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Version 1.0

Total pages 16

Test report of

IES LM-79-08

Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

Applicant:

Sundopt LED Lighting Co., Ltd.

Address:

Bldg 8-6#, TongFuYu Industrial Park Ai, Qun Rd Shiyan Town Baoan District,
Shenzhen, Guangdong 518108

For Product:

2x2 Luminaires for Ambient Lighting of Interior Commercial Spaces

Model No.:

PL10-40DS96-S460[W,S]-bb-A[S,N]

Test laboratory: Shenzhen Belling Efficiency Testing Lab Co.,Ltd, 1Floor, No.1 Building, Meibaohe
Industrial Park, Dalang Street, Longhua District, Shenzhen, Guangdong Prov.518101 China.

Jarvis Zhang

Jason Zhou

Complied by: Jarvis Zhang

Review by: Jason Zhou

Project Engineer

Technical Manager

Note: The test data was only valid for the test sample(s). This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or use in part without prior written consent from Shenzhen Belling Efficiency Testing Lab Co.,Ltd. This report must not be used by the customer to claim product certification, approval, or endorsement By NVLAP, NIST, or any agency of the U.S. Government.



1 General

1.1 Product Information

Manufacturer	Sundopt LED Lighting Co., Ltd.
Manufacturer Address	Bldg 8-6#, TongFuYu Industrial Park Ai, Qun Rd Shiyan Town Baoan District, Shenzhen, Guangdong 518108
Brand Name	Sundopt
Luminaire Type	2x2 Luminaires for Ambient Lighting of Interior Commercial Spaces
Model Number	PL10-40DS96-S460[W,S]-bb-A[S,N]
Rated Inputs	AC 120-277V 50/60Hz
Rated Power	40 W
Nominal CCT	3500K / 4000K / 5000K
Color-Tunable Product	Yes
Date of Receipt Samples	2019-10-09
Date of test	2019-10-10 to 2019-10-18
Burning Time Before Test	0hour(For New Products)

1.2 Standards or methods

- ANSI C78.377-2015:Specifications for the Chromaticity of Solid State Lighting Products
- ANSI C82.77-10:2014:Harmonic Emission Limits - Related Power Quality Requirements for Lighting Equipment - Solid State
- CIE Publication No.13.3-1995:Method of Measuring and Specifying Color Rendering of Light Sources
- IESNA LM-79-08 Approved Method: Electric & Photometric Measurement of Solid-state Lighting Products



1.3 Equipment list

Device	Manufacture	Model No.	Serial No.	Calibration due date
Goniophotometric System	SENSING	GMS-3000	N.A	2020-04-07
AC Power Source	ALL POWER	APW-110N	992257	2020-04-08
Total Luminous Flux Standard Lamp	SENSING	110V/200W	S1520062	2020-04-15
Total Spectral Radiant Flux Standard Lamp	SENSING	12V/20W	LSD12201731	2020-04-15
Digital Power Meter	YOKOGAWA	WT310	C2QM02030V	2020-04-08
Integral Sphere	SENSING	SPR-600M	N.A	2020-04-07
Digital Power Meter	YOKOGAWA	WT210	91L929742	2020-04-08
Optical Color and Electrical Measurement System	SENSING	SPR-3000	S1101108	2020-04-07
Environment Measurer	KTJ	HTC-1	N/A	2020-05-12
Environment Measurer	KTJ	TA218B	N/A	2020-05-12
Stop watch	KISLO	K610	N/A	2020-05-12
Digital Anemometer	TECMAN	TD8901	026141	2020-09-10

Statement of Traceability: Shenzhen Belling Efficiency Testing Lab Co.,Ltd attests that all calibration has been performed using suitable standards traceable to national primary standards and International System of Unit (SI).

1.4 Report Revision

Original report BL191025002-9 dated at 2019-10-28 was recalled and declared as invalid by Shenzhen Belling Efficiency Testing Lab Co.,Ltd. Report BL191025002-9A was issued on to replace report BL191025002-9.

Report Number	Report Data	Contents
BL191025002-9	2019-10-28	Original report
BL191025002-9A	2019-11-13	Correct the model number



2 Test conducted and method

2.1 Ambient Condition

The ambient temperature in which measurements are being taken was maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$, the air flow around the sample(s) being tested did not affect the performance.

2.2 Power Supply Characteristics

The AC power supply had a sinusoidal voltage wave shape at the prescribed frequency (60 Hz) such that the RMS summation of the harmonic components does not exceed 3 percent of the fundamental during operation of the test item.

The voltage of AC power supply (RMS voltage) applied to the device under test was regulated to within ± 0.2 percent under load.

2.3 Seasoning and Stabilization

No seasoning was performed in accordance with IESNA LM-79-08. And before the measurement, the sample was stabilized until the light output and power variations were less than 0.5% in 30 minutes intervals (3 readings, 15 minutes apart).

2.4 Integrating Sphere System

The system includes AC power source, digital power meter, DC power supply, spectrophotometer, and integrating sphere. The integrating sphere system is calibrated by standard light source before measurement. The system and standard light source has been calibrated regularly and traceable to the National Primary Standards. 4π geometry was used during measurement. The product was operated in its intended orientation in application and was recorded in this report.

Integrating Sphere Uncertainty: The uncertainty of the light output (luminous flux) measurements is $U=1.8\%$ ($K=2$), at the 95% confidence level. The uncertainty of the correlated color temperature measurements is $U=20\text{K}$ ($K=2$), at the 95% confidence level. The uncertainty of the CRI is $U=1.8(K=2)$, at the 95% confidence level. The uncertainty of power meter AC current $U=0.18\%$ of rdg, AC Voltage $U=0.16\%$ of rdg, Power $U=0.20\%$ ($K=2$), at the 95% confidence level.



2.5 Goniophotometer System

The goniophotometer system is calibrated by standard light source before measurement. The standard light source has been calibrated regularly and traceable to the National Primary Standards.

Type C goniophotometer was used for measuring total luminous flux, luminous intensity distribution, and color spatial uniformity. The product was operated in its intended orientation in application and was recorded in this report. The method according to IESNA LM-79-08 following chapter.

Goniophotometer Uncertainty :The uncertainty of the luminous intensity is $U=1.6\%$ ($K=2$), at the 95% confidence level.



3 Test Result Summary

3.1 Integrating Sphere System (Total operating time for integrating sphere test: 1.0 hour)

3.1.1 Electrical data

Model Number	Input Voltage(V)	Frequency (Hz)	Input Current (A)	Power (W)	Power Factor
PL10-40DS96-S460[W,S]-bb-A[S, N]	120.06	60	0.338	40.18	0.991
	120.08	60	0.337	40.11	0.991
	120.06	60	0.338	40.24	0.991

3.1.2 Photometric data

Model Number	Luminous Flux (lm)	Efficacy (lm/W)	CCT (K)	CRI	R9
PL10-40DS96-S460[W,S]-bb-A[S, N]	4319.35	107.5	3430	82.7	7
	4392.05	109.5	4006	83.3	10
	4442.50	110.4	4780	81.9	4

3.1.3 Chromaticity Coordinate

Model Number	Duv	x	y	u'	v'
PL10-40DS96-S460[W,S]-bb-A[S, N]	-0.00064	0.4086	0.3909	0.2378	0.5118
	+0.00043	0.3805	0.3777	0.2248	0.5020
	+0.00331	0.3526	0.3642	0.2116	0.4918



3.2 Goniophotometer System (Total operating time for luminous intensity distribution: 1.0 hour)

3.2.1 Electrical data

Model Number	Input Voltage(V)	Frequency (Hz)	Input Current (A)	Power (W)	Power Factor
PL10-40DS96-S460[W,S]-bb-A[S,N]	120.01	60	0.3384	40.237	0.9907

3.2.2 Photometric data

Luminous Flux (lm)	Efficacy (lm/W)	S/MH (C0/180)	S/MH (C90/270)	Zonal Lumen in 0-60°(%lm)
4317.94	107.31	1.26	1.28	78.69

3.3 Additional Test

Model Number	Test Item	Test Voltage (V)	Frequency(Hz)	Test Result
PL10-40DS96-S460[W,S]-bb-A[S,N]	Power Factor	277	60	0.909
	THD	277	60	10.4%

3.4 Data reporting for white-tunable submissions

ANSI CCT Quadrangle (omit any outside product range) / Worst-Case Value	Actual CCT (K)	Power Consumption (W)	Lumen Output (lm)	Input Control Signal Applied
3500K	3430	40.18	4319.35	0%
4000K	4006	40.11	4392.05	50%
5000K	4780	40.24	4442.50	100%
Lowest Efficacy	3430	40.18	4319.35	0%
Maximum Power	4780	40.24	4442.50	100%



4 Test Data

3500K

Test Condition

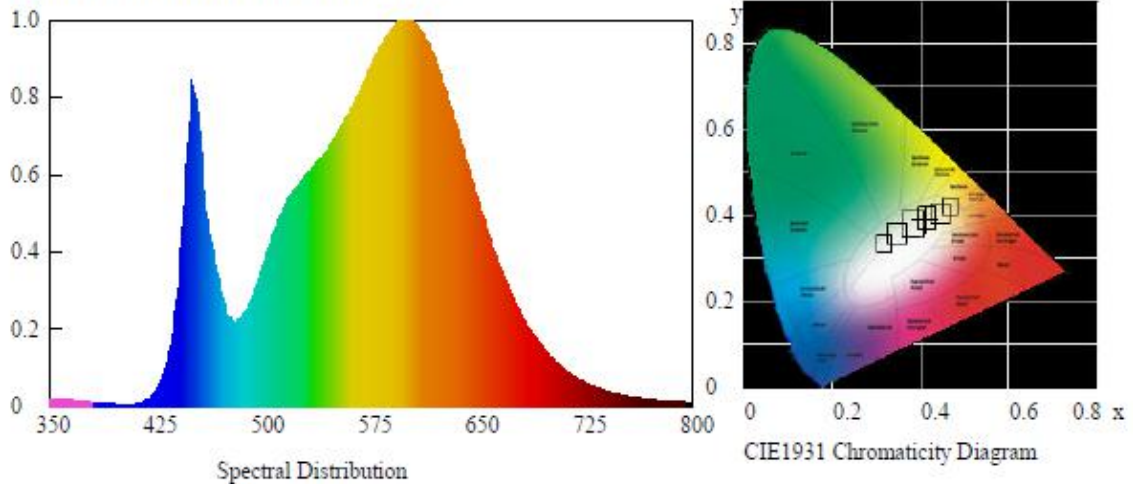
Temperature: 25°C

RH: 58%

Spectrum Range: 350-800 nm

Scan Step: 5 nm

Spectroradiometric Parameters

Chromaticity Coordinates: $x=0.4086$ $y=0.3909$ $u'=0.2378$ $v'=0.5118$

Correlated Color Temperature: 3430 K

Dominant Wavelength: 580.0 nm(E)

Colour Fidelity Index: $R_f=81$ Gamut Index: $R_g=96$

Luminous Flux: 4319.35 lm

Purity: 0.4005

Chromaticity Difference: -0.00064Duv

Peak Wavelength: 595.0 nm

Color Ratio: $K_r=41.6\%$ $K_g=50.1\%$ $K_b=8.2\%$

Bandwidth: 139.6nm

Radiant Flux: 15.556 W

Rendering Index: $R_a=82.7$ $R_1=81$ $R_2=90$ $R_3=96$ $R_4=81$ $R_5=81$ $R_6=87$ $R_7=84$ $R_8=61$ $R_9=7$ $R_{10}=77$ $R_{11}=80$ $R_{12}=64$ $R_{13}=84$ $R_{14}=98$ $R_{15}=75$ $R_e=76$

Electric Parameters

Voltage: 120.06 V

Current: 0.338 A

Power Factor: 0.991

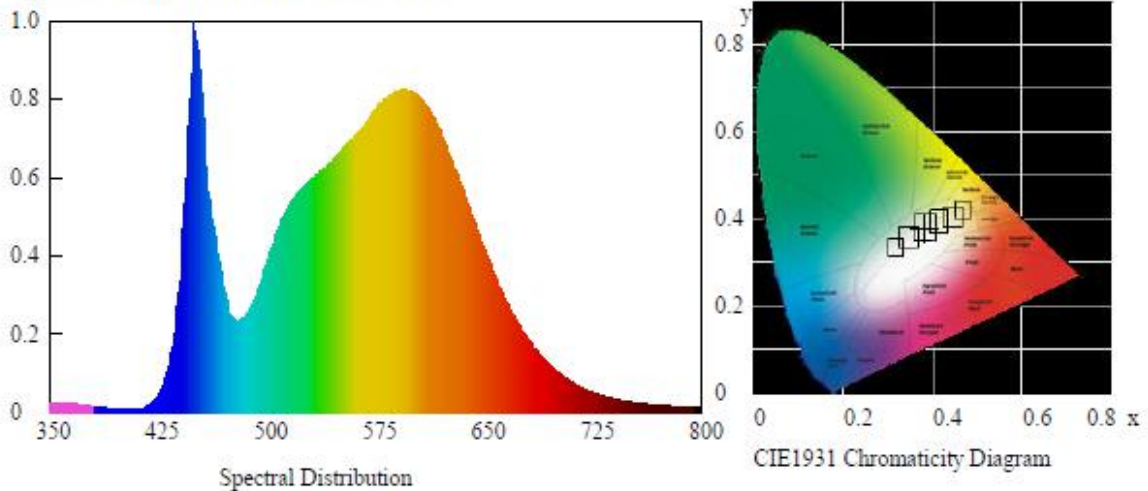
Power: 40.18 W

Luminous Efficacy: 107.5 lm/W

**4000K****Test Condition**

Temperature: 25°C
Spectrum Range: 350-800 nm

RH: 58%
Scan Step: 5 nm

Spectroradiometric Parameters

Chromaticity Coordinates: $x=0.3805$ $y=0.3777$ $u'=0.2248$ $v'=0.502$

Correlated Color Temperature: 4006 K

Dominant Wavelength: 577.0 nm(E)

Colour Fidelity Index: $R_f=81$

Gamut Index: $R_g=95$

Luminous Flux: 4392.05 lm

Purity: 0.2757

Chromaticity Difference: +0.00043Duv

Peak Wavelength: 450.0 nm

Color Ratio: $K_r=38.1\%$ $K_g=52.4\%$ $K_b=9.5\%$

Bandwidth: 19.8nm

Radiant Flux: 16.889 W

Rendering Index: $R_a=83.3$

$R_1=82$ $R_2=89$ $R_3=95$ $R_4=82$ $R_5=82$ $R_6=85$ $R_7=86$ $R_8=65$

$R_9=10$ $R_{10}=75$ $R_{11}=81$ $R_{12}=60$ $R_{13}=84$ $R_{14}=97$ $R_{15}=76$ $R_e=77$

Electric Parameters

Voltage: 120.08 V

Current: 0.337 A

Power Factor: 0.991

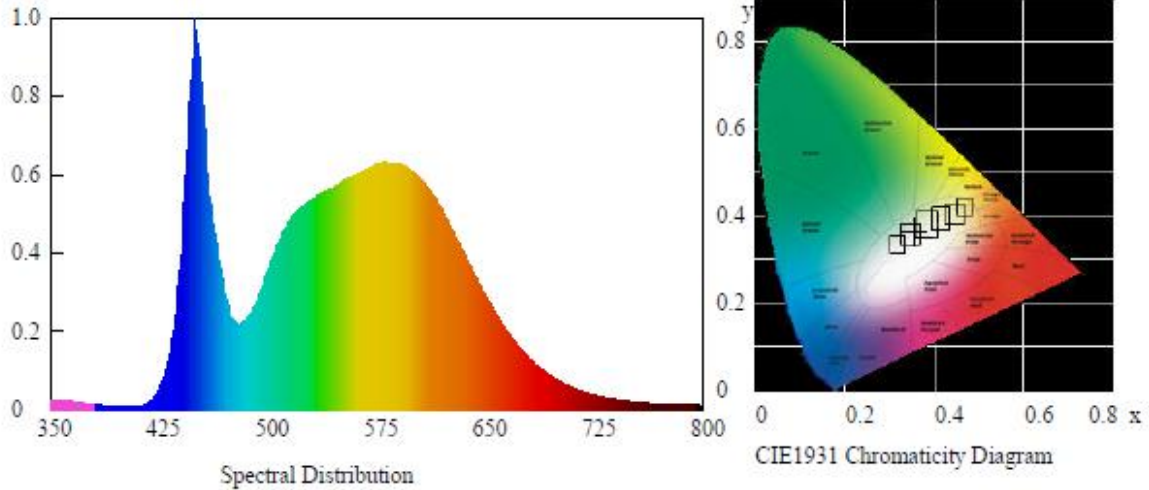
Power: 40.11 W

Luminous Efficacy: 109.5 lm/W

**5000K****Test Condition**

Temperature: 25°C
Spectrum Range: 350-800 nm

RH: 58%
Scan Step: 5 nm

Spectroradiometric Parameters

Chromaticity Coordinates: $x=0.3526$ $y=0.3642$ $u'=0.2116$ $v'=0.4918$

Correlated Color Temperature: 4780 K

Dominant Wavelength: 571.0 nm(E)

Colour Fidelity Index: $R_f=80$

Gamut Index: $R_g=94$

Luminous Flux: 4442.50 lm

Purity: 0.1505

Chromaticity Difference: +0.00331Duv

Peak Wavelength: 450.0 nm

Color Ratio: $K_r=34.3\%$ $K_g=54.9\%$ $K_b=10.7\%$

Bandwidth: 21.6nm

Radiant Flux: 16.201 W

Rendering Index: $R_a=81.9$

$R_1=80$ $R_2=87$ $R_3=93$ $R_4=81$ $R_5=80$ $R_6=81$ $R_7=87$ $R_8=66$

$R_9=4$ $R_{10}=69$ $R_{11}=80$ $R_{12}=54$ $R_{13}=82$ $R_{14}=96$ $R_{15}=74$ $R_e=74$

Electric Parameters

Voltage: 120.06 V

Current: 0.338 A

Power Factor: 0.991

Power: 40.24 W

Luminous Efficacy: 110.4 lm/W



Zonal Flux Diagram

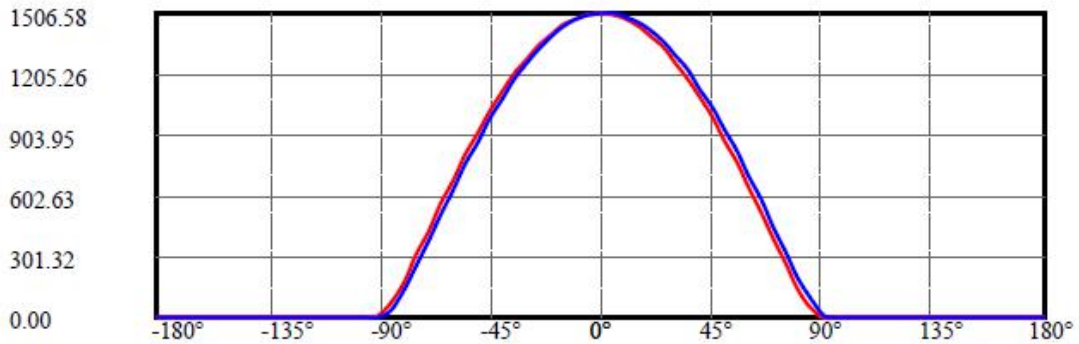
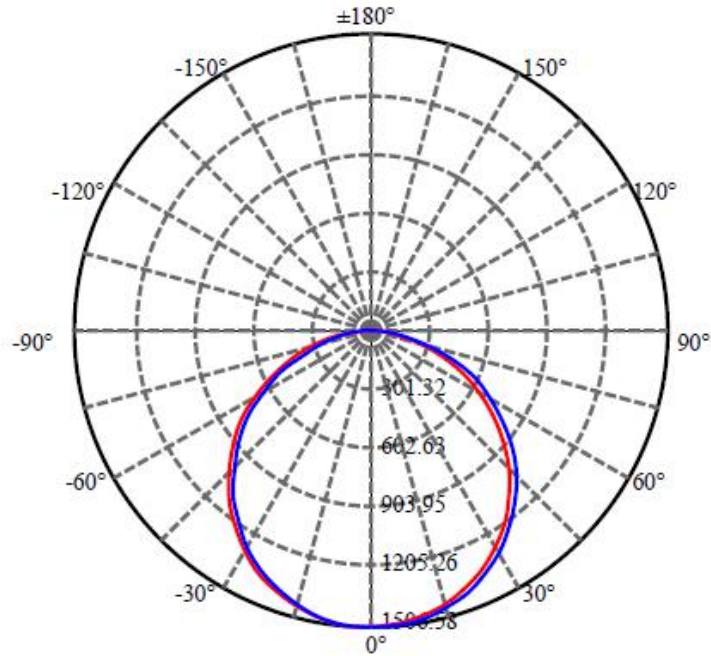
Zonal flux distribution table

$\gamma(^{\circ})$	Average I(cd)	Zonal F(lm)	Sum F(lm)	Eff Flux(%)	Eff Sum(%)
0.0	1505.740	0.000	0	0.00%	0.00%
5.0	1499.025	35.921	35.921	0.83%	0.83%
10.0	1479.310	106.544	142.466	2.47%	3.30%
15.0	1446.529	173.559	316.024	4.02%	7.32%
20.0	1401.434	234.712	550.736	5.44%	12.75%
25.0	1343.312	287.873	838.61	6.67%	19.42%
30.0	1275.566	331.421	1170.031	7.68%	27.10%
35.0	1195.778	363.923	1533.953	8.43%	35.53%
40.0	1106.083	384.048	1918.002	8.89%	44.42%
45.0	1007.999	391.440	2309.441	9.07%	53.48%
50.0	901.019	385.745	2695.186	8.93%	62.42%
55.0	786.341	366.888	3062.074	8.50%	70.92%
60.0	665.641	335.621	3397.696	7.77%	78.69%
65.0	539.291	292.921	3690.617	6.78%	85.47%
70.0	410.499	240.493	3931.11	5.57%	91.04%
75.0	284.186	181.579	4112.689	4.21%	95.25%
80.0	165.571	120.342	4233.032	2.79%	98.03%
85.0	65.353	62.748	4295.779	1.45%	99.49%
90.0	3.454	18.840	4314.619	0.44%	99.92%
95.0	0.012	0.949	4315.568	0.02%	99.95%
100.0	0.025	0.010	4315.578	0.00%	99.95%
105.0	0.074	0.026	4315.605	0.00%	99.95%
110.0	0.099	0.045	4315.65	0.00%	99.95%
115.0	0.160	0.066	4315.716	0.00%	99.95%
120.0	0.222	0.093	4315.808	0.00%	99.95%
125.0	0.358	0.134	4315.942	0.00%	99.95%
130.0	0.518	0.190	4316.133	0.00%	99.96%
135.0	0.642	0.234	4316.367	0.01%	99.96%
140.0	0.765	0.260	4316.628	0.01%	99.97%
145.0	0.827	0.266	4316.893	0.01%	99.98%
150.0	0.876	0.251	4317.144	0.01%	99.98%
155.0	0.975	0.234	4317.378	0.01%	99.99%
160.0	0.987	0.206	4317.584	0.00%	99.99%
165.0	0.913	0.157	4317.741	0.00%	100.00%
170.0	0.925	0.109	4317.85	0.00%	100.00%
175.0	0.962	0.068	4317.917	0.00%	100.00%
180.0	0.999	0.023	4317.941	0.00%	100.00%



Luminous Intensity Distribution Diagram

Light Distribution Curve [Unit:cd]



C0/C180: —

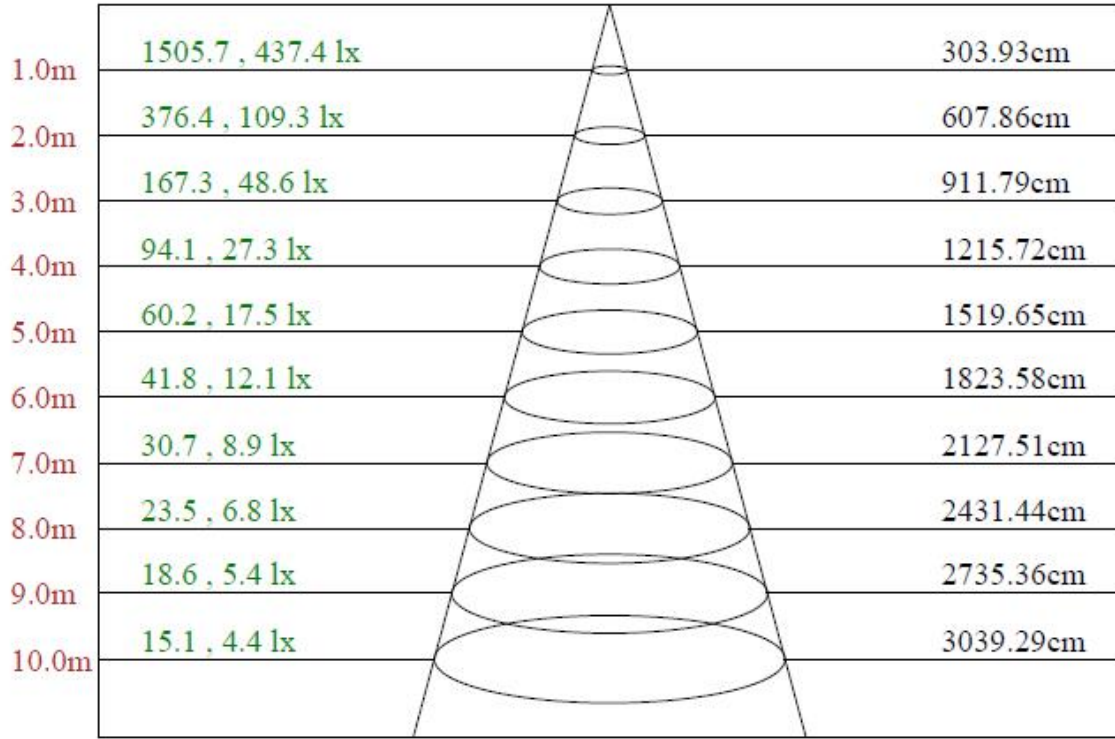
C90/C270: —

Field angle(10%Imax):C0/180Left:81.5 Right:79.7
:C90/270Left:79.5 Right:82.3

Beam Angle(50%Imax):C0/180Left:57.1 Right:55.6
:C90/270Left:55.3 Right:57.8



Lux distance Curve



Max , Ave

Beam angle of C90 plane 113.31

**Luminous Intensity Distribution Data**

C/γ(°)	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0
0.0	1505.74	1496.71	1475.19	1440.64	1393.46	1335.03	1264.36	1182.24	1092.23
22.5	1505.74	1495.52	1472.43	1437.49	1392.08	1331.88	1261.60	1181.85	1090.65
45.0	1505.74	1493.75	1472.62	1437.68	1391.89	1330.69	1262.19	1180.07	1091.44
67.5	1505.74	1496.11	1474.60	1439.85	1392.28	1332.07	1263.38	1182.05	1090.06
90.0	1505.74	1506.58	1489.60	1460.38	1417.75	1362.87	1298.91	1221.53	1134.67
112.5	1505.74	1502.04	1485.26	1455.45	1413.80	1359.12	1292.79	1215.21	1130.33
135.0	1505.74	1502.04	1484.47	1455.25	1412.02	1356.16	1291.21	1215.61	1125.00
157.5	1505.74	1502.63	1485.45	1454.66	1410.64	1354.38	1288.64	1210.08	1121.64
180.0	1505.74	1499.27	1482.30	1449.92	1407.68	1351.02	1283.31	1206.52	1121.25
202.5	1505.74	1498.88	1481.51	1450.12	1406.10	1349.84	1286.87	1206.33	1117.89
225.0	1505.74	1497.50	1479.73	1448.34	1405.70	1350.04	1282.52	1203.56	1115.13
247.5	1505.74	1500.26	1482.49	1452.49	1409.06	1352.80	1287.26	1208.89	1120.46
270.0	1505.74	1500.85	1477.95	1442.22	1392.68	1329.31	1261.21	1178.49	1084.14
292.5	1505.74	1495.92	1473.02	1437.09	1390.31	1330.49	1258.64	1175.93	1085.71
315.0	1505.74	1497.50	1475.39	1440.05	1392.48	1332.27	1262.78	1180.07	1085.12
337.5	1505.74	1498.88	1476.97	1442.82	1395.04	1335.03	1263.38	1184.02	1091.64
360.0	1505.74	1496.71	1475.19	1440.64	1393.46	1335.03	1264.36	1182.24	1092.23
C/γ(°)	45.0	50.0	55.0	60.0	65.0	70.0	75.0	80.0	85.0
0.0	991.95	882.59	767.30	645.51	517.00	391.45	262.94	144.50	47.57
22.5	989.97	881.21	768.29	646.10	518.77	388.88	264.72	147.26	49.55
45.0	991.55	882.98	765.92	642.94	519.56	389.87	262.74	141.93	50.34
67.5	989.38	883.18	766.51	643.93	516.41	386.51	263.34	146.08	47.97
90.0	1042.48	935.89	821.98	700.38	577.60	446.72	317.62	199.38	91.60
112.5	1033.80	928.38	813.89	697.23	570.10	441.00	316.44	197.60	87.45
135.0	1027.48	921.67	811.32	690.91	564.57	439.22	310.12	188.52	86.07
157.5	1026.49	919.90	805.99	688.74	562.40	432.11	303.41	185.95	81.33
180.0	1024.52	917.53	803.23	684.59	557.86	427.18	306.37	180.82	77.38
202.5	1020.37	917.13	803.03	681.83	554.70	429.15	300.25	179.44	81.92
225.0	1020.57	915.16	801.06	684.00	558.25	429.35	300.84	184.37	79.55
247.5	1022.94	919.70	805.60	685.18	560.03	430.54	306.37	185.56	80.93
270.0	981.88	874.89	759.41	636.03	507.92	381.78	255.24	137.79	42.05
292.5	984.05	874.49	757.43	638.60	511.08	381.38	254.45	141.93	45.01
315.0	989.97	880.22	762.76	639.39	515.81	386.32	259.19	141.93	48.17
337.5	990.57	881.40	767.70	644.91	516.60	386.51	262.94	146.08	48.76
360.0	991.95	882.59	767.30	645.51	517.00	391.45	262.94	144.50	47.57
C/γ(°)	90.0	95.0	100.0	105.0	110.0	115.0	120.0	125.0	130.0
0.0	0.00	0.00	0.00	0.00	0.00	0.20	0.40	0.59	0.40
22.5	0.20	0.00	0.00	0.00	0.20	0.20	0.40	0.00	0.59
45.0	0.00	0.00	0.00	0.00	0.20	0.20	0.20	0.40	0.59
67.5	0.00	0.00	0.00	0.20	0.00	0.40	0.00	0.59	0.59
90.0	9.87	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.59
112.5	8.88	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20
135.0	8.09	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.40
157.5	6.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
180.0	5.53	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.40
202.5	4.93	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.40
225.0	4.54	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.40
247.5	5.53	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.40
270.0	0.59	0.20	0.40	0.59	0.59	0.59	0.99	0.79	1.18
292.5	0.39	0.00	0.00	0.20	0.40	0.59	0.59	0.59	0.59
315.0	0.20	0.00	0.00	0.20	0.20	0.20	0.40	0.40	0.59
337.5	0.20	0.00	0.00	0.00	0.00	0.20	0.40	0.40	0.59
360.0	0.00	0.00	0.00	0.00	0.00	0.20	0.40	0.59	0.40

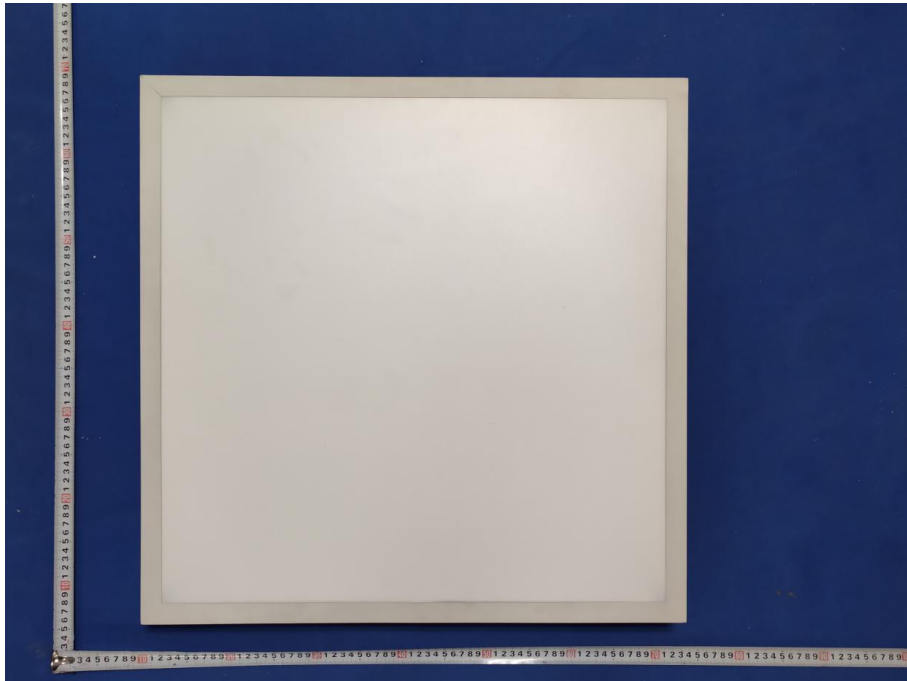


C/γ(°)	135.0	140.0	145.0	150.0	155.0	160.0	165.0	170.0	175.0
0.0	0.79	0.79	0.79	0.99	0.79	0.99	0.79	0.79	0.99
22.5	0.59	0.79	0.79	0.99	0.99	0.99	0.79	0.99	0.99
45.0	0.99	0.79	0.79	0.99	0.99	0.99	0.99	0.59	1.18
67.5	0.59	0.79	0.99	1.18	0.99	1.18	0.79	0.99	0.79
90.0	0.59	0.79	0.79	1.18	1.18	0.99	0.99	0.99	1.18
112.5	0.59	0.59	0.59	0.59	0.79	0.79	0.79	0.99	0.79
135.0	0.40	0.59	0.79	0.59	0.79	1.18	0.79	0.99	0.99
157.5	0.40	0.59	0.79	0.99	0.79	0.79	0.99	0.99	0.79
180.0	0.40	0.79	0.59	0.79	0.79	0.99	0.99	0.79	0.79
202.5	0.40	0.59	0.59	0.79	0.99	0.79	0.99	0.79	0.79
225.0	0.40	0.59	0.79	0.79	0.99	0.99	0.99	0.99	0.59
247.5	0.59	0.79	0.79	0.59	1.18	0.99	0.79	0.79	0.99
270.0	1.18	1.38	1.58	1.18	1.38	1.58	1.38	1.38	1.58
292.5	0.99	0.99	0.99	0.99	0.99	0.79	1.18	0.99	1.18
315.0	0.79	0.79	0.79	0.79	0.99	0.99	0.79	0.99	0.99
337.5	0.59	0.59	0.79	0.59	0.99	0.79	0.59	0.79	0.79
360.0	0.79	0.79	0.79	0.99	0.79	0.99	0.79	0.79	0.99

C/γ(°)	180.0
0.0	1.00
22.5	1.00
45.0	1.00
67.5	1.00
90.0	1.00
112.5	1.00
135.0	1.00
157.5	1.00
180.0	1.00
202.5	1.00
225.0	1.00
247.5	1.00
270.0	1.00
292.5	1.00
315.0	1.00
337.5	1.00
360.0	1.00



Photo Document



****End of test report****