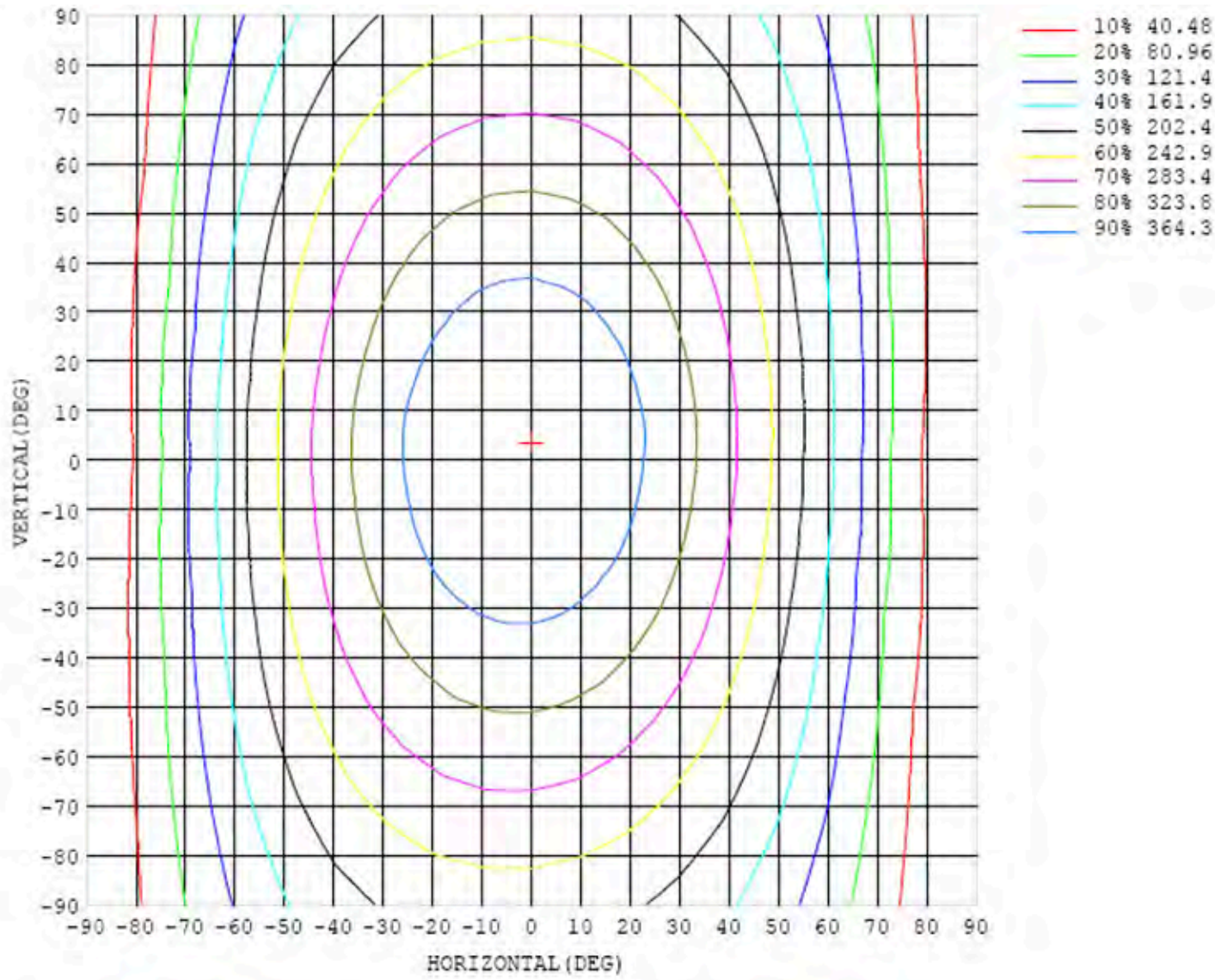


Chart 20: Isocandela Plot

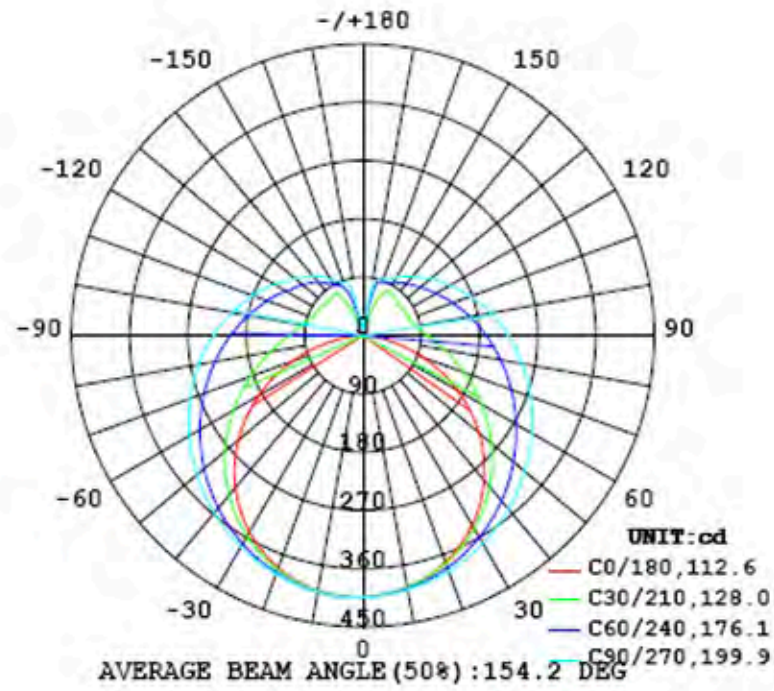


Chart 21: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

γ (DEG) \ C(DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404
5	401	401	401	401	401	401	402	401	402	402	402	402	402	402	403	403	403	403	404
10	395	395	395	395	395	396	397	397	398	398	399	399	399	399	399	399	399	399	400
15	385	385	386	386	387	388	390	391	393	393	394	394	394	393	393	392	391	392	392
20	373	372	373	375	377	379	381	384	385	387	388	388	387	385	384	383	381	381	381
25	357	356	358	360	364	368	371	375	377	379	380	380	378	376	373	370	368	367	367
30	338	338	339	344	349	355	360	365	368	370	371	370	367	365	360	356	352	350	350
35	316	316	319	325	332	340	347	353	358	361	361	360	356	352	345	339	333	330	330
40	291	291	296	305	314	324	333	341	347	350	350	349	344	338	329	321	313	307	306
45	264	265	271	282	295	307	319	328	335	338	339	337	330	323	312	300	289	282	280
50	234	236	245	259	275	290	303	314	322	326	326	324	316	306	293	279	264	254	251
55	202	205	217	235	255	273	288	301	309	314	314	311	302	290	274	257	238	224	220
60	169	173	189	211	234	256	273	287	296	301	301	297	287	274	255	234	212	193	186
65	134	140	161	188	215	239	258	273	283	288	288	284	273	258	237	212	184	161	152
70	98.9	107	134	166	196	223	244	260	270	275	275	270	259	242	219	190	158	128	115
75	65.0	76.2	109	146	179	208	230	246	257	263	262	257	245	227	202	170	133	97.1	78.6
80	33.8	49.5	87.5	128	163	193	216	233	244	250	250	244	232	213	186	152	112	69.3	44.2
85	9.68	29.2	70.2	112	149	179	203	220	231	237	237	231	218	199	172	137	94.0	48.3	16.2
90	0.69	18.3	59.2	100	137	167	191	208	219	225	224	218	206	186	159	124	81.0	35.3	1.41
95	0.56	16.2	52.6	91.3	126	156	179	196	207	212	212	206	193	174	147	113	72.2	29.8	0.69
100	0.94	18.1	49.3	84.6	118	146	168	184	195	200	200	194	182	163	137	105	67.6	29.0	0.97
105	2.15	22.0	48.6	79.7	110	136	157	173	183	188	188	182	170	152	128	98.0	64.8	31.7	1.47
110	4.14	27.0	49.5	76.5	104	128	148	163	172	177	176	171	159	143	120	93.2	64.1	36.2	2.34
115	6.09	32.4	51.7	74.8	98.8	121	139	152	161	166	165	160	149	134	114	89.6	64.8	41.7	3.97
120	6.92	33.9	54.9	74.5	94.9	114	130	143	151	155	155	150	140	126	108	87.4	66.7	47.4	7.46
125	4.18	26.9	57.7	74.8	91.7	108	123	134	141	145	145	140	132	119	104	86.0	69.0	53.3	10.5
130	1.43	20.8	61.2	73.4	89.6	104	116	126	132	136	136	132	124	113	100.0	85.2	71.5	58.5	12.0
135	2.40	23.2	64.6	73.9	87.8	99.7	110	119	124	127	127	124	117	108	97.1	83.3	73.0	48.9	9.23
140	4.01	27.6	66.3	74.9	84.3	96.5	105	112	117	119	119	116	111	104	93.4	82.9	76.3	38.3	3.12
145	3.48	20.0	56.4	77.7	82.8	90.8	100	106	110	112	112	110	106	98.2	89.1	82.7	79.1	35.2	0.01
150	2.92	7.14	45.4	80.6	82.7	88.0	93.0	98.2	103	105	105	102	97.5	92.4	87.9	83.5	67.3	30.3	4.49
155	10.3	8.53	31.4	69.6	84.1	86.4	90.0	93.0	95.2	96.6	96.7	95.2	93.2	90.6	86.6	81.1	55.0	20.4	10.5
160	11.2	16.6	17.7	46.2	77.3	86.1	87.5	89.7	91.1	92.1	92.0	91.4	90.1	87.7	82.1	65.9	33.3	6.36	7.15
165	10.00	6.36	18.7	20.6	46.7	71.2	84.8	87.1	87.8	88.3	88.3	88.1	86.3	77.7	57.8	35.6	12.6	16.6	4.19
170	14.5	9.79	14.8	18.6	9.77	22.8	36.4	48.7	57.1	59.4	59.8	55.8	46.9	32.9	17.4	7.78	12.8	13.3	7.80
175	15.2	12.5	8.55	10.7	16.8	21.6	22.9	19.3	15.4	13.1	12.5	11.9	10.8	7.67	7.45	14.5	11.8	8.09	8.55
180	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68

Table 18: Luminous Intensity Data

Table--2 UNIT: cd

γ (DEG) \ C(DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350
0	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404
5	403	403	404	404	404	405	404	404	404	404	404	403	403	402	402	401	401
10	400	401	401	402	402	402	402	402	401	401	401	400	399	398	397	396	396
15	393	394	395	395	396	397	397	398	397	397	396	394	392	391	389	388	387
20	382	384	385	387	388	390	392	392	392	391	390	387	384	381	378	376	374
25	369	370	372	375	378	381	384	385	386	384	382	378	373	368	365	361	359
30	352	354	358	363	368	371	375	377	377	375	372	367	361	355	349	344	340
35	332	335	341	347	354	360	365	367	368	366	362	355	348	339	331	324	319
40	309	314	321	331	340	347	354	357	358	355	350	343	333	322	311	302	295
45	283	290	301	313	324	334	342	346	347	344	338	329	317	304	290	278	268
50	255	264	278	294	308	320	329	334	335	332	325	314	301	285	268	252	240
55	224	237	255	274	292	305	316	321	323	319	312	300	285	266	245	225	210
60	192	208	231	254	275	291	302	309	309	306	298	285	268	246	222	197	178
65	158	179	207	235	257	276	288	295	297	293	284	270	251	227	199	170	147
70	124	152	184	215	241	261	275	282	284	280	271	255	235	209	178	145	115
75	90.5	125	163	197	225	246	261	269	270	267	257	241	220	192	159	121	84.4
80	59.9	101	145	180	210	232	247	255	257	253	244	228	205	176	142	100.0	58.0
85	35.9	82.1	128	165	196	218	233	242	244	240	230	214	192	162	126	83.3	38.4
90	22.5	68.4	114	153	182	205	220	229	231	227	217	201	179	150	114	71.3	27.5
95	18.7	59.9	103	141	170	192	207	216	218	214	205	189	167	139	103	61.8	20.8
100	19.3	55.5	95.1	130	158	180	194	203	205	201	192	177	156	128	93.5	54.7	18.0
105	22.8	52.8	88.9	121	149	168	182	190	192	189	180	165	145	118	85.6	49.2	21.1
110	25.3	53.9	82.5	114	139	158	171	178	180	177	168	155	135	109	78.9	49.6	24.4
115	28.9	56.0	81.6	105	129	148	160	167	169	165	158	144	126	102	75.6	51.6	27.2
120	33.8	57.3	79.6	102	120	137	149	156	158	155	147	134	117	96.1	75.1	52.7	28.6
125	37.3	60.4	78.9	98.2	115	129	138	144	146	143	136	125	110	93.7	74.6	53.7	31.8
130	38.4	63.5	76.8	94.6	110	122	131	136	137	134	128	118	106	91.0	73.3	53.8	33.1
135	27.3	60.3	75.9	89.8	105	115	122	127	128	126	121	112	102	87.8	71.5	52.3	25.0
140	18.9	57.6	75.6	84.4	97.3	108	115	119	120	119	114	106	95.9	83.2	71.6	49.2	16.7
145	6.60	49.4	78.8	79.5	89.7	99.2	106	110	112	110	106	98.9	89.4	79.6	71.7	41.2	1.41
150	2.64	37.9	72.0	80.2	84.1	91.3	97.9	99.9	100	99.4	96.6	91.7	85.0	78.5	67.5	32.0	2.14
155	1.32	17.0	51.8	73.8	79.7	85.6	88.9	92.0	93.7	93.1	90.7	86.3	81.6	77.9	57.8	17.0	0.00
160	4.43	14.3	17.0	47.0	66.1	74.2	83.0	84.7	84.8	84.4	83.1	80.4	78.6	64.9	28.5	9.65	4.11
165	2.43	6.78	9.33	11.7	27.4	43.1	57.2	74.2	81.2	81.1	77.4	66.9	53.0	29.6	11.8	14.1	5.92
170	9.85	3.89	7.24	13.4	10.7	9.47	11.9	17.3	26.2	23.2	18.3	15.9	9.52	11.5	14.8	9.77	12.7
175	12.0	14.8	10.9	4.69	6.12	9.41	11.8	10.3	8.61	9.61	11.7	11.5	9.08	6.77	9.81	14.3	16.4
180	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68

Table 19: Luminous Intensity Data

TEST RESULTS of 91498

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)	0.278	0.125
Power Factor	0.9955	0.9635
Test Power (W)/2	16.61	16.69
THD A%	6.00	11.69
Luminous Efficacy (lm/W)	131.7	131.1
Total Luminous Flux (lm)	2187.4	2187.6
Color Rendering Index (CRI)	83.3	
R9	8.3	
Correlated Color Temperature (CCT)(K)	5141	
Chromaticity Chroma x	0.3414	
Chromaticity Chroma y	0.3520	
Chromaticity Chroma u	0.2088	
Chromaticity Chroma v	0.3229	
Duv	0.0017	
Chromaticity Chroma u '	0.2088	
Chromaticity Chroma v'	0.4843	

Special Color Rendering Indices	
R1	81.8
R2	88.4
R3	92.4
R4	83.2
R5	82.4
R6	83.3
R7	86.9
R8	67.7
R9	8.3
R10	72
R11	82.7
R12	61.2
R13	83.5
R14	96.1

Table 20: 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

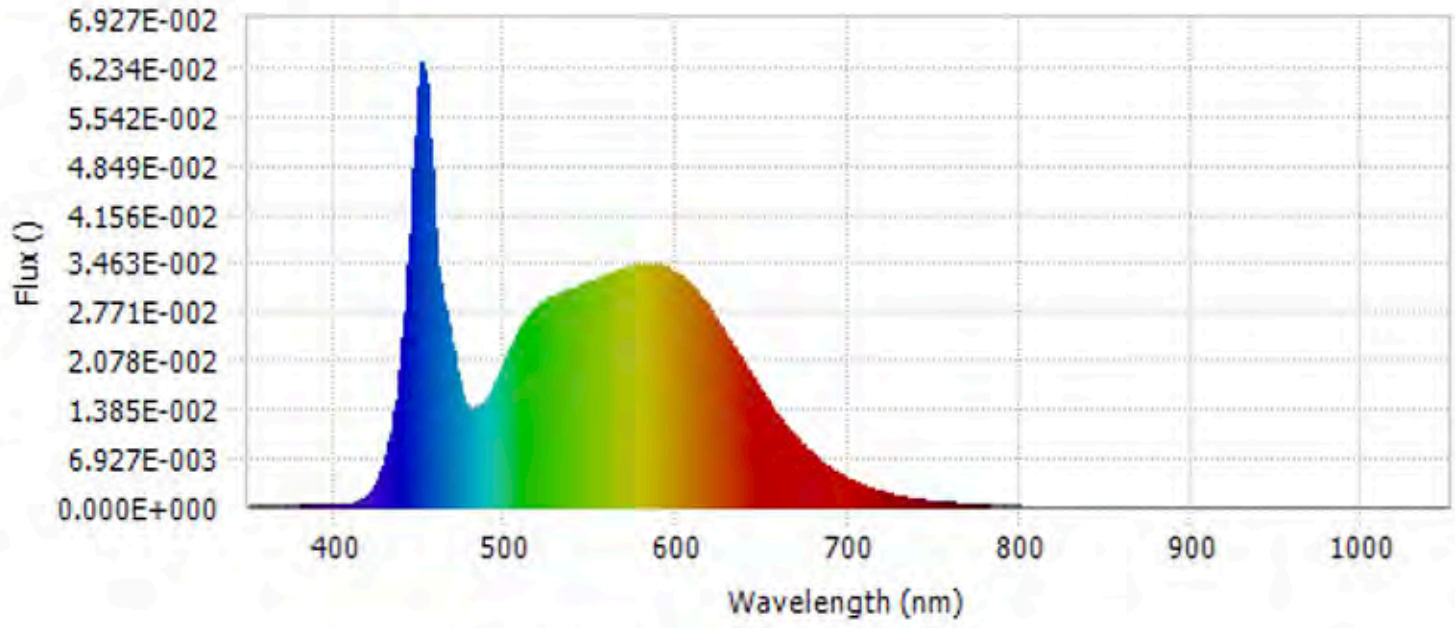
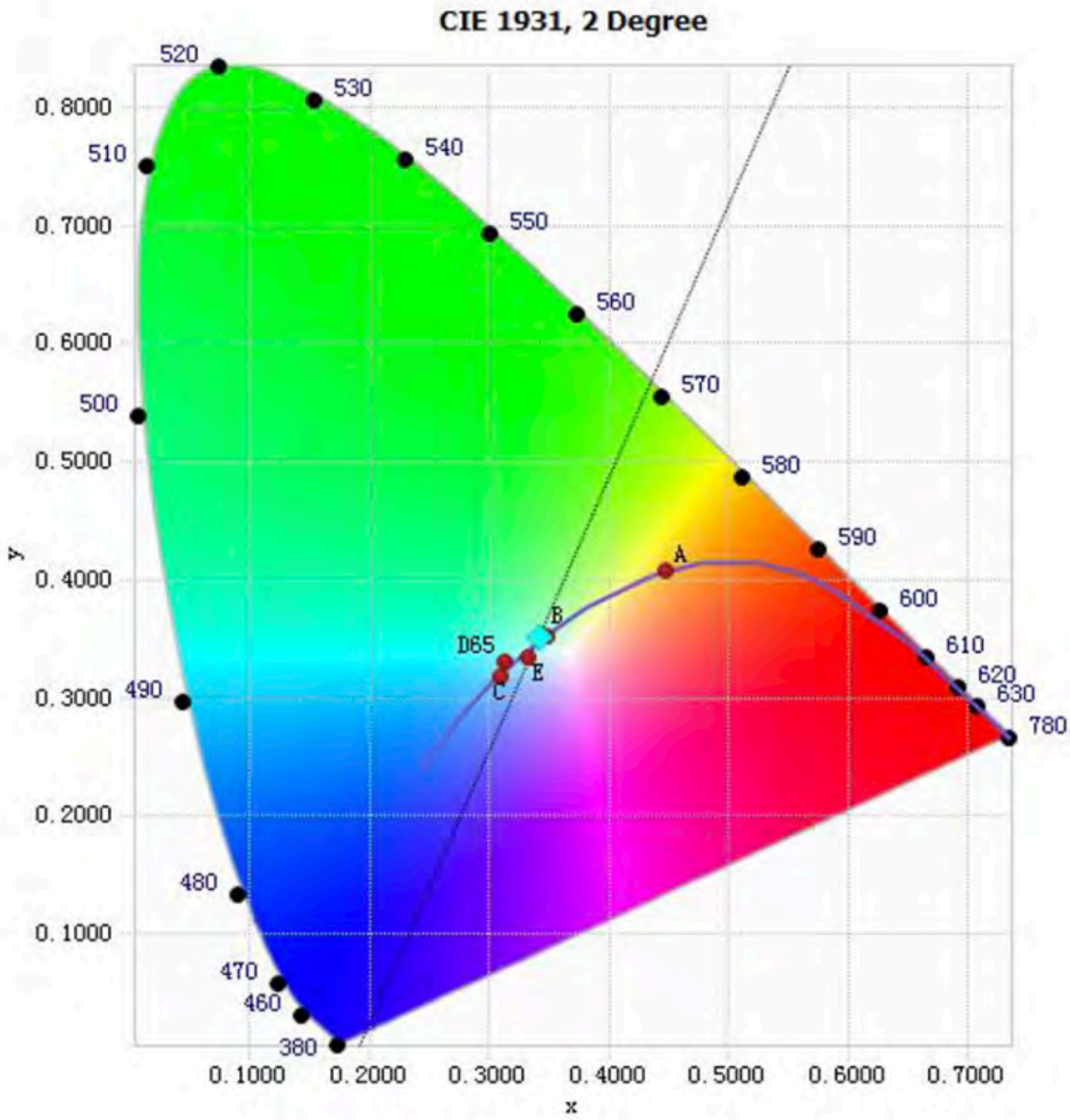


Chart 22: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.73E-04	485	1.44E-02	590	3.43E-02	695	4.57E-03
385	2.49E-04	490	1.58E-02	595	3.38E-02	700	3.90E-03
390	2.57E-04	495	1.83E-02	600	3.31E-02	705	3.36E-03
395	2.44E-04	500	2.11E-02	605	3.21E-02	710	2.84E-03
400	1.95E-04	505	2.37E-02	610	3.07E-02	715	2.44E-03
405	2.85E-04	510	2.58E-02	615	2.92E-02	720	2.08E-03
410	4.56E-04	515	2.75E-02	620	2.74E-02	725	1.79E-03
415	9.16E-04	520	2.87E-02	625	2.55E-02	730	1.53E-03
420	1.83E-03	525	2.95E-02	630	2.36E-02	735	1.29E-03
425	3.70E-03	530	3.01E-02	635	2.15E-02	740	1.10E-03
430	7.30E-03	535	3.06E-02	640	1.95E-02	745	9.50E-04
435	1.36E-02	540	3.11E-02	645	1.76E-02	750	8.13E-04
440	2.42E-02	545	3.15E-02	650	1.58E-02	755	6.90E-04
445	4.32E-02	550	3.20E-02	655	1.40E-02	760	5.94E-04
450	6.20E-02	555	3.26E-02	660	1.24E-02	765	5.07E-04
455	5.23E-02	560	3.30E-02	665	1.09E-02	770	4.42E-04
460	3.39E-02	565	3.35E-02	670	9.50E-03	775	3.79E-04
465	2.67E-02	570	3.39E-02	675	8.25E-03	780	3.25E-04
470	2.05E-02	575	3.43E-02	680	7.16E-03		
475	1.51E-02	580	3.45E-02	685	6.19E-03		
480	1.38E-02	585	3.46E-02	690	5.32E-03		

Table 21: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3414, 0.3520)

Chart 23: 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

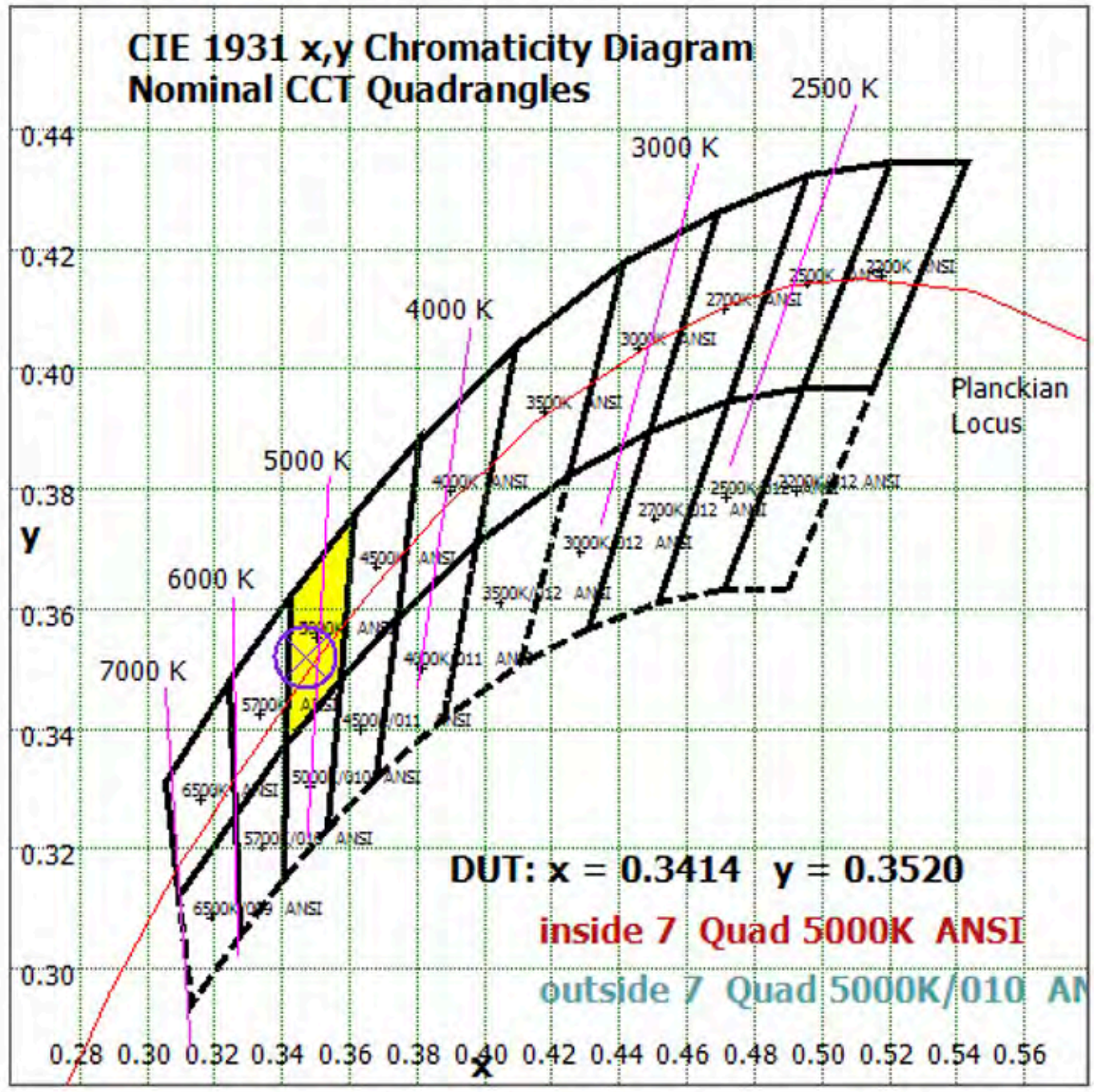


Chart 24: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Quality Assured

Color Rendition Report – Sphere Spectroradiometer Method

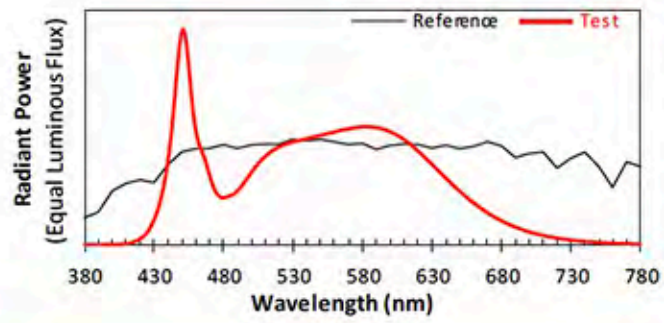
ANSI/IES TM-30-18 Color Rendition Report

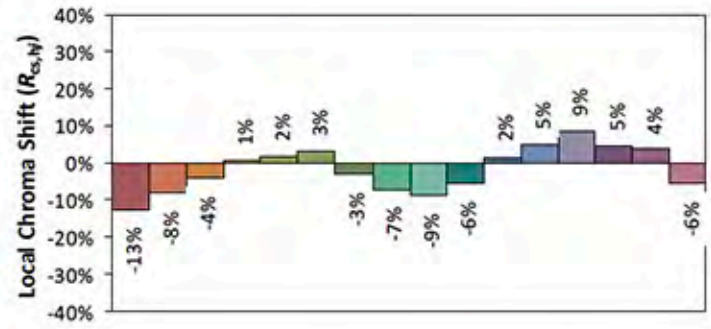
Source: LED

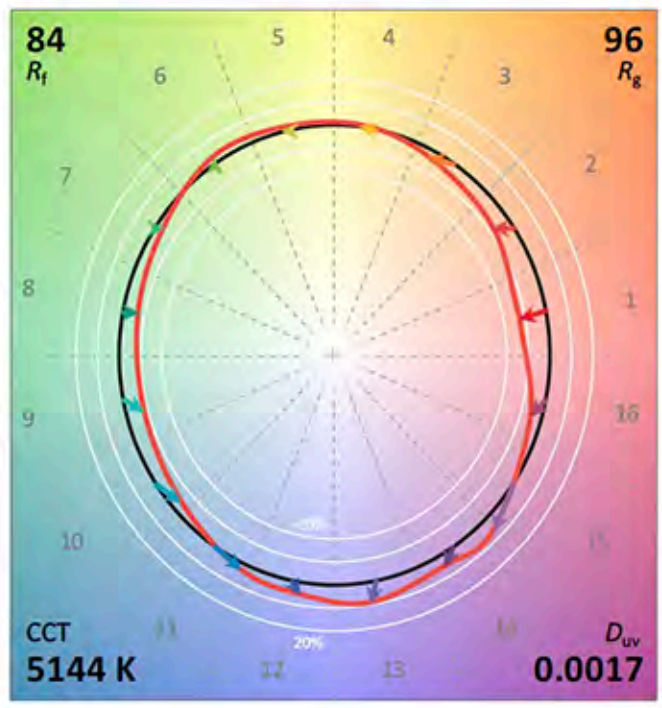
Manufacturer: P.Q.L., Inc.

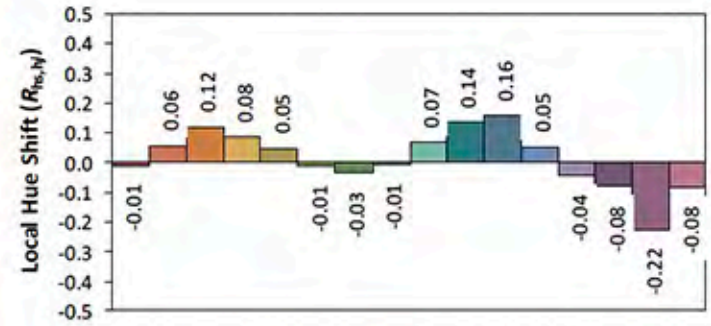
Date: 2022/11/09

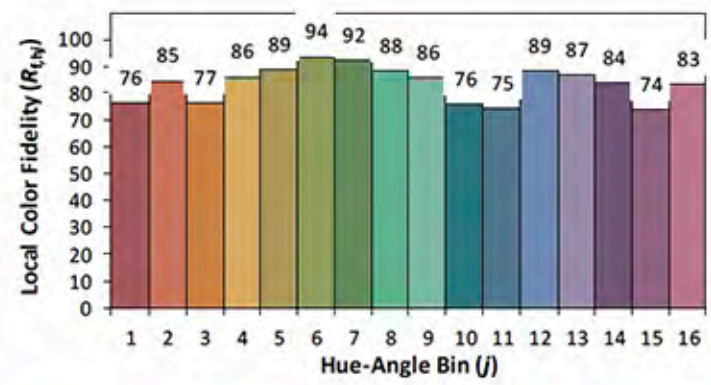
Model: 91498

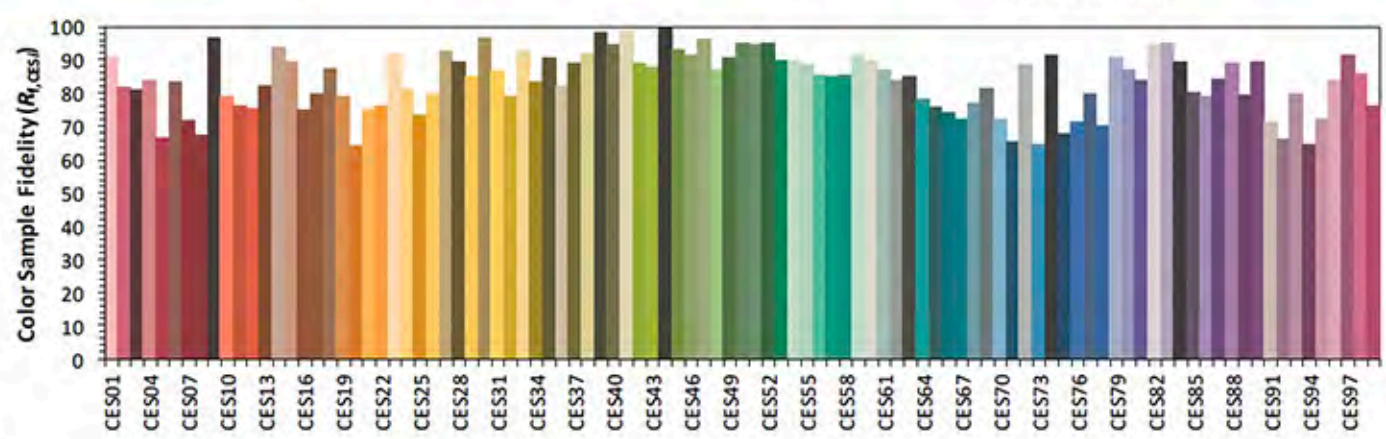












Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x	0.3414
y	0.3520
u'	0.2088
v'	0.4843

CIE 13.3-1995 (CRI)

R_a	83
R_9	8

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

Chart 25: 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 20 due to rounding.

Goniophotometer Method

Test ambient temperature was 25.8°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)	0.278
Power Factor	0.9959
Power (W)/2	16.62
Luminous Efficacy (lm/W)	132.1
Total Luminous Flux (lm)	2194.7
Beam Angle (°)	116.3 (0°-180°) / 245.4 (90°-270°)
Center Beam Candle Power (cd)	339
Maximum Beam Candle Power (cd)	341.4 (At: C=220.0, Gamma=7.0)
Spacing Criteria	1.34 (0°-180°) / 1.49 (90°-270°)
Zonal Lumens in the 0°-60°Zone	41.16%
Zonal Lumens in the 60°-90°Zone	27.16%
Zonal Lumens in the 90°-120°Zone	18.81%
Zonal Lumens in the 120°-180°Zone	12.87%

Table 22: Test data per Goniophotometer Method

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	32.255	1.47%
10- 20	93.934	4.28%
20- 30	147.651	6.73%
30- 40	189.173	8.62%
40- 50	215.378	9.81%
50- 60	224.844	10.25%
60- 70	218.582	9.96%
70- 80	200.308	9.13%
80- 90	177.218	8.07%
90-100	156.705	7.14%
100-110	137.592	6.27%
110-120	118.486	5.40%
120-130	98.314	4.48%
130-140	77.911	3.55%
140-150	56.292	2.56%
150-160	34.843	1.59%
160-170	13.29	0.61%
170-180	1.887	0.09%
Total	2194.7	100%

γ(°)	Lumens	% Total
0- 60	903.235	41.16%
60- 90	596.108	27.16%
0-90	1499.34	68.32%
90- 180	695.32	31.68%
0- 180	2194.7	100%

Table 23: Zonal Lumen

Illuminance Plots- Goniophotometer Method

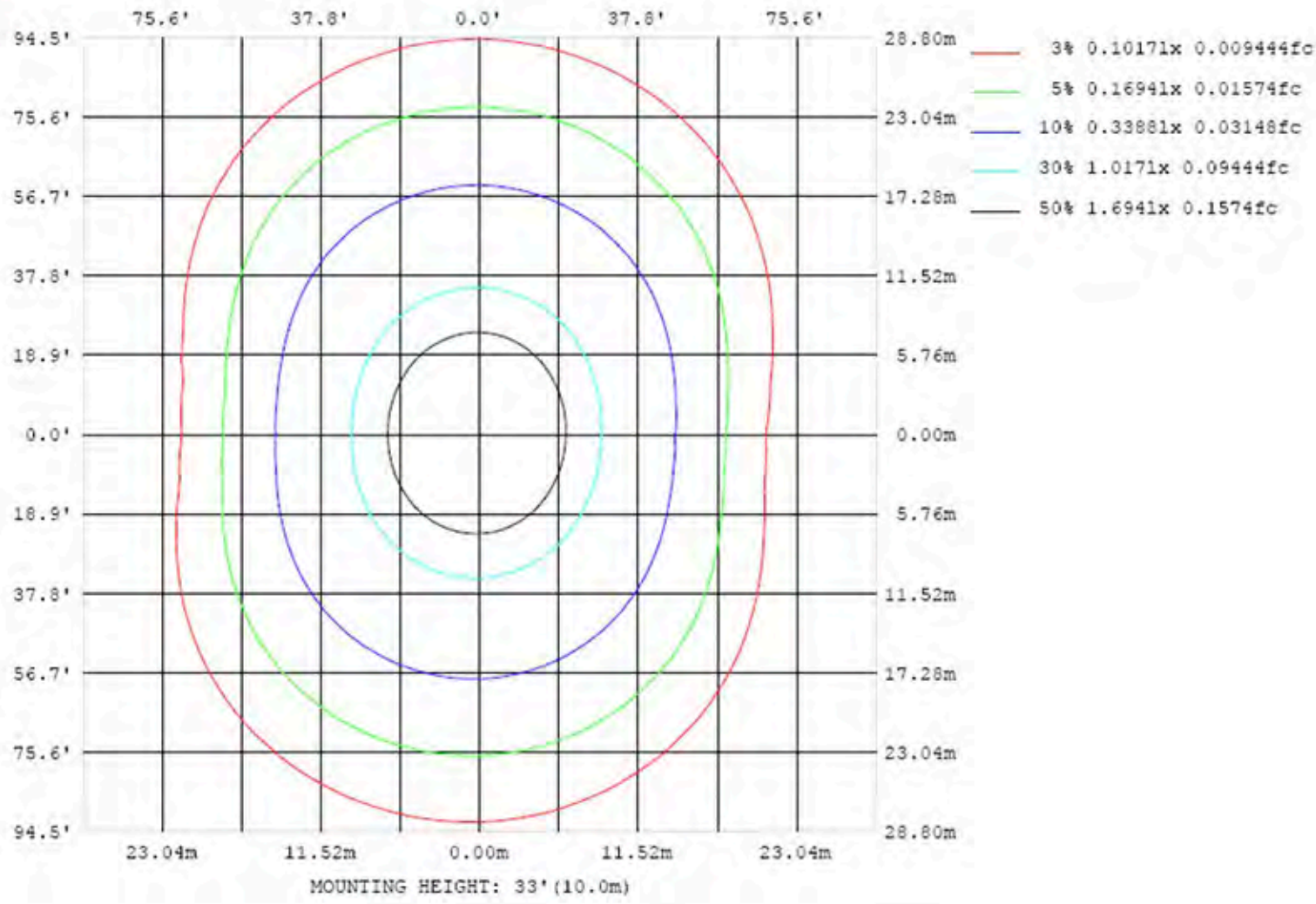


Chart 26: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

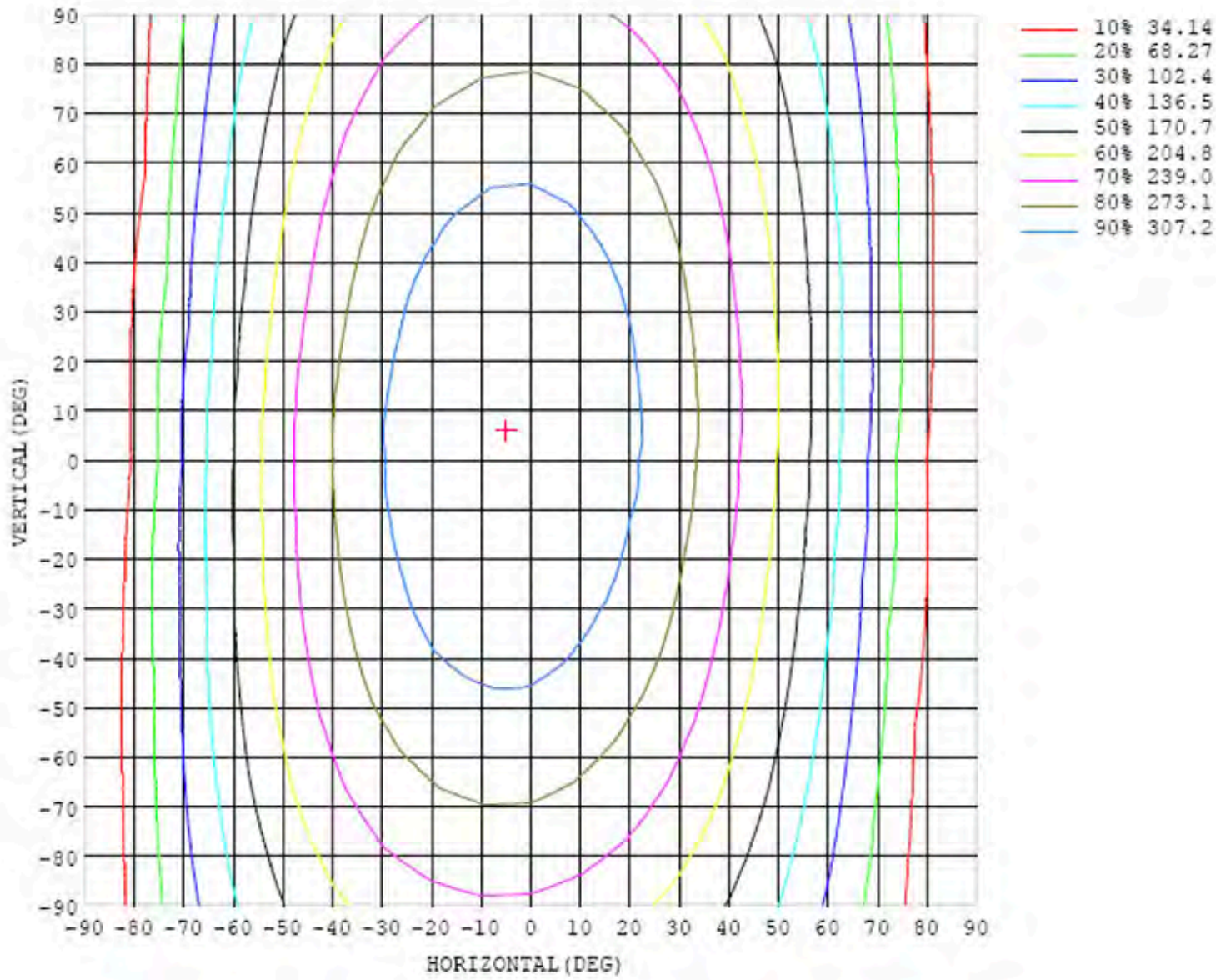


Chart 27: Isocandela Plot

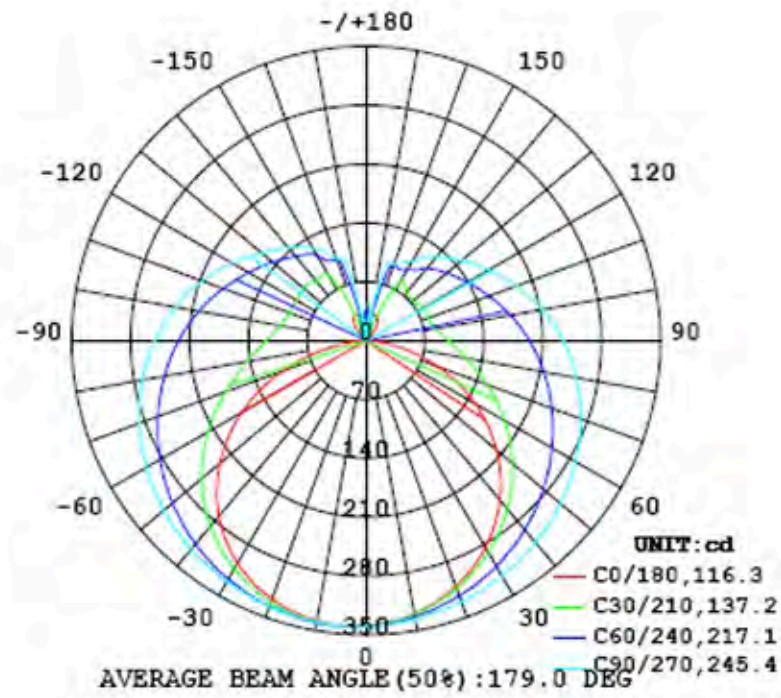


Chart 28: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

γ (DEG) \ C (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339
5	336	337	336	336	336	337	337	338	338	339	339	339	339	339	340	340	340	340	340
10	330	331	331	331	331	333	333	335	336	336	337	338	337	338	339	338	338	338	338
15	322	323	323	324	325	327	329	331	332	334	334	335	335	335	335	335	334	335	334
20	312	312	313	314	317	320	323	326	329	331	332	332	331	331	330	329	328	328	327
25	299	299	301	304	308	313	317	321	325	327	328	329	327	325	324	321	319	319	318
30	284	285	287	291	297	304	309	316	320	323	325	324	323	319	316	312	308	307	306
35	267	268	271	277	285	294	302	309	315	319	320	320	316	312	307	301	295	292	291
40	247	249	253	262	272	283	293	302	309	313	315	314	310	304	296	288	280	275	273
45	226	228	234	245	258	272	284	295	302	308	309	308	303	295	285	273	262	254	252
50	203	205	213	227	244	260	275	287	296	302	304	301	295	285	273	258	243	231	227
55	177	180	191	209	229	248	265	278	289	295	296	293	286	275	259	241	222	206	200
60	150	153	168	190	214	236	255	270	281	287	289	286	277	264	246	224	200	180	171
65	120	125	145	172	199	224	245	262	273	280	281	278	268	252	232	206	177	151	139
70	90.5	97.0	121	153	185	212	235	253	265	272	273	269	258	242	219	189	155	122	105
75	61.5	69.4	99.9	136	171	201	225	243	256	263	264	260	248	230	206	173	134	94.0	70.5
80	33.8	45.3	81.0	121	158	189	214	234	247	254	255	250	239	219	193	158	115	69.4	37.8
85	11.6	26.2	67.2	109	147	179	204	224	237	244	245	240	228	208	181	145	100	51.7	12.6
90	1.90	16.3	56.6	98.2	136	169	194	214	227	234	235	230	217	197	170	134	89.1	41.0	2.63
95	0.47	14.4	50.7	90.3	127	159	184	203	217	224	224	219	206	187	159	124	80.6	34.9	2.28
100	1.09	16.5	48.3	84.5	119	150	174	193	206	213	213	208	196	176	149	114	74.1	34.7	5.03
105	2.74	19.8	48.7	80.8	113	141	165	183	195	201	202	197	184	165	139	107	70.9	37.8	6.99
110	3.84	25.0	50.4	78.7	107	134	155	172	184	190	190	185	173	155	131	102	71.1	42.5	6.09
115	2.72	31.7	51.1	77.8	103	127	147	163	173	179	179	174	163	146	124	99.1	72.5	44.9	3.68
120	2.21	29.7	53.7	77.3	100	121	139	153	163	168	169	164	153	138	119	97.5	74.8	51.2	4.08
125	2.67	13.2	54.8	75.7	97.5	116	132	145	154	158	158	154	145	131	115	96.0	76.2	58.6	4.40
130	2.87	10.9	59.7	73.1	94.3	111	125	137	145	148	148	144	137	125	111	96.1	76.2	63.8	4.29
135	6.59	13.8	65.3	73.1	88.6	106	119	129	135	139	139	136	129	120	108	90.6	76.3	52.1	8.61
140	14.1	13.1	56.3	75.4	86.5	98.4	112	122	128	131	131	128	122	114	101	88.8	80.3	36.4	17.3
145	21.7	8.08	38.9	80.2	85.1	94.4	103	112	119	122	122	120	113	105	96.8	88.4	82.4	17.2	24.9
150	27.9	4.78	16.8	80.4	87.8	90.4	97.4	103	108	110	110	109	104	99.3	93.0	88.8	63.2	9.28	30.3
155	31.4	11.3	10.5	50.3	89.1	92.4	93.7	96.6	100.0	102	102	101	98.3	95.5	91.4	78.9	33.2	16.1	32.9
160	32.7	29.9	17.9	17.9	56.1	89.7	95.1	96.6	97.1	97.6	98.0	98.1	97.4	91.5	76.6	41.6	16.0	17.1	33.4
165	32.4	35.9	7.47	20.6	16.1	34.9	57.3	74.8	90.8	94.5	94.5	90.1	72.4	51.5	29.5	15.7	12.2	9.94	30.2
170	32.5	34.8	24.6	10.5	21.4	16.5	12.1	19.0	23.1	23.9	24.2	18.0	14.4	13.1	9.40	20.1	12.1	7.78	24.8
175	30.6	31.5	43.4	38.6	22.0	10.9	10.0	12.9	14.5	17.6	13.3	8.22	13.5	11.1	9.34	11.2	16.9	31.8	23.6
180	26.4	26.3	22.2	20.9	21.2	22.5	32.2	39.7	40.0	1.66	0.00	55.3	54.8	54.3	49.5	44.7	40.4	37.9	26.0

Table 24: Luminous Intensity Data

Table--2 UNIT: cd

γ (DEG) \ C (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350
0	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339
5	340	340	341	341	341	340	341	341	341	340	339	338	338	337	337	336	337
10	339	339	340	341	341	341	341	340	340	339	338	336	335	334	333	332	331
15	335	336	337	338	338	338	339	339	338	337	335	333	330	329	327	325	323
20	328	331	332	333	335	336	337	337	336	335	332	329	325	321	318	316	314
25	320	322	324	327	330	332	334	335	334	332	328	324	318	314	308	304	302
30	308	310	314	319	324	327	330	332	331	329	324	318	311	304	297	291	288
35	293	296	302	309	316	322	327	328	328	325	319	312	303	293	284	276	271
40	276	280	288	298	308	315	321	324	324	321	314	305	294	282	270	259	253
45	255	261	273	286	298	308	315	319	320	315	308	297	284	270	254	241	232
50	231	241	256	272	288	301	310	314	314	310	301	289	274	257	238	221	209
55	205	217	237	258	277	292	302	308	308	304	294	281	263	244	222	201	185
60	175	192	217	243	266	283	295	301	301	297	287	272	253	230	204	180	160
65	145	167	197	227	253	273	286	294	295	290	279	263	242	216	187	158	134
70	112	142	178	212	241	264	278	286	288	282	271	253	231	203	171	138	108
75	79.6	117	159	198	230	253	269	277	279	274	262	245	220	190	156	118	82.3
80	50.3	94.8	144	185	219	243	260	269	271	266	253	234	210	179	142	100	59.6
85	28.4	78.2	130	173	208	233	250	259	261	256	244	225	200	168	130	86.6	42.0
90	18.3	67.6	119	162	197	223	240	249	251	246	234	215	190	158	121	76.6	31.9
95	16.1	61.6	111	153	187	212	230	239	241	236	224	205	180	150	112	69.7	26.8
100	19.1	59.2	104	145	177	202	219	228	230	225	214	195	171	142	105	65.0	25.0
105	24.7	59.8	99.9	137	167	191	208	217	219	214	203	186	162	135	100	62.3	28.2
110	31.4	62.7	97.2	131	159	181	197	205	207	203	193	176	155	128	96.2	62.7	32.8
115	37.9	66.7	95.9	125	152	171	185	194	196	192	182	167	147	123	94.0	64.8	38.1
120	37.0	71.3	95.9	121	144	162	175	182	184	181	172	158	140	118	93.0	67.7	42.4
125	15.6	74.9	96.5	117	137	154	164	171	173	170	162	150	133	114	92.7	70.8	46.8
130	12.9	78.3	97.3	114	131	145	155	161	162	160	153	142	128	111	93.0	70.9	47.2
135	14.6	81.2	96.5	112	126	138	147	152	153	151	145	135	123	109	93.2	72.2	37.0
140	22.6	76.0	91.8	110	122	131	138	143	144	142	137	128	118	107	89.5	76.1	9.37
145	12.6	54.7	93.9	100	117	125	131	134	135	133	129	122	114	101	88.7	76.6	8.39
150	7.75	15.5	92.2	99.6	104	117	123	126	127	126	122	116	106	96.2	89.4	57.2	20.2
155	14.0	12.1	57.0	91.6	102	106	111	115	116	115	111	106	101	95.7	82.1	18.3	18.2
160	32.5	16.9	10.5	54.1	85.2	102	104	102	106	105	104	101	97.5	85.6	50.5	10.8	11.6
165	12.2	9.57	20.6	6.97	18.0	53.9	76.6	93.6	99.0	98.7	94.9	82.1	66.2	36.9	15.2	25.8	9.09
170	18.8	31.2	8.32	14.1	25.3	11.1	8.56	15.7	19.4	20.0	18.7	16.3	11.5	15.8	28.1	12.0	12.8
175	23.4	23.9	34.1	26.7	13.2	7.31	8.20	6.61	5.35	16.5	13.9	10.8	9.00	9.39	18.8	35.7	38.3
180	26.2	26.2	26.1	25.6	25.1	24.6	23.8	23.2	20.6	9.91	22.6	26.6	29.5	31.1	32.7	33.8	34.7

Table 25: Luminous Intensity Data

ISTMT Test Results

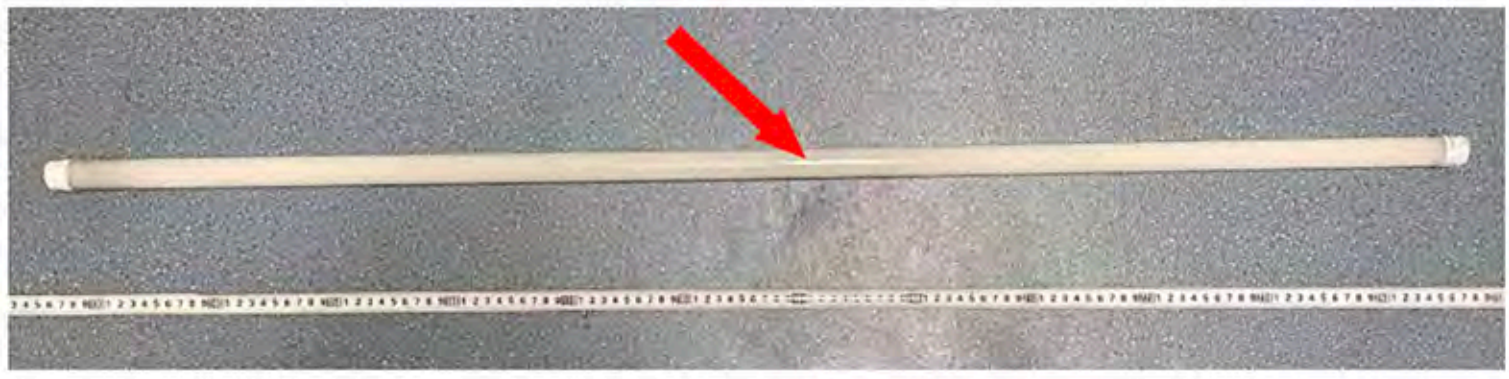
Test ambient temperature was 24.7°C.

Test orientation was light down.

Model of light source: BXVN-30E-11L-3EJ-000-00-00-0

The stabilization time of the sample was 7.5 hours.

View of In-Situ Point- Ts



Location of In-Situ Point from overall view

Input Voltage (V)	Input Power (W)	Tested LED source current (mA)	Measured In-Situ Maximum Temperature (Corrected to Ta=25°C)
120.0	33.75	52.1	48.2
277.0	33.90	52.9	48.0

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
Multi-Meter	FLUKE15B	HZTE020-01	Aug. 05, 2022	Aug. 04, 2023

Table 26: 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 expended 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 expended 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.

ISTMT Measurements

The luminaire was installed to simulate intended usage, in accordance with the manufacturer's instructions.

Temperatures were measured after they stabilized, when the test was run for a minimum of 7.5 h.

The tests were conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or

below 25°C were respectively subtracted from or added to temperatures recorded at points on the luminaire. Temperatures recorded at points on a luminaire were measured by means of thermocouples.

The thermocouples had conductors no larger than No. 24 AWG (0.21mm^2) and no smaller than No. 30 AWG (0.05mm^2). Thermocouples complied with the requirements specified in ASTM MNL 12 and thermocouples as listed in the table of the limits of error specified in NIST ITS 90, or ISA MC96.1.

The luminaire was installed in the test box in the configuration that resulted in the highest operating temperatures, considering different trim and maximum lamp wattage combinations, lamp holder adjustment heights, and the like.

The test box was constructed of 12mm thick plywood as described below:
The test box was rectangular and had four sides and a bottom.
The four sides of the test box for a ceiling-mounted luminaire were a minimum distance of 8.5 in (215mm) from the nearest part of the lamp housing or heat-producing parts. The top edge of the sides of the test box were a minimum of 8.5 in (215mm) above the highest point of any permanently attached part of the lamp housing.
Thermal insulation of the loose-fill type was poured into the test box through the open top, until level with the top, without applying any compacting procedure.
The thermal insulation was conditioned to the density specified by the insulation manufacturer to obtain a required rated thermal resistance of Rsi 0.56 to 0.678 (R3.2 to R3.85).
All spaces around the luminaire and between it and the sides of the box were filled with the thermal insulation.

*** End of Report ***