



LM-79-19 TEST REPORT

for

P.Q.L., Inc.

2285 WARD AVE SIMI VALLEY, CA 93065 USA

LED Tube

Model: 91842

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ23060021a

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

Review by:

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April Zou

Engineer: Wei Fei
Jun. 20, 2023

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Jun. 20, 2023

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	91842 3500K Setting	91842 4000K Setting	91842 5000K Setting
Luminous Efficacy (Lumens /Watt)	139.2	144.1	141.5
Total Luminous Flux (Lumens)	3392.6	3491.9	3438.2
Power (Watts)	24.38	24.24	24.29
Power Factor	0.9932	0.9927	0.9931
CCT (K)	3612	3966	4983
CRI	85.1	85.7	85.4
Stabilization Time(Light & Power)	50	50	50
Note	3500K	4000K	5000K

Table 1: Executive Data Summary

Test specifications:

Date of Receipt : Apr. 13, 2023

Date of Test : Apr. 14, 2023

Test item : Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters

Reference Standard : IESNA LM-79-2019 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
ANSI/IES TM-30-18 IES Method for Evaluating Light Source Color Rendition

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SAMPLE PHOTO



Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 91842
Electrical Ratings	: 120-277V, 50/60Hz, 25W
Product Description	: Color- Tunable 3500K/4000K/5000K

TEST RESULTS (3500K Setting)

Test ambient temperature was 26.0 °C.

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

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

Sphere-Spectroradiometer Method

Parameter	Result	
	Test Voltage (V)	120.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.205	0.098
Power Factor	0.9932	0.8927
Test Power (W)	24.38	24.25
THD A%	6.62	19.68
Luminous Efficacy (lm/W)	139.2	141.8
Total Luminous Flux (lm)	3392.6	3439.3
Color Rendering Index (CRI)	85.1	
R9	17	
Correlated Color Temperature (CCT)(K)	3612	
Chromaticity Chroma x	0.3959	
Chromaticity Chroma y	0.3786	
Chromaticity Chroma u	0.2346	
Chromaticity Chroma v	0.3365	
Duv	-0.0033	
Chromaticity Chroma u'	0.2346	
Chromaticity Chroma v'	0.5047	

Special Color Rendering Indices	
R1	84.7
R2	93.9
R3	95.2
R4	82.8
R5	85
R6	90.7
R7	83.8
R8	64.5
R9	17
R10	85.1
R11	82.6
R12	69.8
R13	87.5
R14	98.3

Table 2: Test data per Sphere-Spectroradiometer Method

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

Spectral Power Distribution - Sphere Spectroradiometer Method

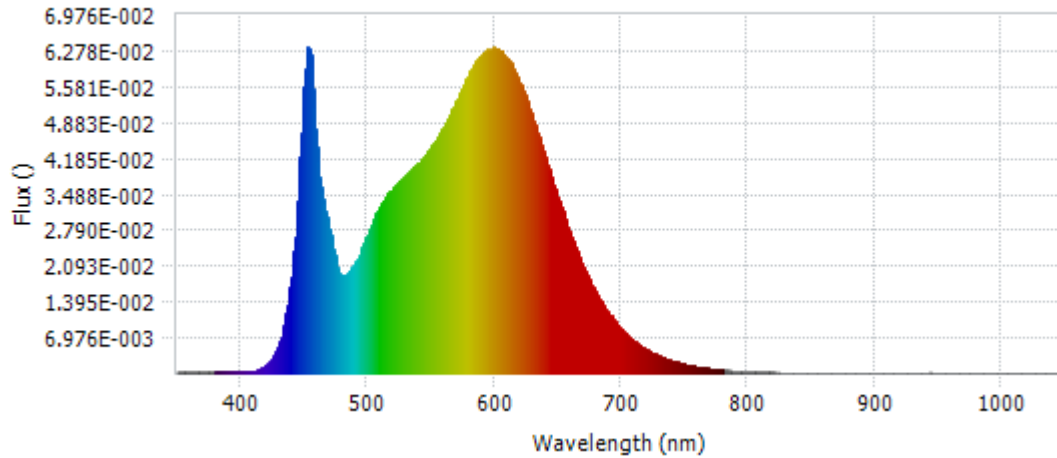
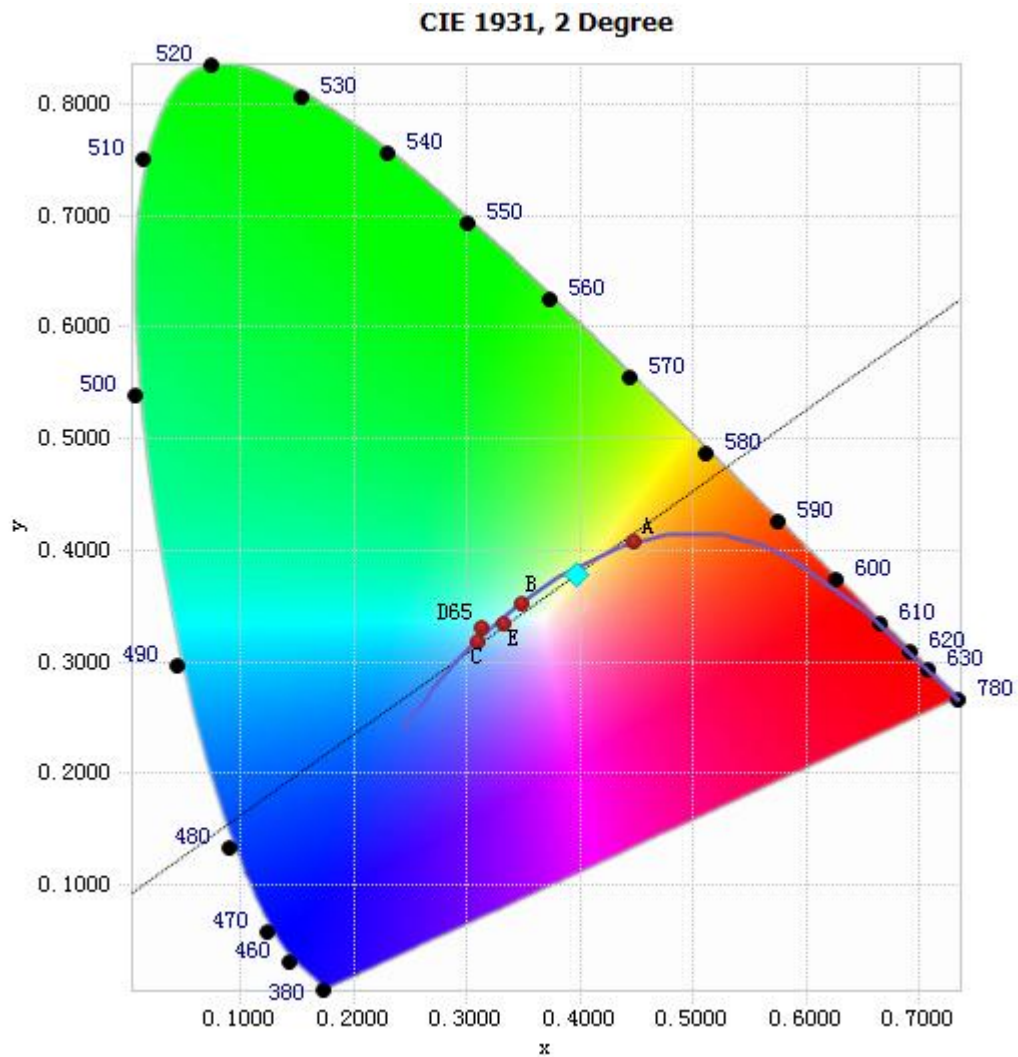


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.15E-04	485	1.98E-02	590	6.20E-02	695	1.01E-02
385	2.95E-04	490	2.13E-02	595	6.30E-02	700	8.70E-03
390	3.17E-04	495	2.39E-02	600	6.34E-02	705	7.43E-03
395	2.73E-04	500	2.70E-02	605	6.27E-02	710	6.37E-03
400	2.87E-04	505	3.01E-02	610	6.13E-02	715	5.46E-03
405	3.53E-04	510	3.24E-02	615	5.94E-02	720	4.62E-03
410	5.04E-04	515	3.46E-02	620	5.65E-02	725	3.99E-03
415	8.91E-04	520	3.59E-02	625	5.35E-02	730	3.40E-03
420	1.63E-03	525	3.73E-02	630	4.98E-02	735	2.89E-03
425	3.00E-03	530	3.85E-02	635	4.62E-02	740	2.46E-03
430	5.63E-03	535	3.96E-02	640	4.23E-02	745	2.10E-03
435	1.04E-02	540	4.09E-02	645	3.84E-02	750	1.79E-03
440	1.89E-02	545	4.23E-02	650	3.44E-02	755	1.55E-03
445	3.36E-02	550	4.39E-02	655	3.08E-02	760	1.31E-03
450	5.56E-02	555	4.57E-02	660	2.72E-02	765	1.11E-03
455	6.18E-02	560	4.79E-02	665	2.40E-02	770	9.64E-04
460	4.40E-02	565	5.04E-02	670	2.08E-02	775	8.41E-04
465	3.38E-02	570	5.30E-02	675	1.82E-02	780	7.14E-04
470	2.83E-02	575	5.56E-02	680	1.59E-02		
475	2.16E-02	580	5.83E-02	685	1.37E-02		
480	1.90E-02	585	6.06E-02	690	1.18E-02		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3959, 0.3786)

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

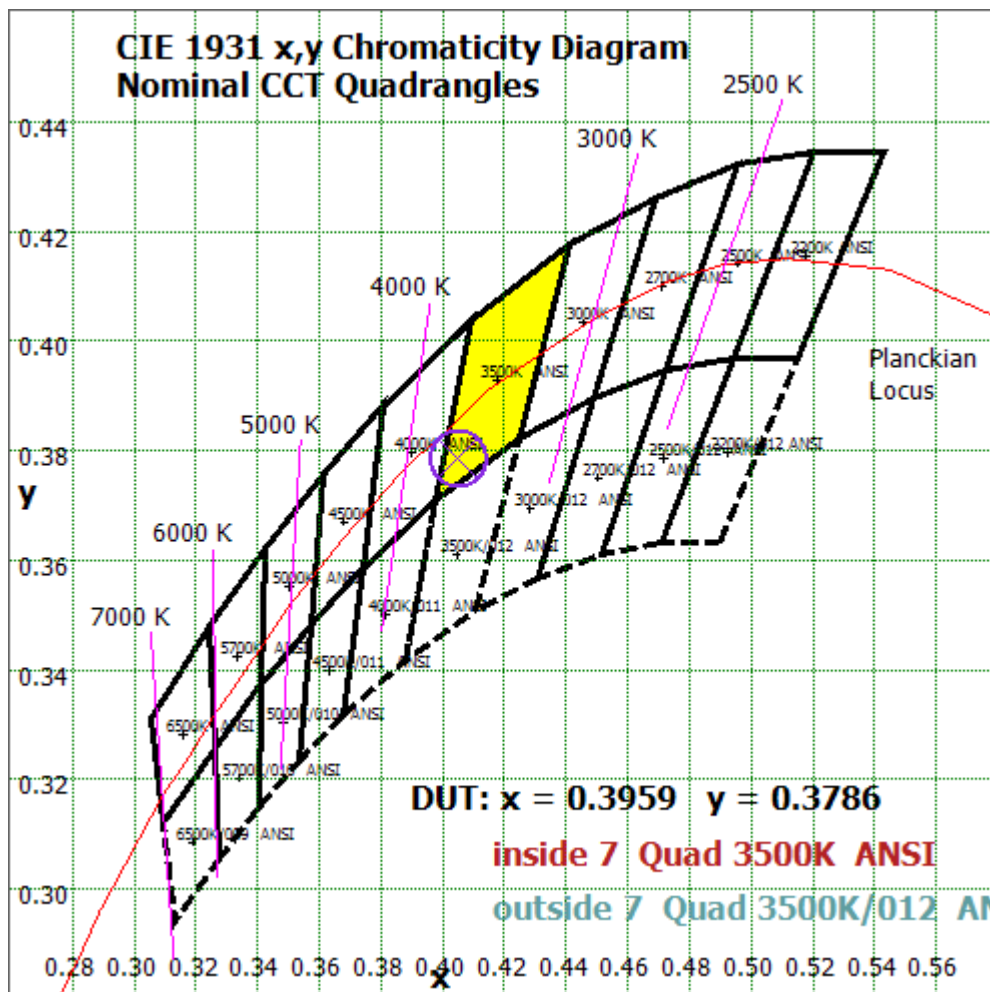


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

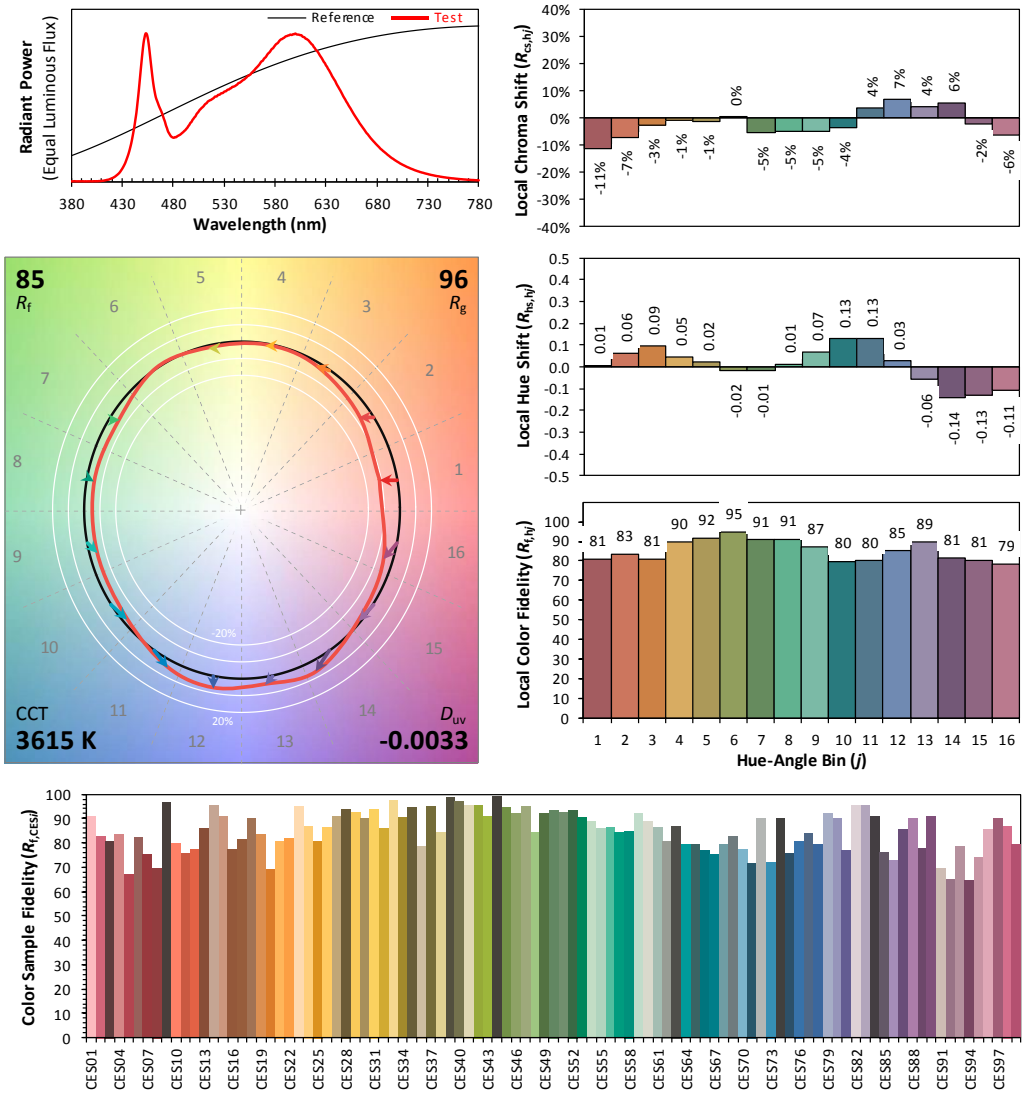
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: P.Q.L., Inc.

Date: 2023/04/14

Model: 91842



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

x 0.3959
 y 0.3786
 u' 0.2346
 v' 0.5047

CIE 13.3-1995 (CRI)	
R_a	85
R_g	17

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

Chart 4: Full Report Created with the IES TM-30 Calculator

Note: The values in this diagram might be a little different from the values in Table 2 due to rounding.

Goniophotometer Method

Test ambient temperature was 25.0 °C.

The photometric distance is 30 m.

Luminous data was taken at 0.5 vertical intervals and 10 horizontal intervals.

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.207
Power Factor	0.9934
Power (W)	24.43
Luminous Efficacy (lm/W)	140.1
Total Luminous Flux (lm)	3423.0
Beam Angle (°)	102.8 (0°-180°) / 141.2 (90°-270°)
Center Beam Candle Power (cd)	856
Maximum Beam Candle Power (cd)	858.8 (At: C=220.0, Gamma=3.0)
Spacing Criteria	1.24 (0°-180°) / 1.34 (90°-270°)
Zonal Lumens in the 0°-60° Zone	57.00%
Zonal Lumens in the 60°-90° Zone	26.29%
Zonal Lumens in the 90°-120° Zone	11.66%
Zonal Lumens in the 120°-180° Zone	5.04%

Table 4: Test data per Goniophotometer Method

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	80.83	2.36%
10- 20	230.33	6.73%
20- 30	347.871	10.16%
30- 40	421.315	12.31%
40- 50	445.797	13.02%
50- 60	425.087	12.42%
60- 70	371.134	10.84%
70- 80	300.08	8.77%
80- 90	228.65	6.68%
90-100	171.767	5.02%
100-110	129.948	3.80%
110-120	97.523	2.85%
120-130	70.974	2.07%
130-140	48.7	1.42%
140-150	30.379	0.89%
150-160	16.234	0.47%
160-170	5.661	0.17%
170-180	0.736	0.02%
Total	3423.0	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1951.23	57.00%
60- 90	899.864	26.29%
0-90	2851.09	83.29%
90- 180	571.922	16.71%
0- 180	3423.0	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

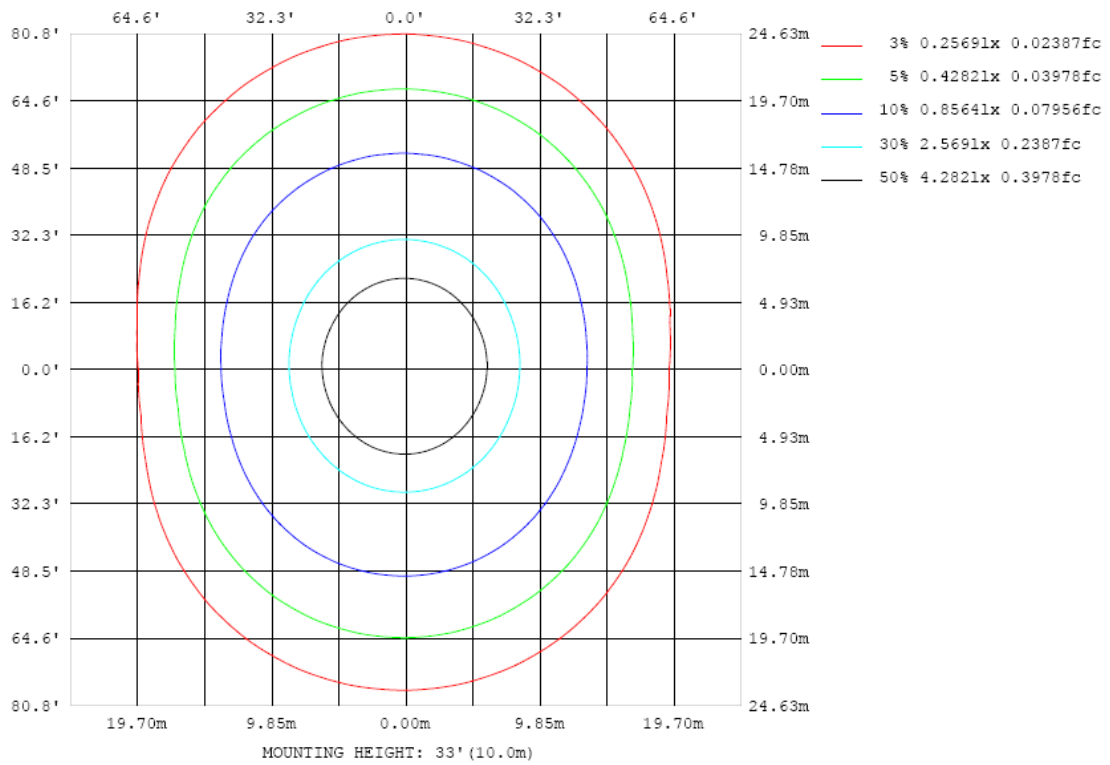


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

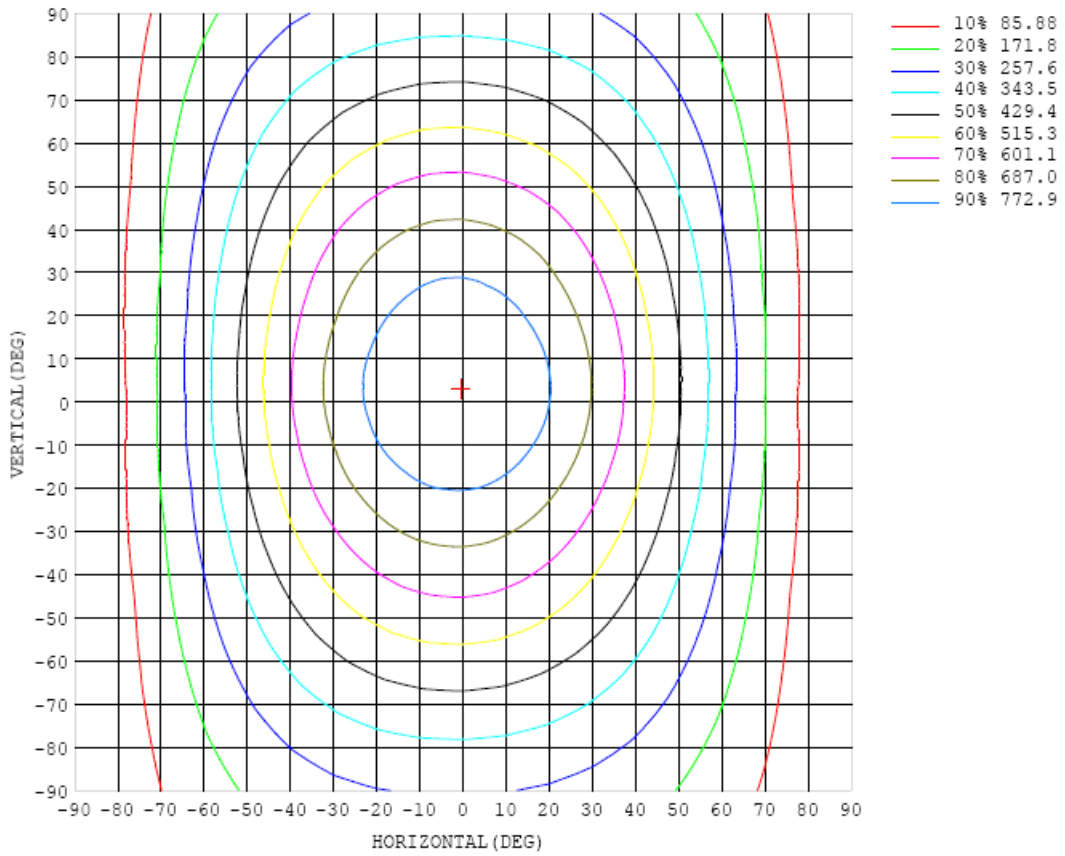


Chart 6: Isocandela Plot

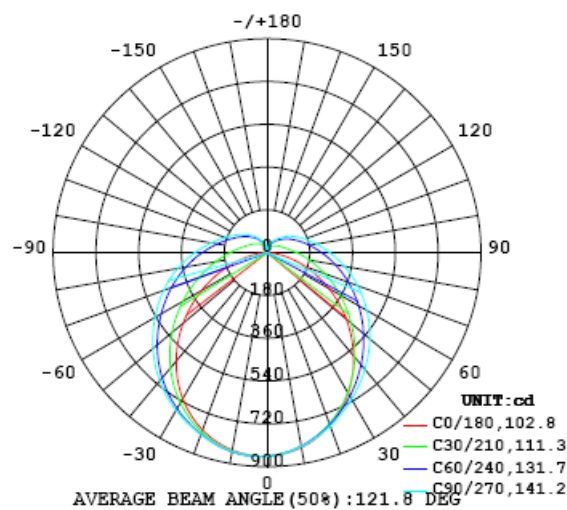


Chart 7: Polar Candela Distribution

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	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856
5	848	847	847	846	845	845	845	845	845	845	846	846	847	848	849	851	852	854	854
10	832	830	828	827	826	826	826	826	826	827	828	829	830	832	834	837	839	841	843
15	806	804	802	800	799	799	800	801	802	803	805	806	807	809	811	814	817	820	823
20	773	769	767	765	765	767	769	771	774	775	776	778	779	780	781	784	787	790	794
25	731	727	725	724	726	730	735	738	742	745	746	747	746	745	745	746	748	752	756
30	682	678	676	678	682	689	696	703	708	711	713	712	710	707	703	702	702	705	710
35	627	623	623	627	635	645	656	665	672	676	678	676	671	665	658	653	649	651	656
40	567	563	565	574	586	600	615	627	636	640	641	638	630	620	609	599	592	591	595
45	502	500	505	518	536	554	573	587	597	603	604	598	588	575	558	543	531	526	530
50	435	434	444	462	485	508	530	547	558	564	564	558	545	528	507	486	468	458	461
55	367	368	383	407	435	462	487	505	518	524	524	517	502	482	456	429	404	389	390
60	299	303	324	354	387	418	445	465	478	484	484	476	460	437	407	374	342	321	319
65	233	241	268	304	342	375	404	425	438	445	444	435	418	393	360	322	284	254	248
70	171	182	217	258	299	335	364	385	399	405	404	395	377	351	316	274	230	192	181
75	113	130	171	217	260	297	327	348	361	367	366	357	339	312	275	231	182	136	119
80	61.6	84.9	133	181	226	263	292	312	325	331	329	320	303	276	239	194	141	88.8	64.0
85	20.5	51.4	102	151	195	232	260	279	291	296	295	286	270	244	208	162	109	54.5	20.5
90	0.28	29.1	77.4	126	169	204	231	249	260	265	263	255	239	215	180	136	85.2	33.1	0.40
95	0.63	15.0	58.7	106	147	179	205	222	232	236	235	227	212	189	157	116	68.9	24.1	0.24
100	1.93	12.7	48.7	90.5	128	158	182	198	207	211	210	203	189	167	137	99.6	58.7	21.2	0.25
105	3.58	12.4	42.5	78.7	112	140	162	176	185	189	188	181	168	148	120	87.0	51.6	20.6	0.28
110	4.73	12.6	38.4	69.4	98.9	124	144	158	166	169	168	162	150	131	107	77.0	46.9	20.3	0.41
115	4.89	13.1	35.7	62.4	87.7	110	128	141	149	152	151	145	133	117	94.8	69.0	43.7	21.5	1.14
120	4.99	8.28	33.9	56.5	78.0	97.9	114	126	133	136	135	129	119	104	84.5	63.0	40.9	21.8	2.10
125	5.70	4.60	31.1	51.6	69.8	86.9	101	112	119	121	120	115	106	92.3	75.5	57.5	37.3	24.9	3.37
130	5.73	4.02	30.2	46.6	62.8	77.1	89.5	99.0	105	107	106	102	93.3	81.8	67.6	52.6	37.0	24.8	4.46
135	5.41	3.63	27.7	41.4	56.9	68.3	78.7	86.9	92.1	94.3	93.4	89.3	82.2	72.5	61.3	45.6	35.3	21.5	5.30
140	5.26	4.02	17.6	39.2	49.3	61.3	69.2	75.9	80.3	82.1	81.5	78.0	72.1	64.2	50.4	43.4	32.1	16.0	6.02
145	5.17	6.74	11.6	35.8	44.6	52.1	60.4	66.1	69.7	71.3	70.6	67.8	62.6	52.7	48.0	40.0	31.0	10.9	6.74
150	5.03	7.34	10.2	26.0	40.4	46.3	51.6	55.7	59.0	60.4	59.5	55.8	53.0	49.1	42.9	35.3	25.0	8.02	7.17
155	5.05	8.64	7.16	15.5	32.7	41.0	44.9	48.4	50.6	51.5	51.0	49.6	46.8	42.9	37.0	30.1	16.1	6.37	7.21
160	4.81	9.82	8.28	10.8	18.1	29.2	37.7	41.8	43.8	44.4	43.8	42.7	40.4	35.3	29.2	19.7	9.34	5.76	7.35
165	4.70	7.87	8.04	7.57	10.5	15.8	20.6	26.8	30.4	32.4	32.3	30.3	27.1	21.7	15.4	9.30	6.15	5.53	7.20
170	6.06	7.54	9.72	8.24	8.52	7.55	8.74	11.7	13.5	14.5	14.6	12.9	10.3	8.06	7.25	7.04	5.73	6.91	7.24
175	7.92	8.91	7.82	8.52	10.1	10.2	9.19	8.66	9.19	9.07	5.15	4.87	6.05	6.79	6.40	7.47	9.11	9.46	7.52
180	7.11	6.99	6.71	6.63	6.62	6.37	6.10	5.72	2.06	5.06	6.28	6.42	6.63	7.90	8.04	8.63	9.20	9.58	7.08

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	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856		
5	855	856	856	857	857	858	858	858	857	857	856	855	854	853	852	851	850		
10	845	847	848	849	850	851	850	850	849	848	847	845	843	841	839	837	835		
15	826	829	831	833	834	834	834	834	834	832	829	827	824	820	817	814	811		
20	798	802	804	808	810	813	814	815	814	812	807	803	797	791	787	782	779		
25	761	766	770	776	782	787	791	792	792	789	782	775	766	757	749	743	738		
30	716	722	729	739	749	757	763	767	766	762	754	743	731	718	706	697	690		
35	663	672	683	698	712	724	733	737	737	732	722	708	692	674	658	645	636		
40	604	616	633	653	672	687	698	703	703	698	686	670	650	627	606	589	577		
45	540	556	579	604	628	646	659	666	666	660	647	628	605	578	552	529	513		
50	473	494	523	553	581	603	618	626	627	620	605	585	559	528	496	468	448		
55	404	430	466	502	534	559	576	585	586	579	564	541	511	477	440	406	381		
60	335	368	409	450	486	514	533	544	545	537	521	496	465	427	385	346	315		
65	268	308	355	401	440	471	491	502	504	496	479	453	419	378	333	288	252		
70	205	252	305	354	395	428	449	461	463	455	438	411	376	333	284	235	192		
75	149	202	259	311	354	387	408	420	422	415	398	371	336	291	240	187	139		
80	100	160	219	271	314	347	368	380	382	375	359	333	298	254	202	147	92.6		
85	63.5	126	185	236	278	309	329	340	342	336	321	297	263	220	169	114	56.8		
90	39.1	100	156	205	245	274	292	302	305	299	285	263	232	191	144	89.3	34.6		
95	24.6	80.9	134	178	215	242	258	268	270	265	253	233	204	166	122	72.0	24.7		
100	21.6	68.2	116	156	189	213	229	237	239	235	224	205	179	145	105	60.5	21.4		
105	20.9	60.0	101	138	167	188	203	210	212	208	198	182	158	128	91.1	53.0	20.8		
110	21.1	54.4	89.3	122	148	167	180	187	189	185	176	161	141	113	80.6	48.0	21.2		
115	21.5	50.4	80.0	108	132	149	160	167	168	165	157	144	125	100	72.2	44.5	22.1		
120	22.5	47.4	72.2	96.4	117	133	144	149	150	148	141	128	111	89.4	65.3	42.0	23.6		
125	17.3	41.3	65.7	86.2	104	118	128	133	135	132	125	114	98.8	79.9	59.5	35.6	24.5		
130	9.22	42.1	60.2	77.3	92.6	105	114	119	120	117	111	101	87.8	71.7	54.6	36.1	23.9		
135	7.22	41.2	53.0	69.5	82.3	92.8	100	105	106	104	98.0	89.3	78.0	64.6	46.0	35.4	19.8		
140	5.89	37.0	48.5	61.6	73.1	81.9	88.1	91.8	92.6	90.7	85.9	78.7	69.3	56.1	44.6	34.4	13.4		
145	5.46	25.6	45.5	51.0	63.4	71.9	77.0	80.0	80.7	79.1	75.2	69.3	59.5	49.5	42.0	32.7	9.74		
150	4.75	14.1	39.4	48.6	53.1	58.7	65.7	69.2	69.9	68.6	64.1	57.4	51.8	45.6	39.9	24.5	6.21		
155	6.64	8.97	24.7	42.0	48.5	52.1	54.3	55.6	55.6	55.8	54.2	50.9	47.0	42.4	35.6	17.1	5.08		
160	6.15	4.78	6.95	21.3	37.6	45.8	47.9	49.2	49.6	49.1	47.8	45.7	42.7	37.3	22.8	11.6	5.32		
165	8.07	5.41	4.64	6.38	10.1	21.7	36.7	40.7	41.8	41.7	40.5	37.6	30.2	20.5	13.5	5.89	5.14		
170	7.42	6.37	5.22	4.42	5.98	6.51	5.05	12.8	17.0	17.6	16.7	14.8	12.6	8.66	4.55	6.50	5.83		
175	7.53	8.63	8.02	7.97	6.35	5.17	4.41	3.71	3.53	4.54	4.44	6.05	7.53	8.17	8.12	6.29	6.30		
180	7.09	7.10	7.06	6.96	6.81	6.60	6.17	6.26	6.16	2.64	5.78	6.29	6.66	7.66	8.15	8.84	9.22		

Table 7: Luminous Intensity Data

TEST RESULTS (4000K Setting)

Test ambient temperature was 26.0 °C.

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

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

Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.203	0.097
Power Factor	0.9927	0.8912
Test Power (W)	24.24	24.04
THD A%	6.72	19.98
Luminous Efficacy (lm/W)	144.1	146.8
Total Luminous Flux (lm)	3491.9	3528.1
Color Rendering Index (CRI)	85.7	
R9	19.8	
Correlated Color Temperature (CCT)(K)	3966	
Chromaticity Chroma x	0.3793	
Chromaticity Chroma y	0.3687	
Chromaticity Chroma u	0.2277	
Chromaticity Chroma v	0.3319	
Duv	-0.0035	
Chromaticity Chroma u'	0.2277	
Chromaticity Chroma v'	0.4978	

Special Color Rendering Indices	
R1	85.4
R2	93.8
R3	95.6
R4	83.6
R5	85.5
R6	89.8
R7	85.1
R8	66.9
R9	19.8
R10	84.4
R11	83.4
R12	67.1
R13	88.1
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

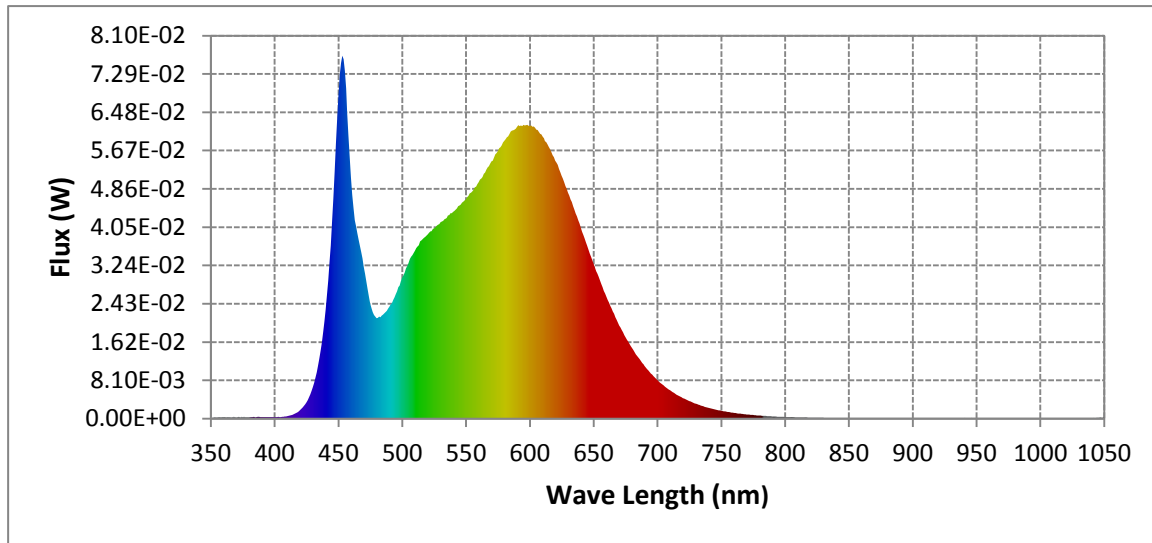
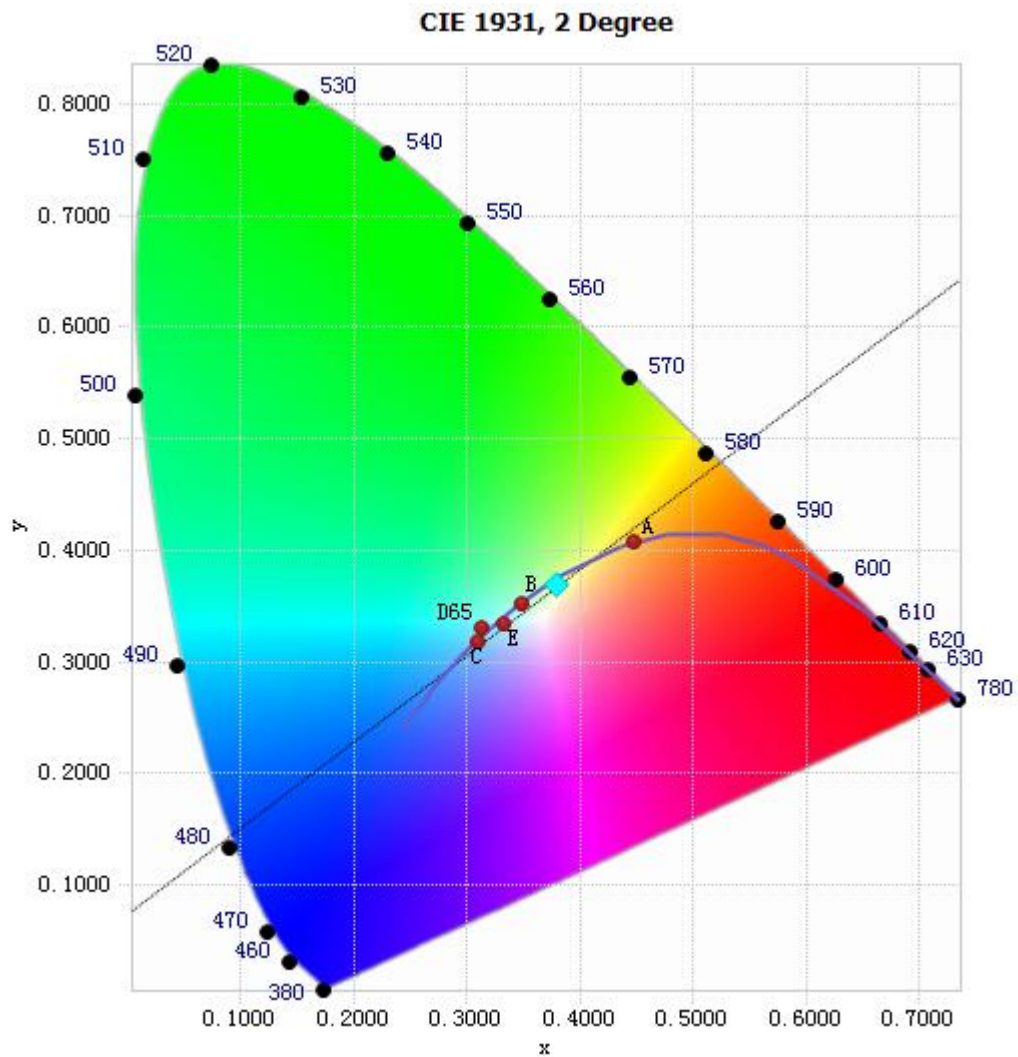


Chart 8: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.55E-04	485	2.20E-02	590	6.17E-02	695	9.56E-03
385	2.96E-04	490	2.37E-02	595	6.21E-02	700	8.20E-03
390	3.53E-04	495	2.64E-02	600	6.20E-02	705	7.02E-03
395	3.17E-04	500	2.98E-02	605	6.11E-02	710	5.99E-03
400	3.28E-04	505	3.30E-02	610	5.96E-02	715	5.09E-03
405	3.59E-04	510	3.55E-02	615	5.74E-02	720	4.34E-03
410	5.16E-04	515	3.77E-02	620	5.46E-02	725	3.70E-03
415	9.26E-04	520	3.90E-02	625	5.14E-02	730	3.19E-03
420	1.81E-03	525	4.03E-02	630	4.78E-02	735	2.73E-03
425	3.46E-03	530	4.16E-02	635	4.42E-02	740	2.31E-03
430	6.71E-03	535	4.25E-02	640	4.04E-02	745	1.96E-03
435	1.27E-02	540	4.37E-02	645	3.66E-02	750	1.68E-03
440	2.31E-02	545	4.51E-02	650	3.27E-02	755	1.44E-03
445	4.17E-02	550	4.64E-02	655	2.92E-02	760	1.22E-03
450	6.85E-02	555	4.81E-02	660	2.58E-02	765	1.06E-03
455	7.36E-02	560	5.01E-02	665	2.27E-02	770	9.04E-04
460	5.10E-02	565	5.20E-02	670	1.97E-02	775	7.76E-04
465	3.92E-02	570	5.44E-02	675	1.72E-02	780	6.84E-04
470	3.21E-02	575	5.66E-02	680	1.50E-02		
475	2.44E-02	580	5.87E-02	685	1.29E-02		
480	2.13E-02	585	6.07E-02	690	1.12E-02		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3793, 0.3687)

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

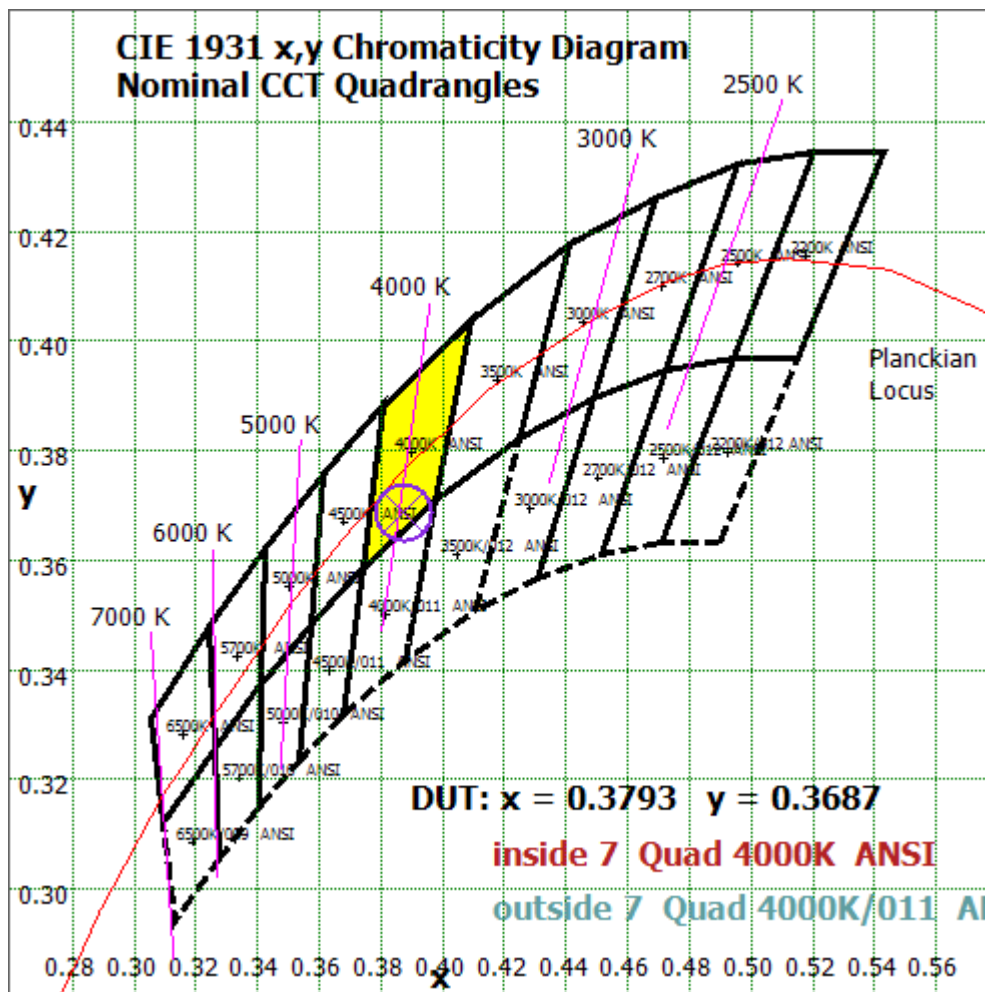


Chart 10: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

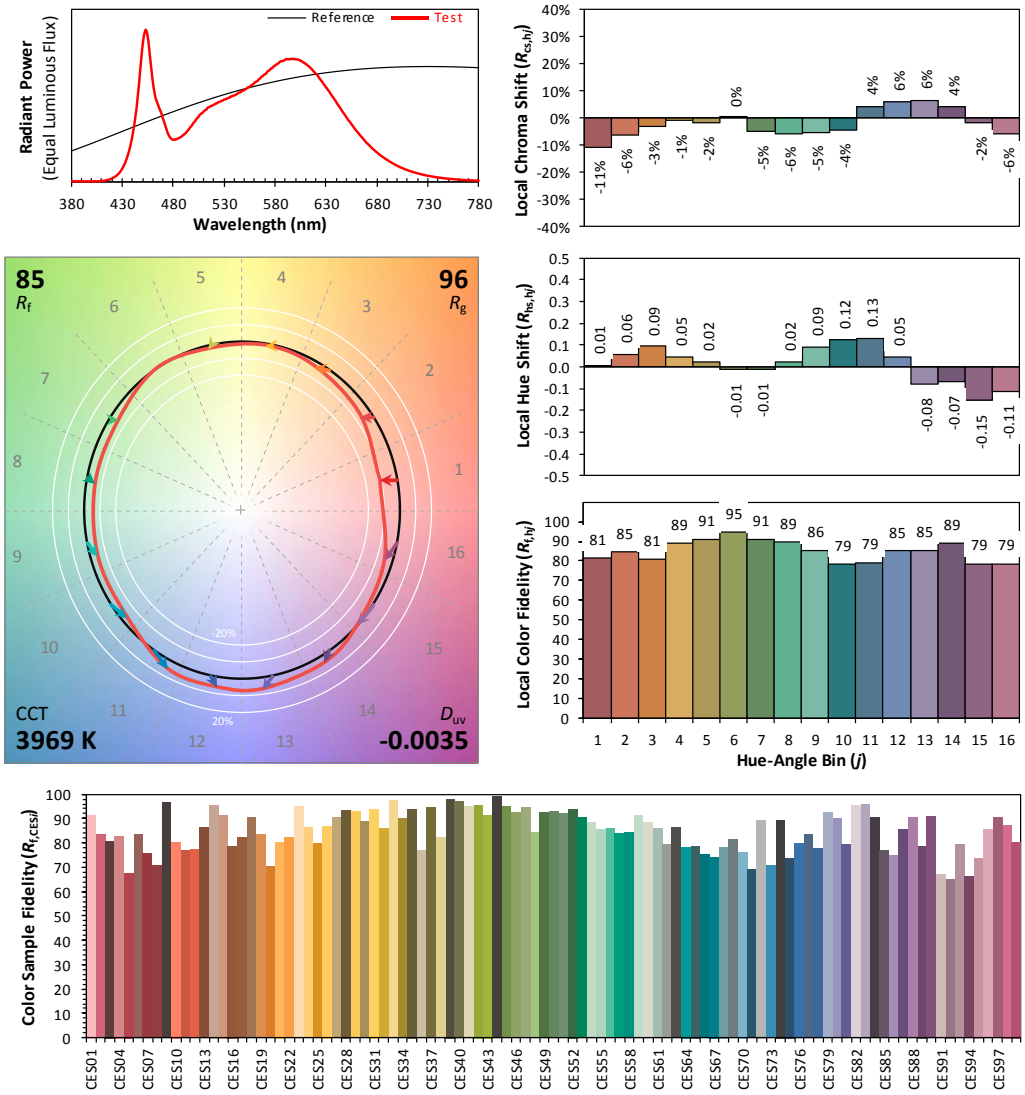
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: P.Q.L., Inc.

Date: 2023/04/14

Model: 91842



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

x 0.3793
 y 0.3687
 u' 0.2277
 v' 0.4978

CIE 13.3-1995 (CRI)	
R_a	86
R_g	20

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

Chart 11: Full Report Created with the IES TM-30 Calculator

Note: The values in this diagram might be a little different from the values in Table 8 due to rounding.

TEST RESULTS (5000K Setting)

Test ambient temperature was 26.0 °C.

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

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

Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.204	0.098
Power Factor	0.9931	0.8926
Test Power (W)	24.29	24.21
THD A%	6.61	19.02
Luminous Efficacy (lm/W)	141.5	144.4
Total Luminous Flux (lm)	3438.2	3497.0
Color Rendering Index (CRI)	85.4	
R9	18.8	
Correlated Color Temperature (CCT)(K)	4983	
Chromaticity Chroma x	0.3451	
Chromaticity Chroma y	0.3477	
Chromaticity Chroma u	0.2130	
Chromaticity Chroma v	0.3218	
Duv	-0.0020	
Chromaticity Chroma u'	0.2130	
Chromaticity Chroma v'	0.4827	

Special Color Rendering Indices	
R1	84.7
R2	92.5
R3	95.1
R4	83.2
R5	84.3
R6	87
R7	86.9
R8	69.5
R9	18.8
R10	80.8
R11	82.7
R12	60.3
R13	87.5
R14	98

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

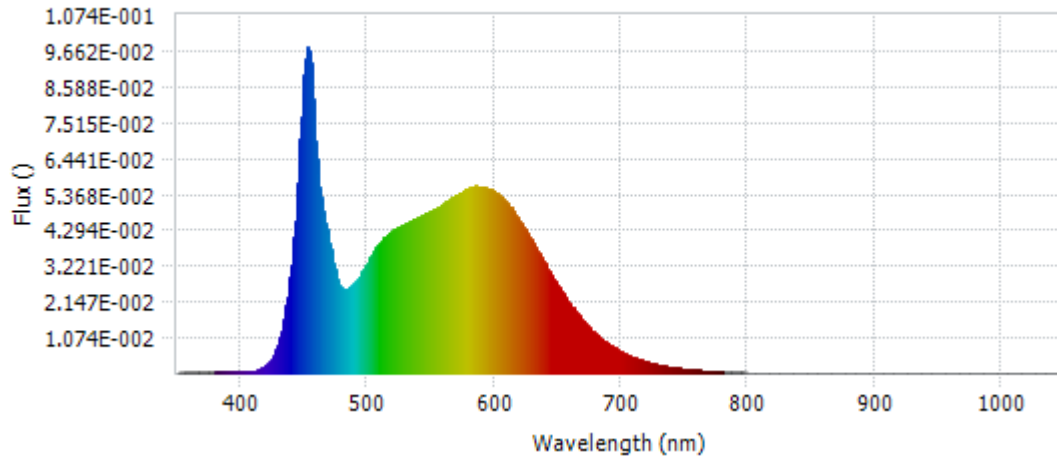
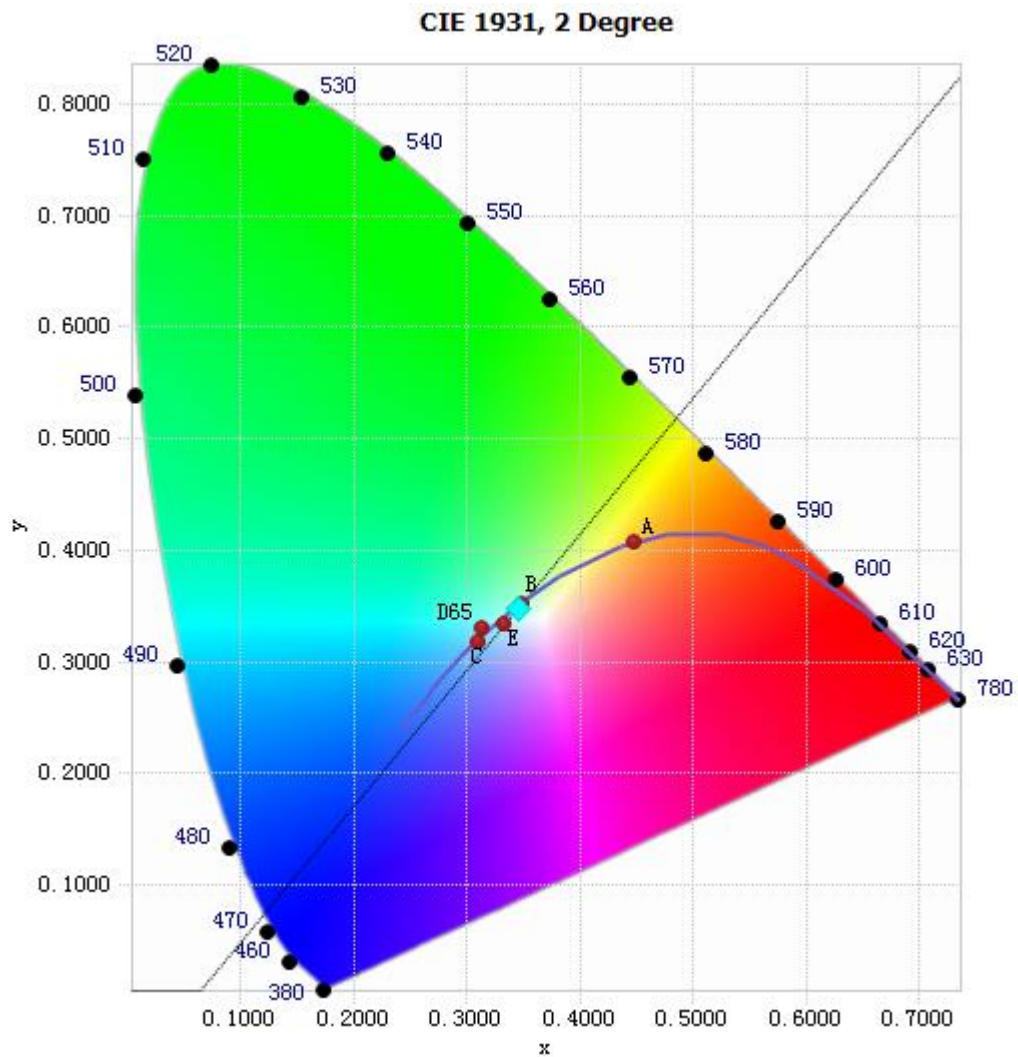


Chart 12: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.23E-04	485	2.57E-02	590	5.61E-02	695	7.58E-03
385	3.60E-04	490	2.71E-02	595	5.54E-02	700	6.48E-03
390	4.01E-04	495	2.99E-02	600	5.46E-02	705	5.54E-03
395	3.54E-04	500	3.33E-02	605	5.29E-02	710	4.76E-03
400	3.72E-04	505	3.65E-02	610	5.10E-02	715	4.03E-03
405	4.41E-04	510	3.92E-02	615	4.85E-02	720	3.47E-03
410	6.80E-04	515	4.13E-02	620	4.56E-02	725	2.97E-03
415	1.24E-03	520	4.25E-02	625	4.26E-02	730	2.54E-03
420	2.44E-03	525	4.38E-02	630	3.94E-02	735	2.17E-03
425	4.87E-03	530	4.48E-02	635	3.60E-02	740	1.86E-03
430	9.55E-03	535	4.56E-02	640	3.28E-02	745	1.58E-03
435	1.80E-02	540	4.66E-02	645	2.95E-02	750	1.35E-03
440	3.25E-02	545	4.77E-02	650	2.63E-02	755	1.16E-03
445	5.68E-02	550	4.84E-02	655	2.34E-02	760	9.96E-04
450	8.93E-02	555	4.94E-02	660	2.06E-02	765	8.56E-04
455	9.30E-02	560	5.08E-02	665	1.81E-02	770	7.34E-04
460	6.41E-02	565	5.21E-02	670	1.57E-02	775	6.30E-04
465	4.85E-02	570	5.33E-02	675	1.36E-02	780	5.45E-04
470	3.92E-02	575	5.44E-02	680	1.19E-02		
475	2.94E-02	580	5.53E-02	685	1.02E-02		
480	2.53E-02	585	5.61E-02	690	8.85E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3451, 0.3477)

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

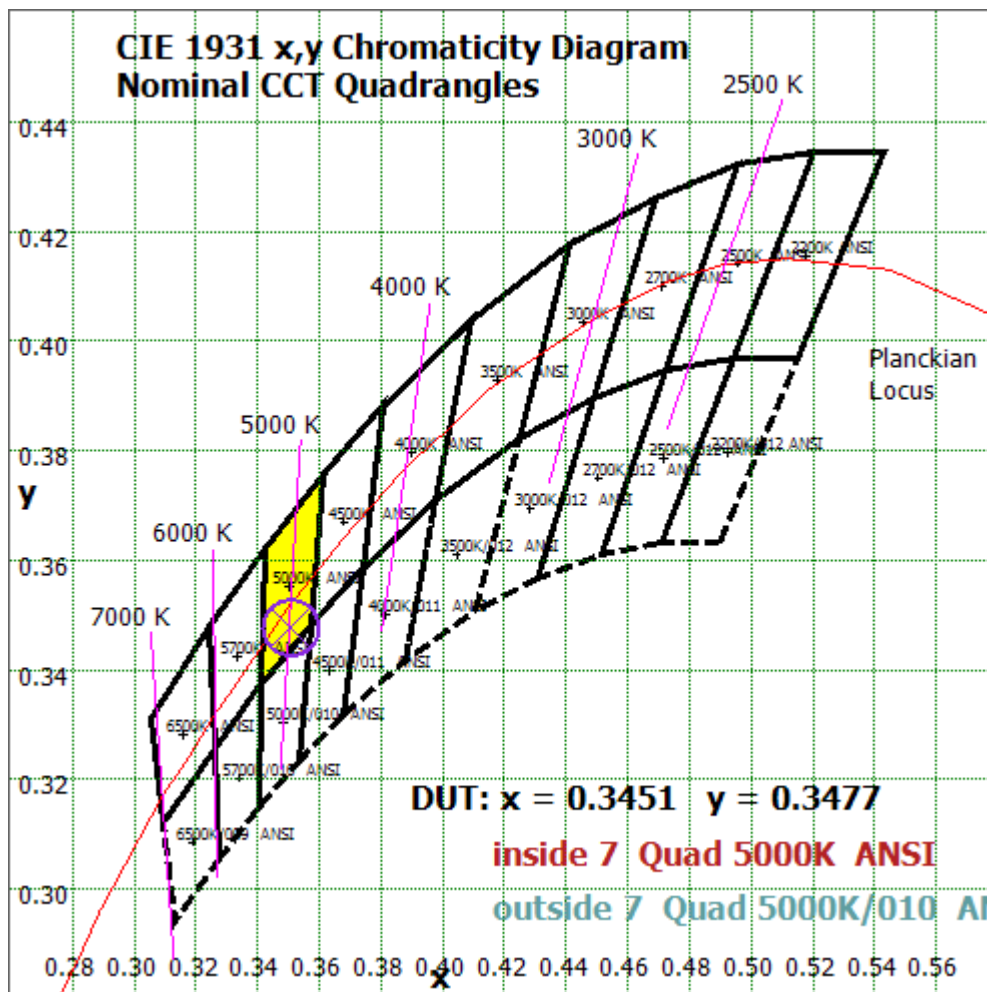


Chart 14: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

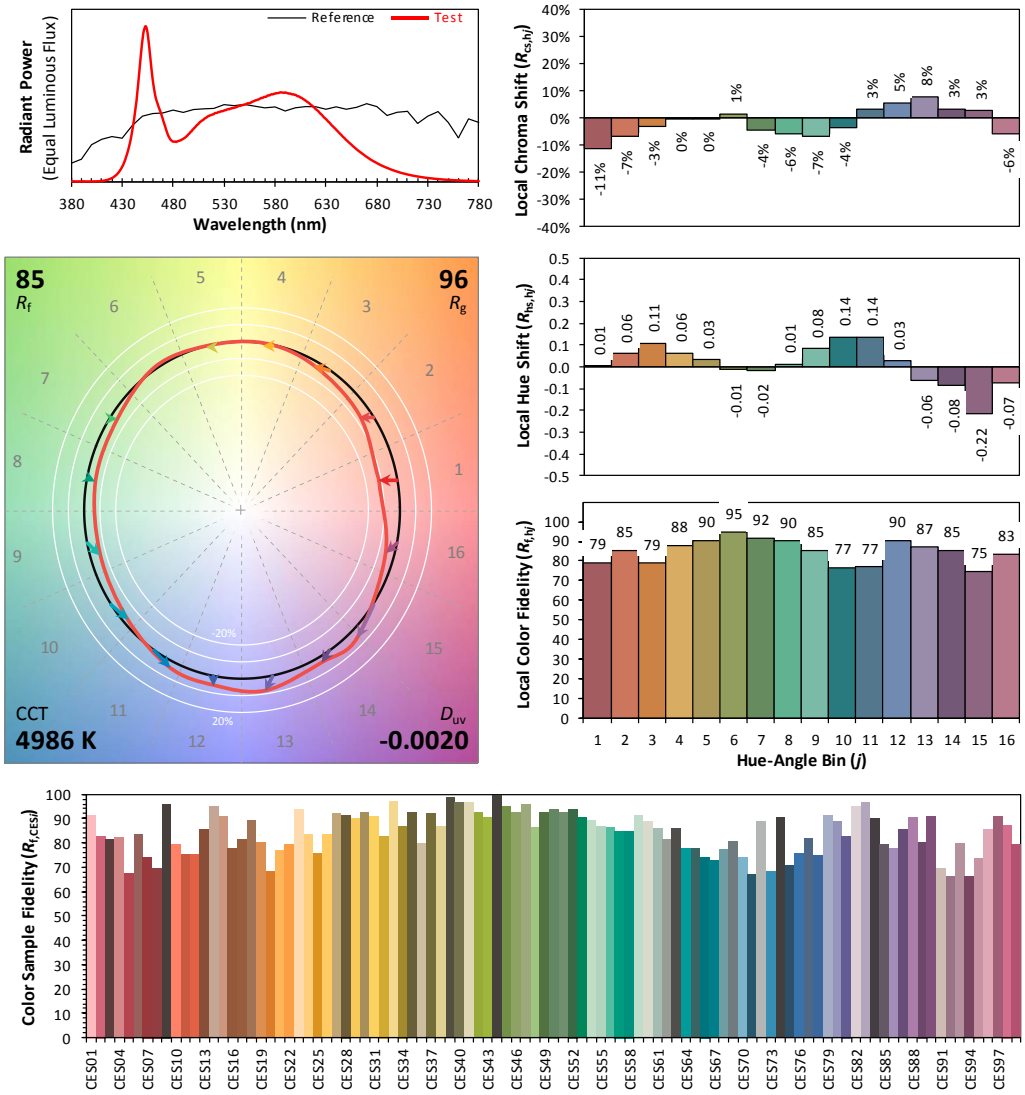
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: P.Q.L., Inc.

Date: 2023/04/14

Model: 91842



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

x 0.3451
 y 0.3477
 u' 0.2130
 v' 0.4827

CIE 13.3-1995 (CRI)	
R_a	85
R_g	19

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

Chart 15: Full Report Created with the IES TM-30 Calculator

Note: The values in this diagram might be a little different from the values in Table 10 due to rounding.

EQUIPMENT LIST

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

Table 12: Test Equipment List

TEST METHODS

Seasoning of SSL Product

For the purpose of rating new SSL products, SSL products shall be tested with no seasoning. Therefore, no seasoning was performed.

Sphere-Spectroradiometer Method- Photometric and Electrical Measurements

A Labsphere Model CDS 2100 Spectroradiometer and 3 Meter Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit. The coating reflectance of each sphere is 98%. The measure geometry is 4π . Self-absorption correction is conducted in testing. Bandwidth of spectroradiometer is 350nm-1050nm.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation.

The stabilization time typically ranges from 30 min (small integrated LED lamps) to 2 or more hours for large SSL luminaires). It can be judged that stability is reached when the variation (maximum – minimum) of at least 3 readings of the light output and electrical power over a period of 20 min, taken 10 minutes apart, is less than 0.5 %.

Electrical measurements including voltage, current, and power were measured using the Yokogawa Power Analyzer.

The standard reference of the integrated sphere system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Standards and Technology.

The uncertainty of integrating sphere system reported in this document is expanded uncertainty is 2.1% with a coverage factor $k=2$.

Goniophotometer Method

Photometric and Electrical Measurements

An EVERFINE Type C Model GO-R5000 Goniophotometer was used to measure the intensity at each angle of distribution for each sample. The photometric distance is 2.475m for near-field measurement or 30m for far-field measurement. Bandwidth of spectroradiometer is 380nm-780nm.

Ambient temperature was measured at the same height of the sample mounted on the Goniophotometer equipment. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation.

The stabilization time typically ranges from 30 min (small integrated LED lamps) to 2 or more hours for large SSL luminaires). It can be judged that stability is reached when the variation (maximum – minimum) of at least 3 readings of the light output and electrical power over a period of 20 min, taken 10 minutes apart, is less than 0.5 %.

Electrical measurements including voltage, current, and power were measured using the Everfine Digital Power Meter.

Some graphics were created with Photometric Plus software.

The standard reference of the Goniophotometer system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Metrology P.R. China.

The uncertainty of goniophotometer system reported in this document is expanded uncertainty is 2.3% with a coverage factor $k=2$.

Color Characteristics Measurements

The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as values that are spatially average, weighted to intensity, over the angular range where light is intentionally emitted from the SSL product. The color characteristics measurements are using gonio-spectroradiometer.

*** End of Report ***

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