Test Report of ANSI/IES LM-79-19

Approved Method for Optical and Electrical Measurements of Solid-State Lighting Products

Report Number.....	:	N01A25080248L00101
Client.....	:	Astera LED Technology GmbH.
Address.....	:	Schatzbogen 60 81829 Munich Germany
Test Model.....	:	AST-BLBSL-E27, AST-BLBSL-E26, AST-BLBSL-B22 (All models are identical except model no.)
Brand Name.....	:	N/A
Testing Laboratory...	:	Guangdong GTG Testing Technology Co., Ltd.
Address.....	:	1-2/F., Building A, and 1/F., Building B, No.11, & Room 102, Unit 1, and Room 101 Unit 2, Building 1, No.9, Zongbu 2nd Road, Songshan Lake High-Tech Industrial Development Zone, Dongguan, Guangdong, China
Testing location.....	:	As above
Date of receipt.....	:	August 12, 2025
Date of test	:	August 20, 2025 - August 21, 2025
Date of report.....	:	August 29, 2025

Tested by:	**Checked by:**	**Approved by:**
Allen Chen	Sujay Zhou	Sandy Chen
Allen Chen/ Test Engineer	Sujay Zhou/ Project Engineer	Sandy Chen/ Approver

Guangdong GTG Testing Technology Co., Ltd. CERTIFICATE

Note 1: 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 Guangdong GTG Testing Technology 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 Federal Government.
Note 2: This report does not imply product certification, approval, or endorsement by NVLAP, NIST,or any agency of the Federal Government.

1. Product Description for Equipment under Test (EUT)

Representative (Tested) Model:	AST-BLBSL-E27, AST-BLBSL-E26, AST-BLBSL-B22
Manufacturer:	Astera Manufacturing Limited
Address:	101，201，301，401，501,Bldg.3,CLT Science & Technology Park,No.7, GanLiliu Road, Jihua subdistrict, Longgang District, Shenzhen, Guangdong Province, P.R. China
Product Type:	SolaBulb
Rated Voltage/Frequency:	9-18VDC-2.1A, 100-240VAVc,50/60Hz
Rated Power:	19.85W
Rated Luminous Flux:	/
Nominal CCT:	2700K-6500K

2. Standards Used

- ANSI/IES LM-79-19: APPROVED METHOD:OPTICAL AND ELECTRICAL MEASUREMENTS OF SOLID-STATE LIGHTING PRODUCTS
- ANSI C78.377-2017: Specifications for the Chromaticity of Solid-State Lighting Products
- IES TM-30-18: IES Method for Evaluating Light Source Color Rendition (This Method is not in Nvlap accreditation scope)

3. Test Equipment List

Test Equipment	Serial No.	Model No.	Calibration Due Date
Full-field Speed Goniophotometer	01-L-182	GO-R5000	2026/03/11
Digital Power Meter	01-L-161	PF2010	2026/03/11
AC Testing Power Source	01-L-162	DPS1060	2026/03/11
Total Spectral Radiant Flux Standard Lamp	01-L-165	D908S	2026/03/24
Integrating Sphere System	01-L-183	2M	2026/03/11
High Accuracy Array Spectroradio Meter	01-L-169	HAAS-3000	2026/03/11
Digital Power Meter	01-L-166	PF310	2026/03/11
AC Testing Power Source	01-L-168	DPS1010	2026/03/11
Standard Lamp	01-L-190	D204	2026/03/24

Statement of Traceability: Guangdong GTG Testing Technology Co., Ltd. attested that all calibration has been performed using suitable standards traceable to national primary standards and International System of Unit(SI).

4. Test Method

Requirements of Ambient Condition
Product was tested with no seasoning. All stabilization and measurements were made in compliance with ANSI/IES LM-79-19. The product was operated at rated voltage or at voltage required by manufacturer. The ambient temperature of the sample was maintained at 25°C±1.2°C during measurement. And relative humidity between 10% and 65%.

Goniophotometer System
The sample was tested according to the ANSI/IES LM-79-19.

Photometric paramters were measured using a type C goniophotometer and software. The samples were operated at rated voltage and was stabilized before measurement. Luminous flux, Luminous efficacy, zonal flux were calculated from the software taken at 1° vertical intervals and 22.5°horizontal intervals.Photometric distance was more than five times of the Largest dimension of the test SSL product.

Integrating Sphere System
The sample was tested according to the ANSI/IES LM-79-19.

The sample measurements were made using a spectroradiometer connected by a fiber optic cable and detector through the detector port of the integrating sphere. Coating reflectance of the integrating sphere was 90% to 98%. Photometric measurement conditions was using 4π geometry. The self-absorption factor is applied in the final test result. The sample was operated at rated voltage and was stabilized before measurement. Chromaticity coordinates, correlated color temperature and color rendering index were calculated from the spectral radiant flux measurements taken at 1 nm intervals over the range of 380 to 780 nm. All the colors in this report is for reference only.

Fidelity Index (R_f) and Gamut Index (R_g) Calculation
The R_f, R_g was calculated according to IES TM-30-18 by using calculation tools. The calculation was based on the measured SPD from 380nm to 780nm with 1nm intervals.

5. Integrating Sphere Test Results

5.1 Test Data

Test Ambient Temperature (Integrating Sphere Internal Temperature)	25.0℃	Test Orientation	Downward
Operate Time(Min.)	60	Stabilization Time(Min.)	30

Optical and Electrical Measurement Result

Model	Voltage (V)	Frequency (Hz)	Current (A)	Power (W)	Power Factor
3200K, Goniometer:50 degree	230.06	50	0.113	14.42	0.5548
4000K, Goniometer:50 degree	230.06	50	0.1124	14.35	0.5551
5500K, Goniometer:50 degree	230.06	50	0.09927	12.47	0.546

Model	CCT (K)	Ra	R9	x	y	u'	v'	Duv
3200K, Goniometer:50 degree	3066	98.2	94	0.4331	0.404	0.2481	0.5208	5.23e-004
4000K, Goniometer:50 degree	3836	98.2	93	0.3884	0.3826	0.228	0.5053	4.74e-004
5500K, Goniometer:50 degree	5301	97.2	95	0.3373	0.3483	0.2074	0.4819	1.58e-003

5.2 Color Rendering Index

3200K, Goniometer:50 degree：

Ra
98.2

R1	R2	R3	R4	R5
99	99	99	98	98
R6	R7	R8	R9	R10
97	98	97	94	98
R11	R12	R13	R14	R15
95	88	99	99	98

4000K, Goniometer:50 degree：

Ra
98.2

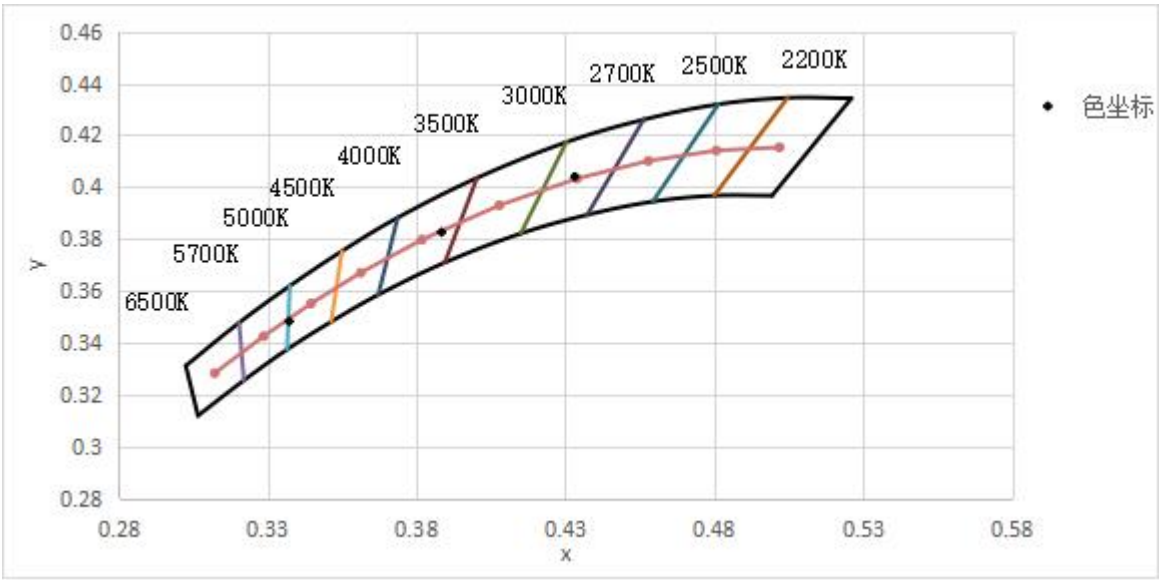
R1	R2	R3	R4	R5
99	100	98	99	98
R6	R7	R8	R9	R10
97	98	97	93	98
R11	R12	R13	R14	R15
98	80	100	99	97

5500K, Goniometer:50 degree：

Ra
97.2

R1	R2	R3	R4	R5
98	98	96	98	97
R6	R7	R8	R9	R10
95	99	98	95	94
R11	R12	R13	R14	R15
97	75	99	98	97

5.3 7-Step Chromaticity Quadrangles

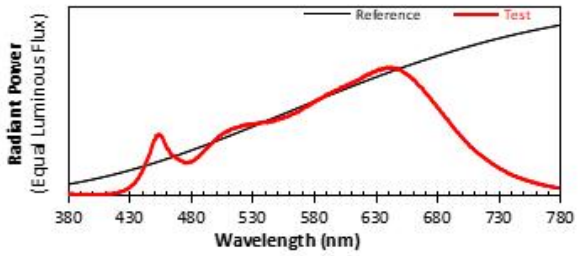


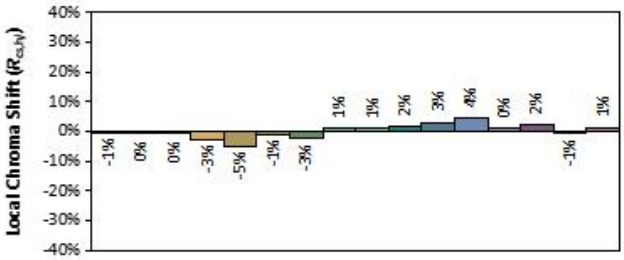
***5.4 ANSI/IES TM-30-18 Color Rendition Report**

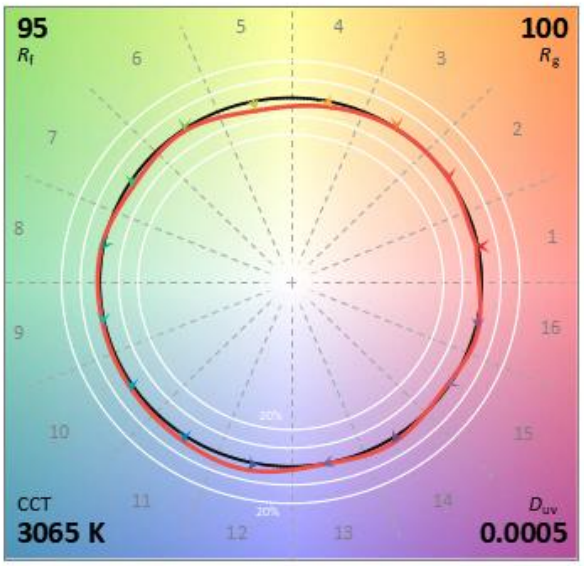
3200K, Goniometer:50 degree：

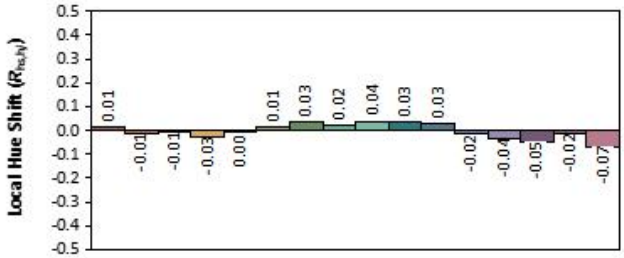
ANSI/IES TM-30-18 Color Rendition Report

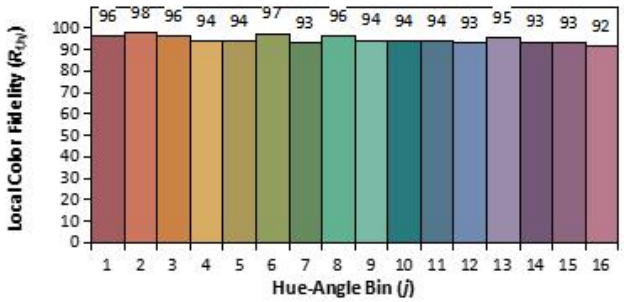
Source:		**Manufacturer:**	Astera Manufacturing Limited
Date:	2025/8/21	**Model:**	AST-BLBSL-E27

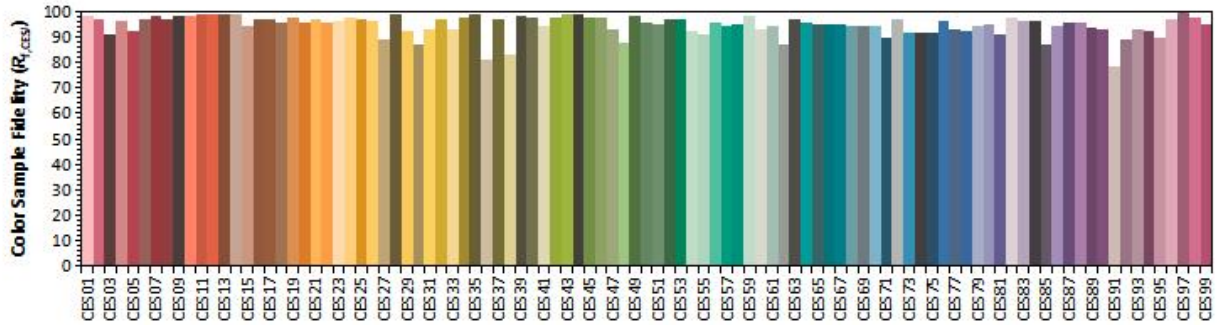












Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x	0.4331
y	0.4040
u'	0.2481
v'	0.5208

CIE 13.3-1995 (CRI)	
R_a	98
R_9	94

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

4000K, Goniometer:50 degree：

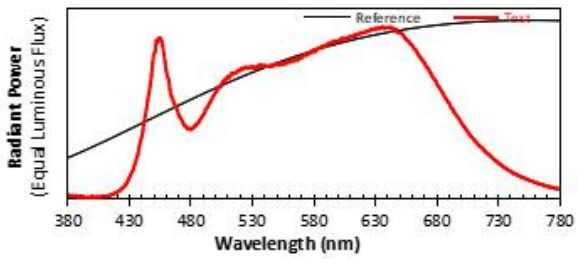
ANSI/IES TM-30-18 Color Rendition Report

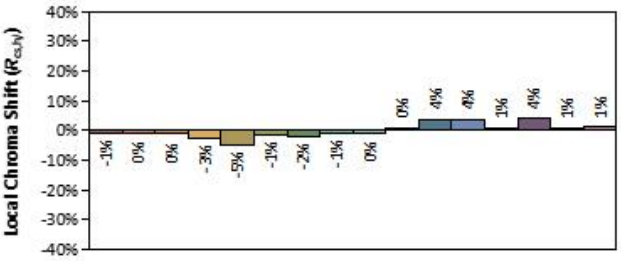
Source:

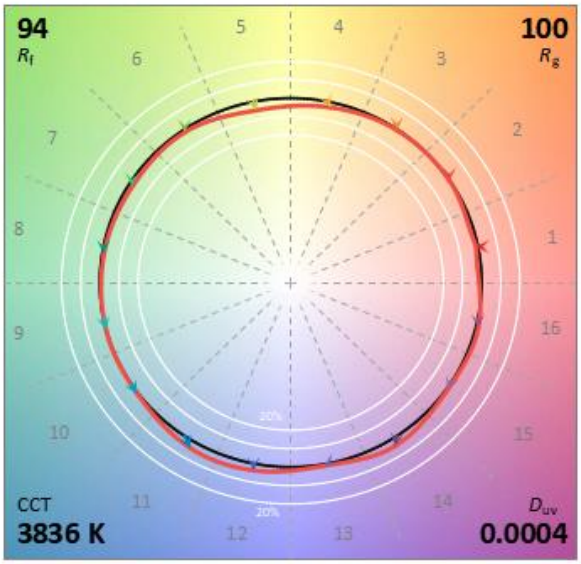
Manufacturer: Astera Manufacturing Limited

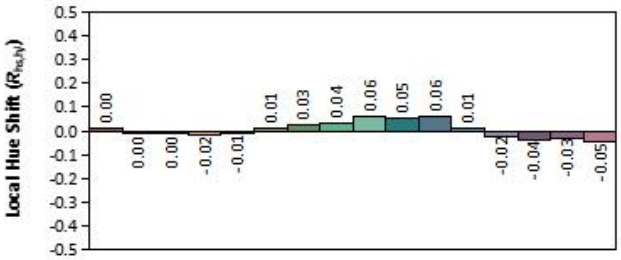
Date: 2025/8/21

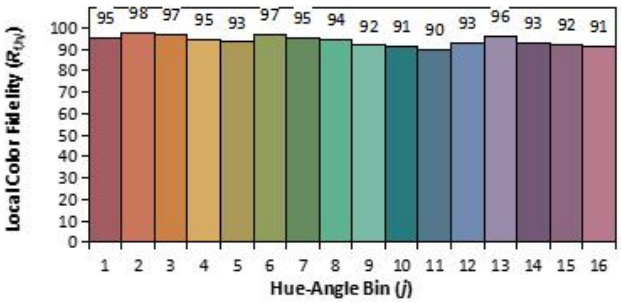
Model: AST-BLBSL-E27

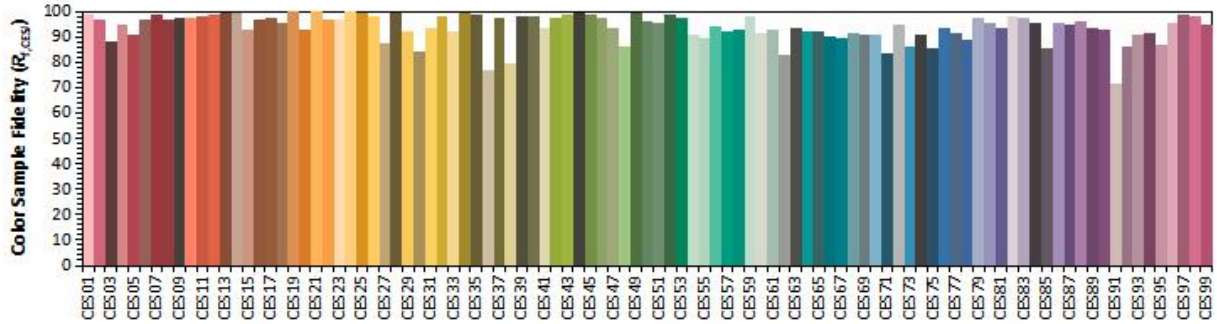












Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x	0.3883
y	0.3825
u'	0.2280
v'	0.5052

CIE 13.3-1995 (CRI)

R_a	98
R_9	93

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

5500K, Goniometer:50 degree：

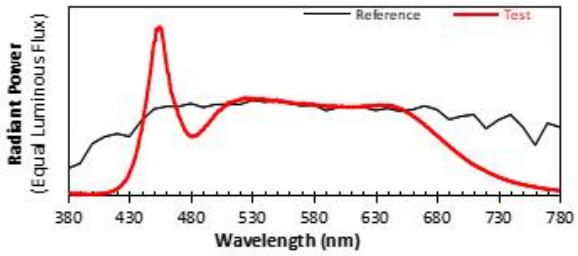
ANSI/IES TM-30-18 Color Rendition Report

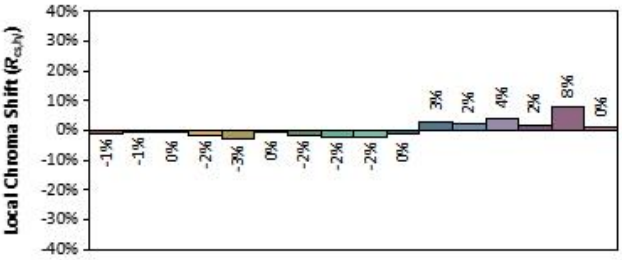
Source:

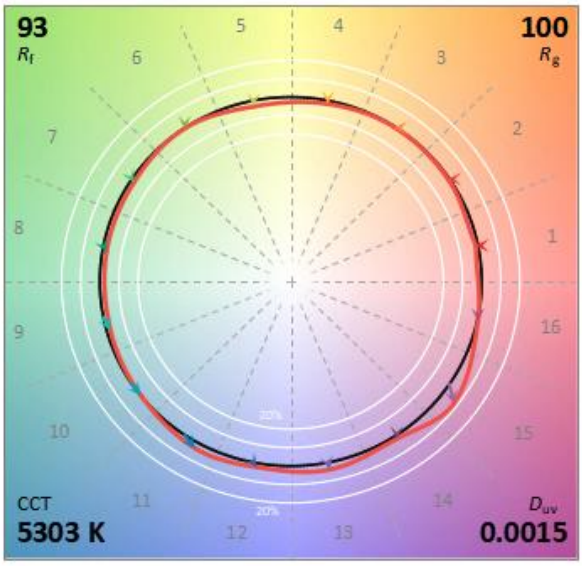
Manufacturer: Astera Manufacturing Limited

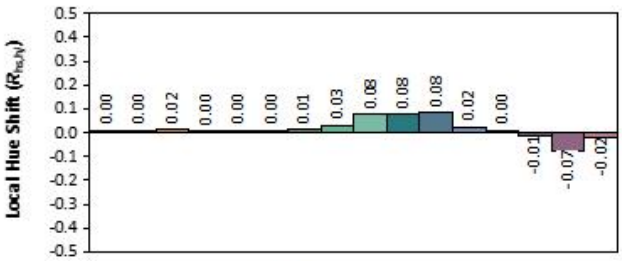
Date: 2025/8/21

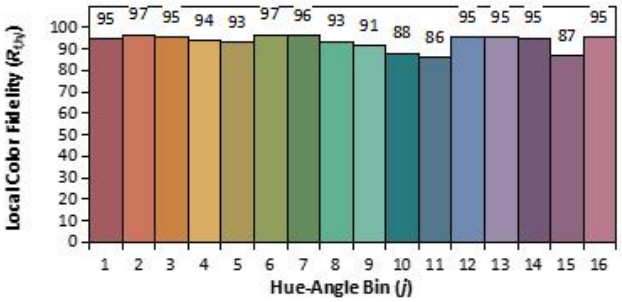
Model: AST-BLBSL-E27

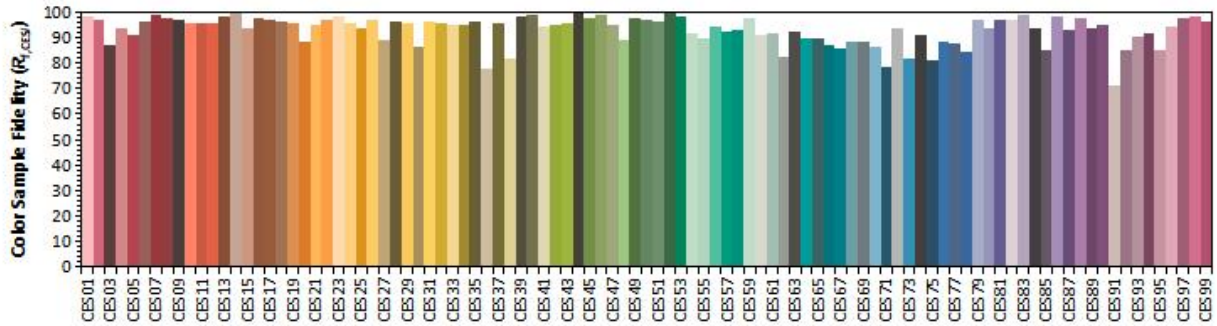












Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x	0.3372
y	0.3482
u'	0.2074
v'	0.4818

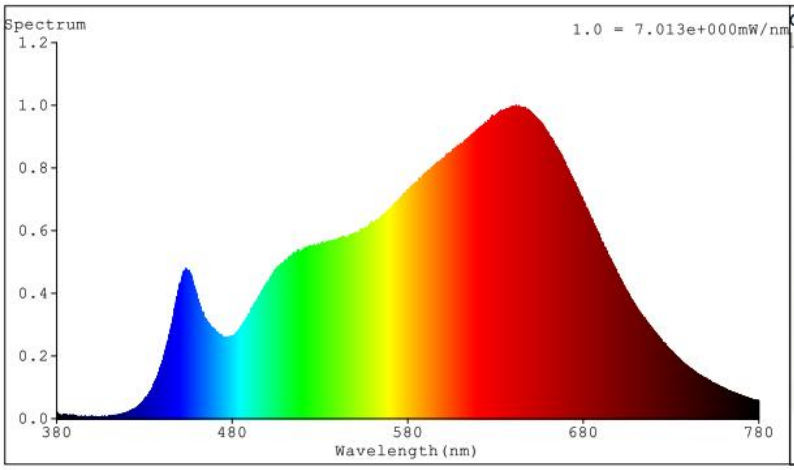
CIE 13.3-1995 (CRI)

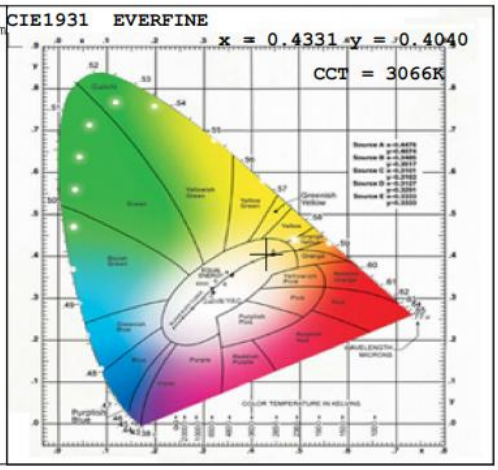
R_a	97
R_9	95

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

5.5 Relative Spectral Power Distribution

3200K, Goniometer:50 degree：

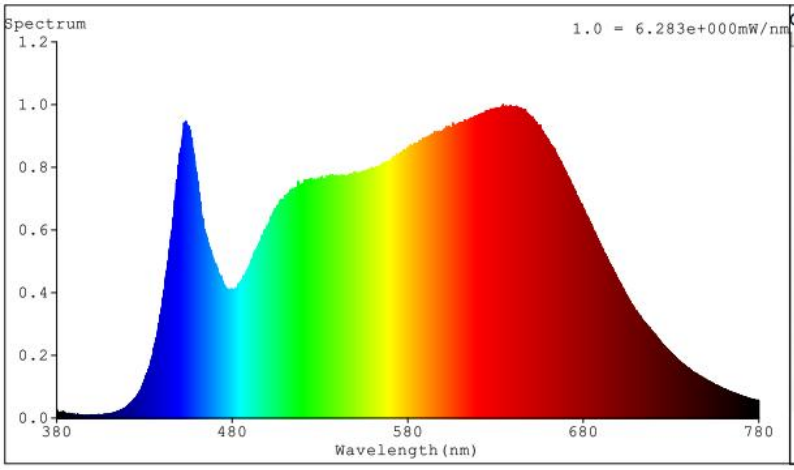


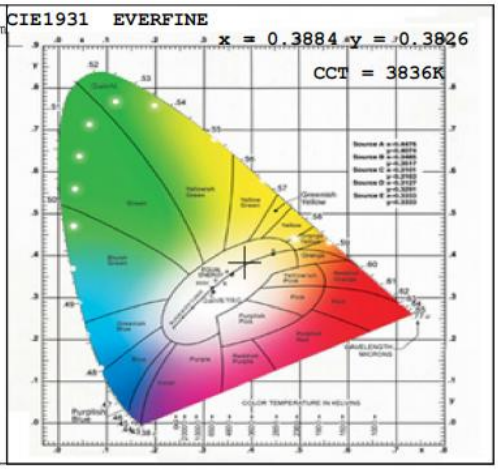


nm	mW	nm	mW	nm	mW	nm	mW	nm	mW
380	0.0156	414	0.0089	448	0.368	482	0.2692	516	0.5218
381	0.006	415	0.0089	449	0.3946	483	0.2753	517	0.5283
382	0.0116	416	0.0113	450	0.4258	484	0.2829	518	0.529
383	0.0057	417	0.0126	451	0.4332	485	0.295	519	0.5337
384	0.0122	418	0.0173	452	0.4666	486	0.2958	520	0.5334
385	0.0038	419	0.0174	453	0.4602	487	0.3094	521	0.5423
386	0.0069	420	0.0178	454	0.475	488	0.3179	522	0.5418
387	0.0056	421	0.0207	455	0.4699	489	0.326	523	0.5424
388	0.0045	422	0.0257	456	0.4625	490	0.3347	524	0.5505
389	0.0044	423	0.025	457	0.4488	491	0.3463	525	0.5499
390	0.0084	424	0.0297	458	0.4248	492	0.3591	526	0.55
391	0.0084	425	0.0334	459	0.4028	493	0.3643	527	0.5531
392	0.0057	426	0.0354	460	0.3812	494	0.3735	528	0.5467
393	0.0043	427	0.0431	461	0.3596	495	0.3854	529	0.5572
394	0.008	428	0.0463	462	0.357	496	0.3945	530	0.551
395	0.007	429	0.053	463	0.3347	497	0.4008	531	0.5575
396	0.0076	430	0.0598	464	0.3191	498	0.4142	532	0.5549
397	0.0041	431	0.0669	465	0.3128	499	0.4225	533	0.5597
398	0.0029	432	0.0753	466	0.3084	500	0.4336	534	0.5612
399	0.0066	433	0.0852	467	0.3012	501	0.4387	535	0.5607
400	0.0075	434	0.0908	468	0.2903	502	0.4525	536	0.5659
401	0.0048	435	0.1023	469	0.2876	503	0.4608	537	0.5645
402	0.0065	436	0.1185	470	0.2798	504	0.4641	538	0.5699
403	0.0037	437	0.1274	471	0.2734	505	0.4725	539	0.5674
404	0.0054	438	0.1443	472	0.272	506	0.4809	540	0.5736
405	0.0054	439	0.1621	473	0.2637	507	0.4851	541	0.5712
406	0.0069	440	0.1754	474	0.2608	508	0.4904	542	0.566
407	0.006	441	0.1982	475	0.2527	509	0.4948	543	0.5713
408	0.0043	442	0.217	476	0.2563	510	0.5049	544	0.5744
409	0.0059	443	0.2436	477	0.253	511	0.4995	545	0.5771
410	0.0073	444	0.2633	478	0.2566	512	0.5112	546	0.5764
411	0.008	445	0.285	479	0.2608	513	0.5147	547	0.5799
412	0.0076	446	0.309	480	0.2596	514	0.5189	548	0.5781
413	0.0105	447	0.3321	481	0.2623	515	0.5236	549	0.5877

nm	mW	nm	mW	nm	mW	nm	mW	nm	mW
550	0.5934	599	0.8207	648	0.9798	697	0.4904	746	0.1391
551	0.5917	600	0.8236	649	0.9848	698	0.4799	747	0.1375
552	0.5924	601	0.8309	650	0.9808	699	0.4661	748	0.1323
553	0.6015	602	0.8421	651	0.9724	700	0.4591	749	0.1299
554	0.6035	603	0.8446	652	0.9676	701	0.4465	750	0.126
555	0.6002	604	0.8458	653	0.9596	702	0.4363	751	0.1222
556	0.6074	605	0.8507	654	0.9526	703	0.4239	752	0.1194
557	0.6107	606	0.8523	655	0.9493	704	0.4146	753	0.1158
558	0.6131	607	0.8631	656	0.9376	705	0.4065	754	0.1138
559	0.6133	608	0.8603	657	0.9367	706	0.3945	755	0.111
560	0.6231	609	0.8672	658	0.9289	707	0.38	756	0.1076
561	0.6248	610	0.8756	659	0.9171	708	0.3763	757	0.105
562	0.6318	611	0.8753	660	0.9136	709	0.368	758	0.1015
563	0.6341	612	0.8801	661	0.8996	710	0.3581	759	0.1011
564	0.6373	613	0.887	662	0.8947	711	0.349	760	0.0959
565	0.6418	614	0.8867	663	0.8849	712	0.3392	761	0.0942
566	0.6485	615	0.8977	664	0.869	713	0.3327	762	0.0907
567	0.6466	616	0.8978	665	0.8598	714	0.3241	763	0.0879
568	0.6563	617	0.9041	666	0.8508	715	0.3188	764	0.0872
569	0.6635	618	0.9067	667	0.8436	716	0.3094	765	0.0839
570	0.6692	619	0.9181	668	0.8361	717	0.304	766	0.0803
571	0.6723	620	0.9169	669	0.8236	718	0.2968	767	0.0784
572	0.684	621	0.9299	670	0.8048	719	0.2904	768	0.0768
573	0.6866	622	0.9315	671	0.797	720	0.28	769	0.0751
574	0.6896	623	0.9347	672	0.7851	721	0.2742	770	0.0725
575	0.6933	624	0.9456	673	0.7785	722	0.2675	771	0.0711
576	0.7022	625	0.9374	674	0.7651	723	0.262	772	0.0705
577	0.711	626	0.9461	675	0.755	724	0.2532	773	0.0648
578	0.7104	627	0.9536	676	0.738	725	0.2459	774	0.066
579	0.722	628	0.9637	677	0.727	726	0.2406	775	0.0633
580	0.7302	629	0.9602	678	0.715	727	0.2342	776	0.0614
581	0.7257	630	0.9677	679	0.7072	728	0.2285	777	0.0597
582	0.7411	631	0.9689	680	0.6904	729	0.2219	778	0.0589
583	0.7457	632	0.9781	681	0.6819	730	0.2158	779	0.0578
584	0.7446	633	0.9845	682	0.6717	731	0.209	780	0.0579
585	0.7549	634	0.9732	683	0.655	732	0.2037		
586	0.7539	635	0.9798	684	0.6422	733	0.1997		
587	0.7636	636	0.9887	685	0.6368	734	0.1947		
588	0.7671	637	0.9843	686	0.6193	735	0.19		
589	0.7773	638	0.9901	687	0.6065	736	0.1844		
590	0.7856	639	0.9938	688	0.5944	737	0.1764		
591	0.7837	640	0.997	689	0.5899	738	0.1711		
592	0.7908	641	0.9919	690	0.572	739	0.1689		
593	0.7925	642	0.99	691	0.5615	740	0.1634		
594	0.7985	643	0.9972	692	0.5458	741	0.1582		
595	0.8064	644	0.9934	693	0.5364	742	0.1543		
596	0.8026	645	0.9912	694	0.5223	743	0.1498		
597	0.8146	646	0.9821	695	0.5129	744	0.1485		
598	0.8212	647	0.9923	696	0.4971	745	0.143		

4000K, Goniometer:50 degree：

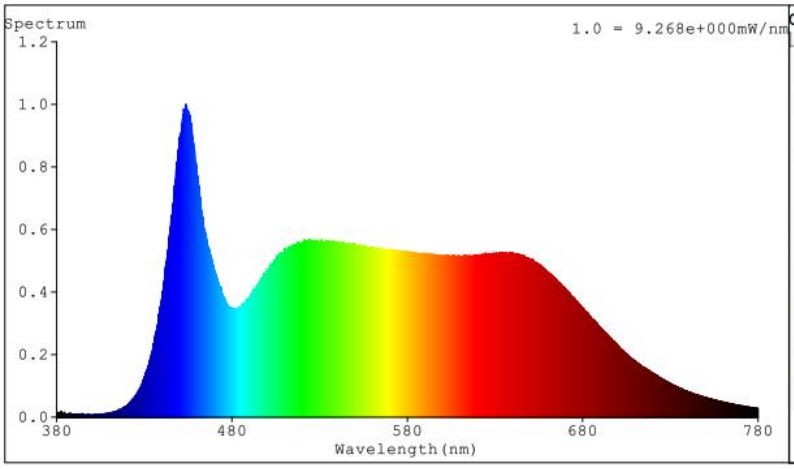


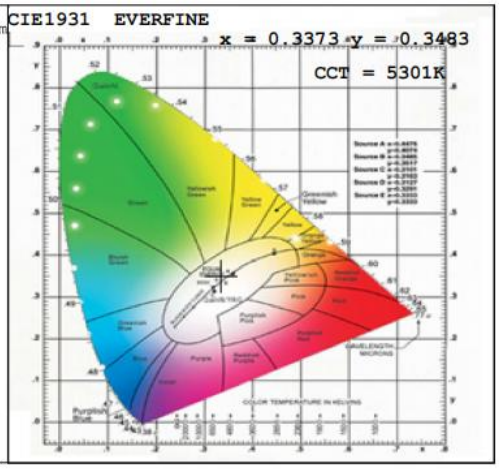


nm	mW	nm	mW	nm	mW	nm	mW	nm	mW
380	0.0258	414	0.017	448	0.7122	482	0.4104	516	0.7281
381	0.0185	415	0.0203	449	0.7874	483	0.4207	517	0.732
382	0.0123	416	0.023	450	0.8388	484	0.4226	518	0.7378
383	0.0129	417	0.0268	451	0.8517	485	0.4364	519	0.7453
384	0.0173	418	0.0289	452	0.9168	486	0.4372	520	0.7441
385	0.0148	419	0.0321	453	0.9076	487	0.4504	521	0.7539
386	0.0134	420	0.0364	454	0.9295	488	0.4634	522	0.7506
387	0.0161	421	0.0411	455	0.931	489	0.4739	523	0.7551
388	0.0078	422	0.0447	456	0.9193	490	0.4843	524	0.7606
389	0.0115	423	0.0512	457	0.8925	491	0.4953	525	0.7611
390	0.0062	424	0.0583	458	0.8433	492	0.5156	526	0.7569
391	0.009	425	0.0645	459	0.7957	493	0.5247	527	0.7589
392	0.0132	426	0.0692	460	0.7433	494	0.5358	528	0.7616
393	0.0078	427	0.082	461	0.7098	495	0.5521	529	0.764
394	0.0053	428	0.0892	462	0.6893	496	0.5623	530	0.7591
395	0.0037	429	0.1044	463	0.6349	497	0.5758	531	0.7645
396	0.0069	430	0.1207	464	0.5964	498	0.5911	532	0.7571
397	0.0068	431	0.1353	465	0.5836	499	0.6021	533	0.7585
398	0.0057	432	0.1524	466	0.5597	500	0.6143	534	0.7649
399	0.0097	433	0.1638	467	0.5458	501	0.6206	535	0.77
400	0.0082	434	0.1894	468	0.5274	502	0.6423	536	0.7766
401	0.0079	435	0.2074	469	0.5149	503	0.6513	537	0.77
402	0.0065	436	0.237	470	0.4881	504	0.6465	538	0.7712
403	0.0079	437	0.2567	471	0.4734	505	0.6623	539	0.7701
404	0.01	438	0.2989	472	0.4636	506	0.679	540	0.7724
405	0.0083	439	0.3281	473	0.4485	507	0.6795	541	0.7694
406	0.0086	440	0.3562	474	0.4347	508	0.6931	542	0.7663
407	0.0094	441	0.3942	475	0.4211	509	0.6942	543	0.769
408	0.0135	442	0.4408	476	0.4192	510	0.7082	544	0.7693
409	0.012	443	0.4826	477	0.4089	511	0.7013	545	0.7691
410	0.0141	444	0.5219	478	0.404	512	0.7115	546	0.7679
411	0.0123	445	0.5701	479	0.4076	513	0.7241	547	0.7754
412	0.0146	446	0.6152	480	0.4004	514	0.7296	548	0.7732
413	0.0153	447	0.6572	481	0.4066	515	0.7248	549	0.7823

nm	mW	nm	mW	nm	mW	nm	mW	nm	mW
550	0.7859	599	0.9123	648	0.9654	697	0.4732	746	0.1343
551	0.775	600	0.9133	649	0.9634	698	0.4628	747	0.1313
552	0.7756	601	0.9209	650	0.9639	699	0.45	748	0.128
553	0.7826	602	0.9268	651	0.9597	700	0.4395	749	0.1236
554	0.7838	603	0.9292	652	0.9522	701	0.4284	750	0.1229
555	0.7793	604	0.9285	653	0.9449	702	0.4171	751	0.1187
556	0.7879	605	0.9263	654	0.9319	703	0.4097	752	0.1159
557	0.7825	606	0.9262	655	0.9252	704	0.3986	753	0.1106
558	0.7899	607	0.9335	656	0.9191	705	0.3895	754	0.1107
559	0.79	608	0.9308	657	0.9142	706	0.3772	755	0.1058
560	0.7971	609	0.9392	658	0.9009	707	0.3665	756	0.1038
561	0.7934	610	0.9386	659	0.8957	708	0.3596	757	0.1013
562	0.7986	611	0.9411	660	0.8893	709	0.3508	758	0.0984
563	0.8021	612	0.942	661	0.8755	710	0.3436	759	0.0959
564	0.8006	613	0.9496	662	0.8679	711	0.3355	760	0.0924
565	0.8041	614	0.9436	663	0.861	712	0.3262	761	0.0918
566	0.8061	615	0.9515	664	0.8475	713	0.3191	762	0.0874
567	0.802	616	0.9537	665	0.8331	714	0.3099	763	0.0851
568	0.8172	617	0.9582	666	0.827	715	0.3053	764	0.0837
569	0.8173	618	0.9585	667	0.8119	716	0.2984	765	0.0813
570	0.8176	619	0.963	668	0.8091	717	0.2908	766	0.0785
571	0.8231	620	0.9606	669	0.7947	718	0.2842	767	0.0776
572	0.8321	621	0.9654	670	0.7868	719	0.2764	768	0.0744
573	0.8342	622	0.966	671	0.7706	720	0.2686	769	0.0726
574	0.8329	623	0.9698	672	0.7602	721	0.262	770	0.0701
575	0.8385	624	0.9743	673	0.7548	722	0.257	771	0.0685
576	0.8414	625	0.9707	674	0.7404	723	0.2501	772	0.0677
577	0.8489	626	0.9757	675	0.7287	724	0.2424	773	0.0644
578	0.8471	627	0.9827	676	0.7111	725	0.2378	774	0.0629
579	0.8546	628	0.9826	677	0.7029	726	0.2297	775	0.0607
580	0.8628	629	0.9808	678	0.6915	727	0.2245	776	0.0592
581	0.852	630	0.9867	679	0.6835	728	0.2182	777	0.0595
582	0.8676	631	0.9847	680	0.6662	729	0.2148	778	0.0568
583	0.8678	632	0.989	681	0.654	730	0.2044	779	0.0568
584	0.8733	633	0.991	682	0.6454	731	0.202	780	0.057
585	0.8758	634	0.9875	683	0.6335	732	0.197		
586	0.8757	635	0.9918	684	0.6213	733	0.1903		
587	0.885	636	0.9963	685	0.6112	734	0.1839		
588	0.8843	637	0.9879	686	0.5956	735	0.1815		
589	0.8853	638	0.9912	687	0.5831	736	0.1756		
590	0.8917	639	0.9917	688	0.5734	737	0.1705		
591	0.8898	640	0.9926	689	0.5624	738	0.1656		
592	0.8988	641	0.9899	690	0.5538	739	0.161		
593	0.9012	642	0.9956	691	0.5379	740	0.1578		
594	0.9009	643	0.9878	692	0.5225	741	0.1508		
595	0.9097	644	0.9883	693	0.5191	742	0.1488		
596	0.9035	645	0.9846	694	0.5023	743	0.1437		
597	0.9128	646	0.9719	695	0.4939	744	0.1407		
598	0.9152	647	0.9831	696	0.482	745	0.1381		

5500K, Goniometer:50 degree：





nm	mW	nm	mW	nm	mW	nm	mW	nm	mW
380	0.01	414	0.0177	448	0.7615	482	0.3447	516	0.5445
381	0.0136	415	0.0207	449	0.832	483	0.3449	517	0.5498
382	0.0141	416	0.0229	450	0.8837	484	0.347	518	0.5536
383	0.007	417	0.0243	451	0.8996	485	0.3524	519	0.5541
384	0.0087	418	0.0307	452	0.9659	486	0.3542	520	0.5559
385	0.0082	419	0.0338	453	0.9591	487	0.3621	521	0.5603
386	0.008	420	0.0369	454	0.975	488	0.3735	522	0.5592
387	0.0122	421	0.0427	455	0.9774	489	0.3739	523	0.5598
388	0.0068	422	0.0467	456	0.966	490	0.3819	524	0.5672
389	0.0081	423	0.0543	457	0.9238	491	0.3891	525	0.565
390	0.0066	424	0.061	458	0.8766	492	0.4041	526	0.5585
391	0.0079	425	0.0696	459	0.8185	493	0.4068	527	0.5654
392	0.008	426	0.0767	460	0.7719	494	0.4134	528	0.5571
393	0.0068	427	0.0868	461	0.7205	495	0.427	529	0.5648
394	0.0077	428	0.0954	462	0.7033	496	0.4345	530	0.559
395	0.0088	429	0.11	463	0.6444	497	0.4422	531	0.5634
396	0.0047	430	0.1286	464	0.6008	498	0.45	532	0.5577
397	0.0062	431	0.1431	465	0.5836	499	0.4606	533	0.5609
398	0.0053	432	0.1616	466	0.5527	500	0.4705	534	0.5614
399	0.006	433	0.1814	467	0.5376	501	0.477	535	0.5601
400	0.0056	434	0.2029	468	0.5083	502	0.4884	536	0.5608
401	0.0075	435	0.2218	469	0.4948	503	0.492	537	0.5571
402	0.0086	436	0.2576	470	0.4635	504	0.4953	538	0.5632
403	0.0064	437	0.279	471	0.4507	505	0.5	539	0.5598
404	0.0086	438	0.3211	472	0.4352	506	0.5106	540	0.5577
405	0.0081	439	0.3537	473	0.415	507	0.5141	541	0.5558
406	0.0089	440	0.3796	474	0.4018	508	0.5218	542	0.5526
407	0.0107	441	0.4262	475	0.3803	509	0.5258	543	0.5557
408	0.0105	442	0.4757	476	0.3745	510	0.5383	544	0.5544
409	0.0109	443	0.5151	477	0.3612	511	0.5286	545	0.5529
410	0.0109	444	0.5588	478	0.3526	512	0.5413	546	0.548
411	0.014	445	0.6087	479	0.3494	513	0.5413	547	0.5504
412	0.0153	446	0.66	480	0.3442	514	0.5442	548	0.5482
413	0.0158	447	0.7064	481	0.343	515	0.5457	549	0.5537

nm	mW	nm	mW	nm	mW	nm	mW	nm	mW
550	0.5558	599	0.5171	648	0.5062	697	0.2449	746	0.07
551	0.5471	600	0.5133	649	0.5074	698	0.2415	747	0.0672
552	0.5441	601	0.5143	650	0.5033	699	0.2332	748	0.0662
553	0.5499	602	0.5173	651	0.5031	700	0.2279	749	0.0644
554	0.5474	603	0.5184	652	0.5001	701	0.2233	750	0.0623
555	0.5428	604	0.5142	653	0.4941	702	0.2171	751	0.062
556	0.5468	605	0.5139	654	0.49	703	0.2126	752	0.0596
557	0.5401	606	0.5127	655	0.4866	704	0.2067	753	0.058
558	0.5401	607	0.5141	656	0.4819	705	0.2025	754	0.0569
559	0.5409	608	0.5115	657	0.4787	706	0.1976	755	0.0544
560	0.5426	609	0.5152	658	0.4766	707	0.1909	756	0.0533
561	0.5371	610	0.513	659	0.4692	708	0.1868	757	0.0526
562	0.5376	611	0.5115	660	0.4642	709	0.1823	758	0.0503
563	0.5359	612	0.5123	661	0.4574	710	0.1778	759	0.0502
564	0.535	613	0.517	662	0.4553	711	0.1748	760	0.0483
565	0.5348	614	0.5122	663	0.4495	712	0.1703	761	0.0472
566	0.5324	615	0.5133	664	0.4453	713	0.1669	762	0.0453
567	0.5323	616	0.5157	665	0.4395	714	0.1617	763	0.0445
568	0.5345	617	0.5141	666	0.4323	715	0.1585	764	0.0434
569	0.5342	618	0.5126	667	0.4275	716	0.1557	765	0.0418
570	0.5309	619	0.5176	668	0.4218	717	0.1512	766	0.0403
571	0.5328	620	0.5182	669	0.4167	718	0.1488	767	0.0401
572	0.5361	621	0.5183	670	0.4117	719	0.1449	768	0.0391
573	0.5294	622	0.518	671	0.4029	720	0.1406	769	0.037
574	0.5308	623	0.5182	672	0.3959	721	0.1359	770	0.0359
575	0.5314	624	0.5209	673	0.3937	722	0.1325	771	0.0352
576	0.5291	625	0.5163	674	0.3858	723	0.13	772	0.0339
577	0.531	626	0.5196	675	0.38	724	0.1261	773	0.0336
578	0.5269	627	0.5212	676	0.3731	725	0.1232	774	0.0321
579	0.5285	628	0.5216	677	0.3654	726	0.1201	775	0.0326
580	0.5291	629	0.5205	678	0.3593	727	0.1163	776	0.0306
581	0.5217	630	0.5228	679	0.3535	728	0.1137	777	0.0301
582	0.526	631	0.5211	680	0.3492	729	0.1099	778	0.0289
583	0.5242	632	0.5246	681	0.3425	730	0.1078	779	0.0285
584	0.5237	633	0.5263	682	0.3371	731	0.1037	780	0.0285
585	0.5243	634	0.5223	683	0.3315	732	0.1015		
586	0.5218	635	0.5237	684	0.322	733	0.0981		
587	0.5222	636	0.5248	685	0.3169	734	0.0957		
588	0.5197	637	0.5216	686	0.3108	735	0.0936		
589	0.521	638	0.5226	687	0.304	736	0.0918		
590	0.5203	639	0.5228	688	0.3	737	0.0884		
591	0.5175	640	0.5254	689	0.2936	738	0.086		
592	0.5167	641	0.5187	690	0.2867	739	0.084		
593	0.5178	642	0.521	691	0.2807	740	0.081		
594	0.5183	643	0.5187	692	0.2733	741	0.0794		
595	0.5218	644	0.5198	693	0.2683	742	0.0774		
596	0.5139	645	0.5189	694	0.2637	743	0.0753		
597	0.5175	646	0.5138	695	0.2566	744	0.0728		
598	0.5176	647	0.513	696	0.249	745	0.0719		

6. Goniophotometer Test Results

6.1 Test Data

Test Ambient Temperature	25.2℃	Test Orientation	Downward
Operate Time(Min.)	90	Stabilization Time(Min.)	30

Electrical Measurement

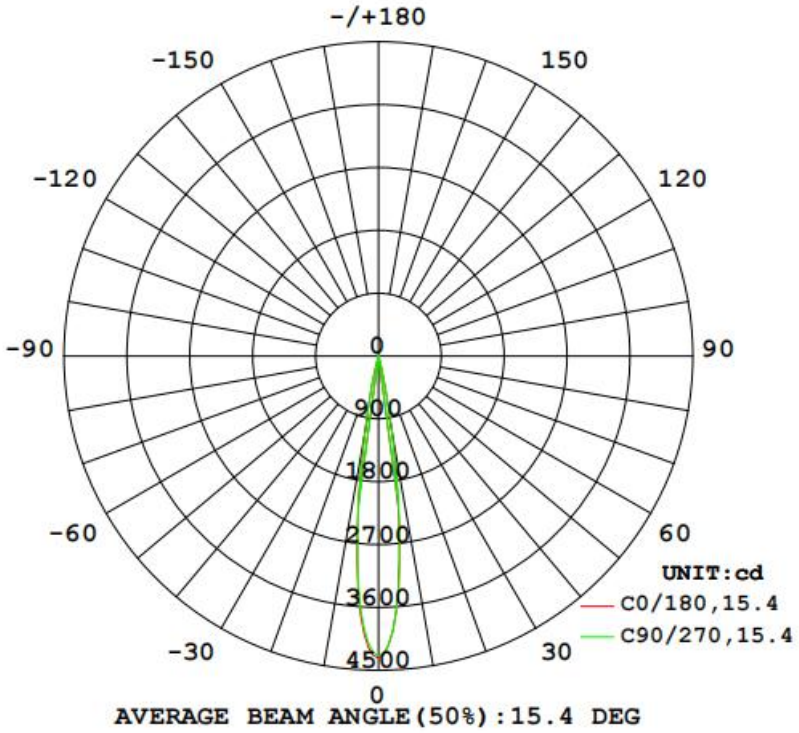
Model	Input Voltage (V)	Frequency (Hz)	Input Current(A)	Power Factor	Power(W)
3200K, Goniometer:15 degree	230.01	50	0.1131	0.5560	14.475
3200K, Goniometer:30 degree	230.02	50	0.1130	0.5555	14.447
3200K, Goniometer:50 degree	230.01	50	0.1130	0.5548	14.424
4000K, Goniometer:15 degree	230.02	50	0.1122	0.5560	14.352
4000K, Goniometer:30 degree	230.02	50	0.1123	0.5548	14.343
4000K, Goniometer:50 degree	230.02	50	0.1123	0.5550	14.348
5500K, Goniometer:15 degree	230.03	50	0.1005	0.5405	12.496
5500K, Goniometer:30 degree	230.03	50	0.1001	0.5428	12.496
5500K, Goniometer:50 degree	230.13	50	0.0993	0.5460	12.481

Optical Measurement

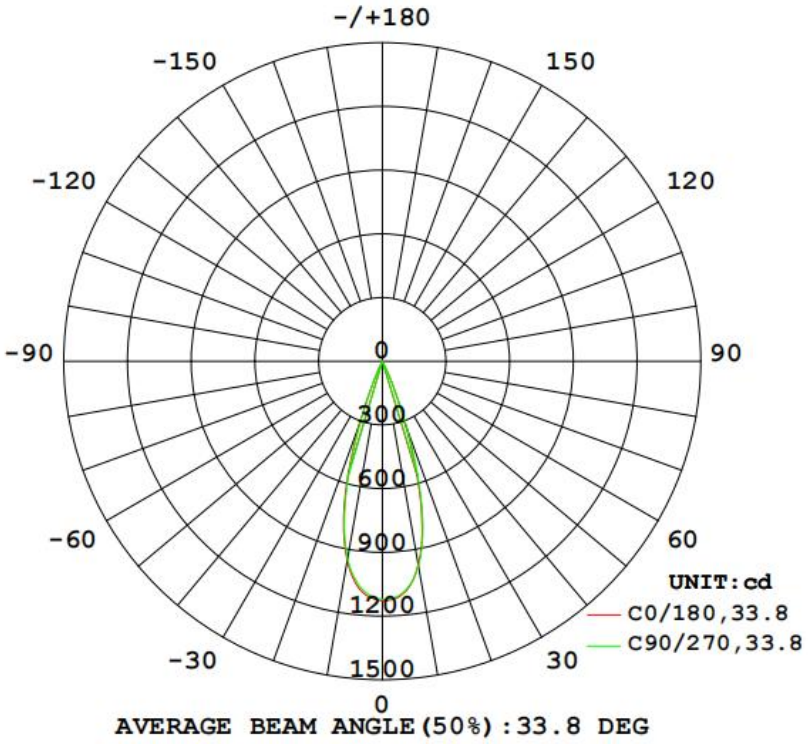
Model	Luminous Flux (lm)	Efficacy(lm/W)	Imax (cd)	η up(%)	η down(%)
3200K, Goniometer:15 degree	316.299	21.85	4323	0.1	99.9
3200K, Goniometer:30 degree	331.653	22.96	1129	0.1	99.9
3200K, Goniometer:50 degree	332.85	23.08	432.3	0	100
4000K, Goniometer:15 degree	336.193	23.42	4614	0.1	99.9
4000K, Goniometer:30 degree	360.827	25.16	1311	0.1	99.9
4000K, Goniometer:50 degree	366.496	25.54	473.4	0	100
5500K, Goniometer:15 degree	312.352	25.00	4272	0.1	99.9
5500K, Goniometer:30 degree	336.479	26.93	1273	0.1	99.9
5500K, Goniometer:50 degree	356.39	28.55	465.8	0	100

6.2 Luminous Intensity Distribution

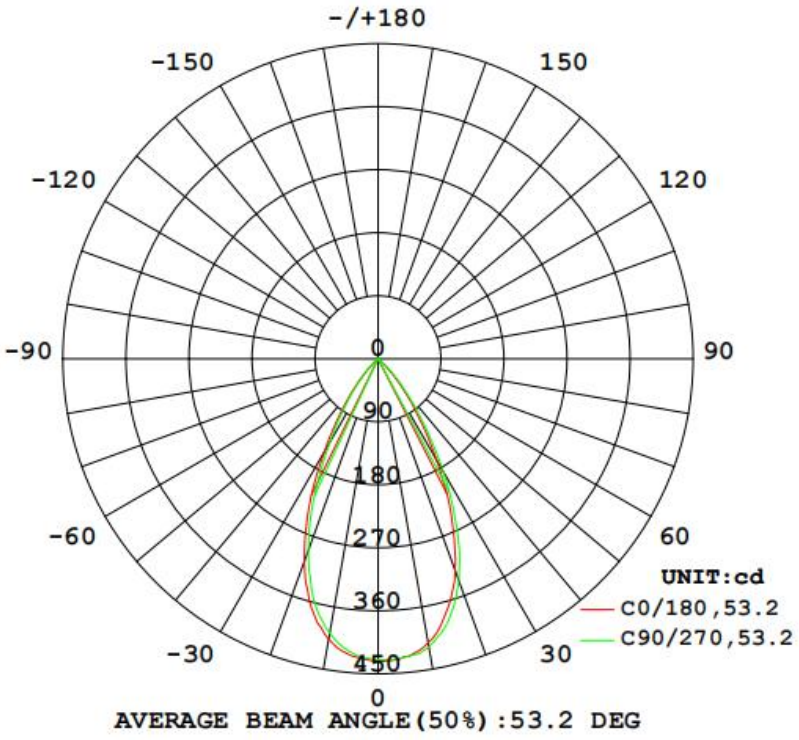
3200K, Goniometer:15 degree



3200K, Goniometer:30 degree



3200K, Goniometer:50 degree



6.3 Zonal Flux Diagram

3200K, Goniometer:15 degree

γ	C0	C45	C90	C135	C180	C225	C270	C315	γ	Φ zone	Φ total	%lum,lamp
10	1174	1031	1182	790.7	1199	1072	1136	1438	0- 10	238.4	238.4	75.4,75.4
20	19.68	18.35	17.90	17.95	26.21	20.94	18.16	21.09	10- 20	61.70	300.1	94.9,94.9
30	8.532	9.540	9.215	8.338	8.993	9.066	9.028	9.612	20- 30	6.101	306.2	96.8,96.8
40	4.114	4.462	4.199	3.898	4.214	4.242	4.220	4.379	30- 40	3.861	310.1	98,98
50	2.695	2.722	2.602	2.525	2.689	2.718	2.645	2.705	40- 50	2.551	312.7	98.8,98.8
60	1.709	1.634	1.598	1.545	1.656	1.695	1.693	1.749	50- 60	1.915	314.6	99.5,99.5
70	0.6600	0.6009	0.5949	0.5320	0.6542	0.6481	0.6218	0.7158	60- 70	1.134	315.7	99.8,99.8
80	0	0	0	0	0	0	0	0	70- 80	0.2449	316.0	99.9,99.9
90	0	0	0	0	0	0	0	0	80- 90	0	316.0	99.9,99.9
100	0	0	0	0	0	0	0	0	90-100	0	316.0	99.9,99.9
110	0	0	0	0	0	0	0	0	100-110	0	316.0	99.9,99.9
120	0	0	0	0	0	0	0	0	110-120	0	316.0	99.9,99.9
130	0	0	0	0	0	0	0	0	120-130	0	316.0	99.9,99.9
140	0	0	0	0	0	0	0	0	130-140	0	316.0	99.9,99.9
150	0.1495	0.1507	0.1493	0.1548	0.3995	0.3905	0.3959	0.3419	140-150	0.0568	316.0	99.9,99.9
160	0.0443	0.0436	0.0488	0.0239	0.7664	0.7645	0.7611	0.7533	150-160	0.1715	316.2	100,100
170	0	0	0	0	0.5353	0.5350	0.5308	0.5664	160-170	0.1007	316.3	100,100
180	0	0	0	0	0	0	0	0.0004	170-180	0.0178	316.3	100,100
DEG	LUMINOUS INTENSITY:cd									UNIT:lm		

3200K, Goniometer:30 degree

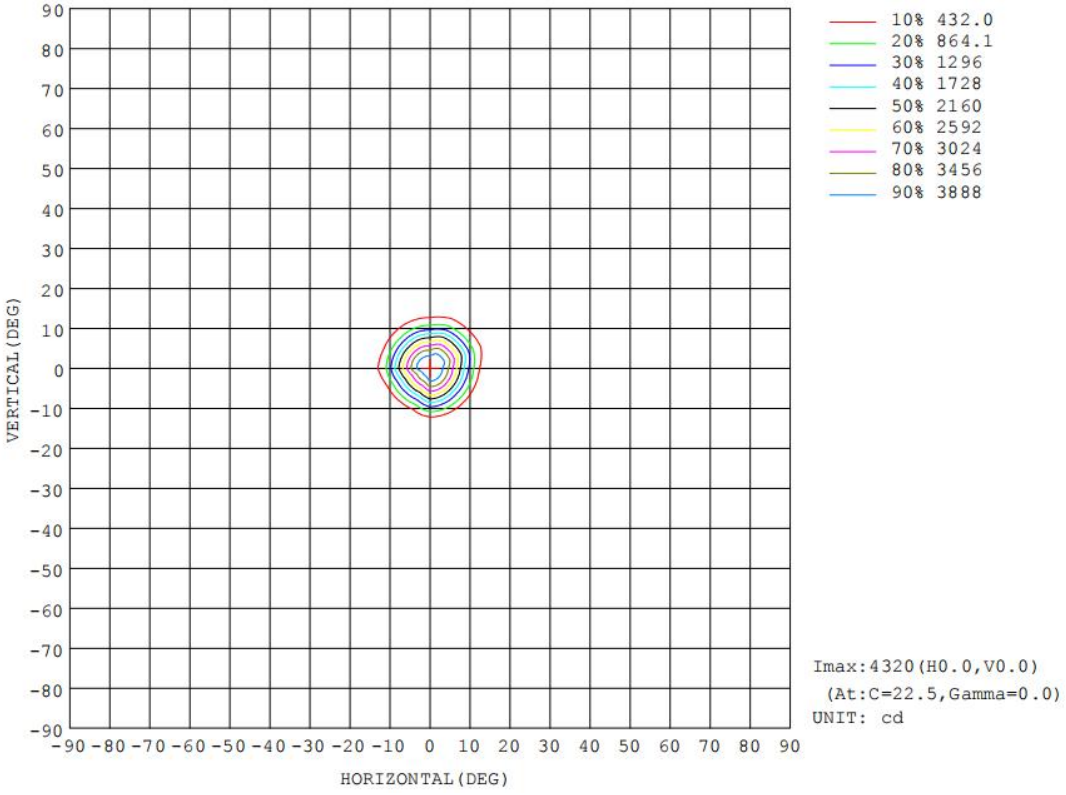
γ	C0	C45	C90	C135	C180	C225	C270	C315	γ	Φ zone	Φ total	%lum,lamp
10	974.4	979.0	979.6	965.7	955.0	934.5	944.5	961.5	0- 10	100.0	100.0	30.2,30.2
20	326.7	344.8	349.6	331.7	320.0	309.8	308.9	314.5	10- 20	182.5	282.5	85.2,85.2
30	6.200	8.760	9.511	8.290	7.054	8.237	7.082	5.322	20- 30	42.95	325.5	98.1,98.1
40	2.182	2.391	2.317	2.062	2.250	2.390	2.205	2.056	30- 40	2.102	327.6	98.8,98.8
50	1.592	1.680	1.689	1.548	1.608	1.617	1.560	1.549	40- 50	1.455	329.0	99.2,99.2
60	1.134	1.187	1.192	1.150	1.123	1.100	1.076	1.102	50- 60	1.224	330.3	99.6,99.6
70	0.6387	0.7072	0.7117	0.6106	0.5920	0.5724	0.5310	0.5572	60- 70	0.8525	331.1	99.8,99.8
80	0	0	0	0	0	0	0	0	70- 80	0.2400	331.4	99.9,99.9
90	0	0	0	0	0	0	0	0	80- 90	0	331.4	99.9,99.9
100	0	0	0	0	0	0	0	0	90-100	0	331.4	99.9,99.9
110	0	0	0	0	0	0	0	0	100-110	0	331.4	99.9,99.9
120	0	0	0	0	0	0	0	0	110-120	0	331.4	99.9,99.9
130	0	0	0	0	0	0	0	0	120-130	0	331.4	99.9,99.9
140	0	0	0	0	0.0006	0.0052	0.0048	0.0013	130-140	0.0000	331.4	99.9,99.9
150	0.0415	0.0363	0.0338	0.0332	0.3113	0.3138	0.3110	0.3051	140-150	0.0485	331.4	99.9,99.9
160	0.1269	0.1216	0.1172	0.1137	0.5794	0.5776	0.5725	0.5696	150-160	0.1241	331.5	100,100
170	0.0958	0.0908	0.0839	0.0814	0.5042	0.4991	0.4913	0.4903	160-170	0.0948	331.6	100,100
180	0.2341	0.2245	0.2187	0.2197	0.2317	0.2278	0.2202	0.2158	170-180	0.0242	331.7	100,100
DEG	LUMINOUS INTENSITY:cd									UNIT:lm		

3200K, Goniometer:50 degree

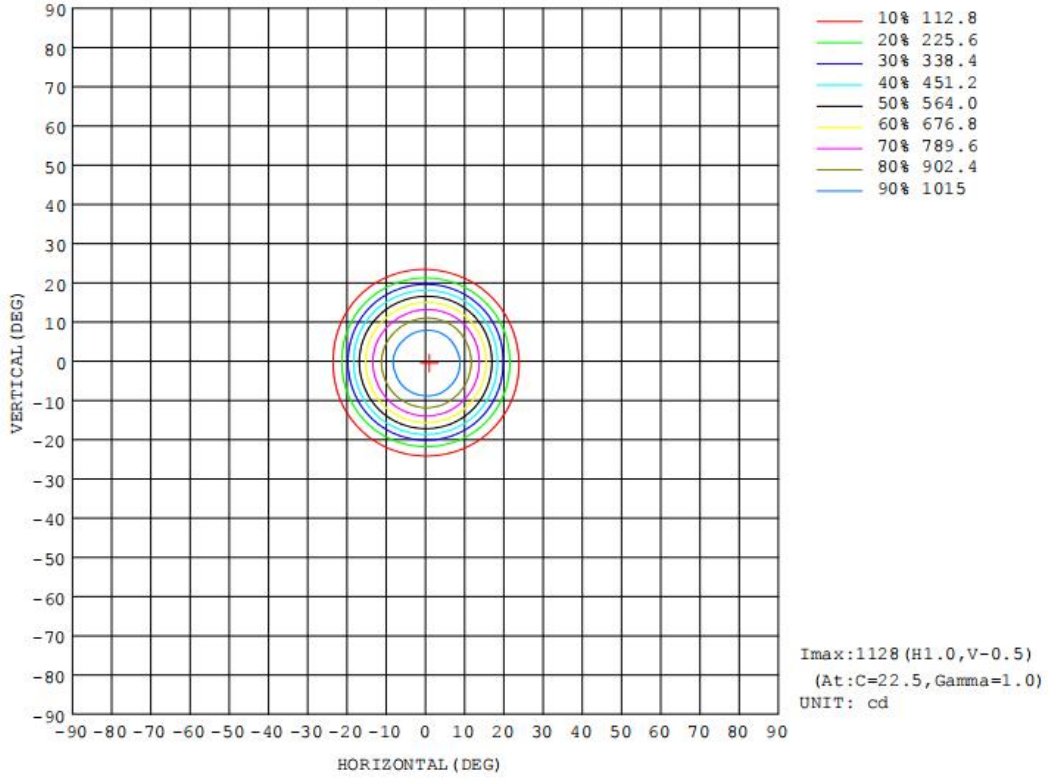
γ	C0	C45	C90	C135	C180	C225	C270	C315	γ	Φ zone	Φ total	%lum,lamp
10	411.8	413.5	417.2	412.8	406.7	403.9	398.2	400.6	0- 10	40.08	40.08	12,12
20	322.1	324.2	338.0	326.7	307.7	303.6	291.5	299.7	10- 20	102.8	142.9	42.9,42.9
30	168.1	171.7	186.7	177.2	153.6	152.2	138.7	146.3	20- 30	108.7	251.6	75.6,75.6
40	53.79	57.46	64.27	58.34	46.67	44.21	39.95	41.10	30- 40	61.51	313.1	94.1,94.1
50	5.136	5.392	8.237	6.583	4.206	3.737	3.729	3.697	40- 50	16.86	330.0	99.1,99.1
60	0.9409	0.9699	1.304	1.059	0.8871	0.8709	0.9448	0.8699	50- 60	1.908	331.9	99.7,99.7
70	0.4475	0.5754	0.7768	0.6501	0.5078	0.4930	0.3503	0.3717	60- 70	0.6961	332.6	99.9,99.9
80	0	0	0	0	0	0	0	0	70- 80	0.1416	332.7	100,100
90	0	0	0	0	0	0	0	0	80- 90	0	332.7	100,100
100	0	0	0	0	0	0	0	0	90-100	0	332.7	100,100
110	0	0	0	0	0	0	0	0	100-110	0	332.7	100,100
120	0	0	0	0	0	0	0	0	110-120	0	332.7	100,100
130	0	0	0	0	0	0	0	0	120-130	0	332.7	100,100
140	0	0	0	0	0.0001	0	0.0026	0	130-140	0.0000	332.7	100,100
150	0	0	0	0	0.1388	0.1402	0.1507	0.1453	140-150	0.0218	332.7	100,100
160	0.0610	0.0580	0.0513	0.0539	0.2557	0.2567	0.2583	0.2556	150-160	0.0516	332.8	100,100
170	0.1091	0.1061	0.1013	0.1021	0.2649	0.2632	0.2591	0.2574	160-170	0.0479	332.8	100,100
180	0.2176	0.2151	0.2026	0.2061	0.2185	0.2140	0.2021	0.2021	170-180	0.0183	332.8	100,100
DEG	LUMINOUS INTENSITY:cd									UNIT:lm		

6.4 Isocandela Diagram

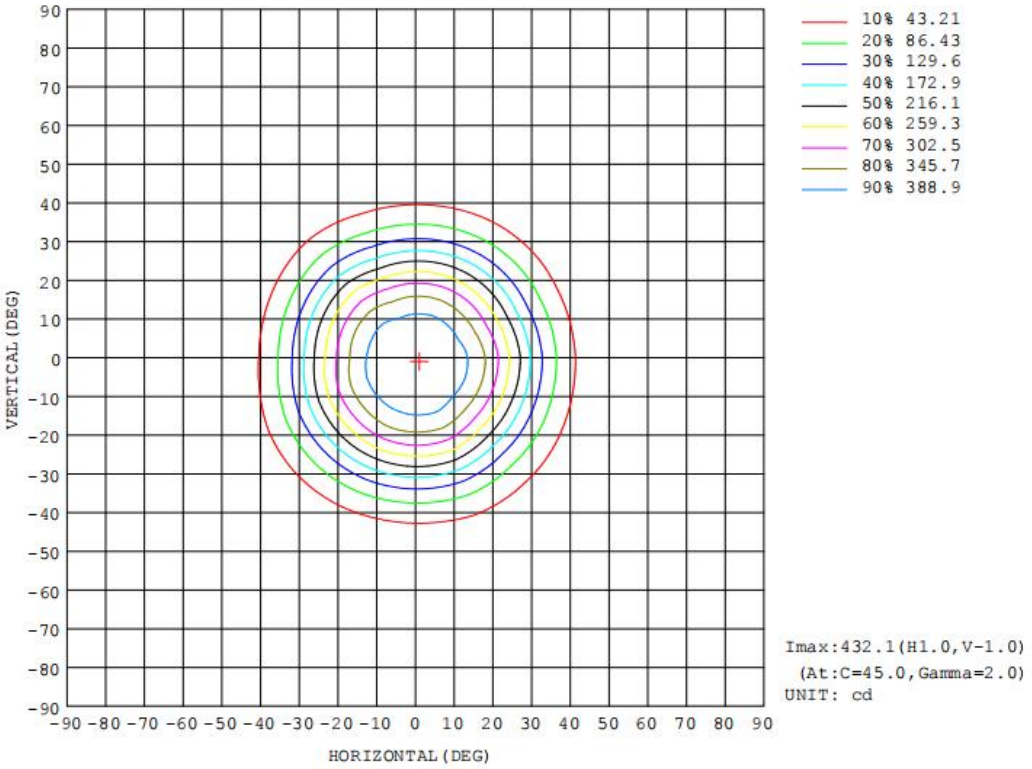
3200K, Goniometer:15 degree



3200K, Goniometer:30 degree



3200K, Goniometer:50 degree



6.5 Luminous Distribution Intensity Data

3200K, Goniometer:15 degree

Table--1 UNIT: cd

γ (DEG) \ C (DEG)	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5
0	4320	4323	4311	4305	4291	4252	4249	4239	4320	4323	4311	4305	4291	4252	4249	4239
5	3302	3263	3260	3303	3325	2892	2886	2923	3369	3350	3326	3333	3301	3607	3600	3601
10	1174	1062	1031	1104	1182	778	791	877	1199	1115	1072	1128	1136	1442	1438	1506
15	127	106	101	113	121	75.3	80.8	95.3	138	119	103	99.8	98.2	158	157	184
20	19.7	18.9	18.4	17.7	17.9	16.8	18.0	19.6	26.2	22.6	20.9	19.1	18.2	20.3	21.1	22.3
25	13.1	12.7	13.5	12.9	12.9	12.3	12.3	12.8	13.8	13.3	13.5	12.9	12.8	13.7	13.9	15.0
30	8.53	8.32	9.54	9.08	9.22	8.47	8.34	8.62	8.99	8.59	9.07	8.88	9.03	9.70	9.61	10.4
35	5.71	5.65	6.39	6.04	6.13	5.69	5.47	5.66	6.05	5.79	6.10	6.04	6.16	6.63	6.45	6.97
40	4.11	4.08	4.46	4.18	4.20	3.99	3.90	4.01	4.21	4.13	4.24	4.19	4.22	4.47	4.38	4.72
45	3.26	3.21	3.37	3.17	3.16	3.09	3.08	3.13	3.27	3.23	3.29	3.25	3.24	3.38	3.35	3.56
50	2.69	2.63	2.72	2.62	2.60	2.53	2.53	2.56	2.69	2.68	2.72	2.71	2.64	2.75	2.70	2.84
55	2.16	2.10	2.16	2.08	2.05	2.02	2.03	2.05	2.16	2.17	2.21	2.20	2.16	2.21	2.20	2.27
60	1.71	1.64	1.63	1.58	1.60	1.55	1.54	1.56	1.66	1.67	1.69	1.71	1.69	1.74	1.75	1.80
65	1.19	1.14	1.12	1.09	1.12	1.03	1.03	1.06	1.19	1.20	1.20	1.18	1.18	1.27	1.24	1.30
70	0.66	0.64	0.60	0.59	0.59	0.53	0.53	0.53	0.65	0.66	0.65	0.63	0.62	0.72	0.72	0.73
75	0.25	0.23	0.20	0.17	0.19	0.15	0.18	0.15	0.26	0.25	0.25	0.30	0.24	0.28	0.28	0.28
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
105	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
115	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
135	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
140	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
145	0.06	0.06	0.06	0.06	0.05	0.08	0.08	0.07	0.12	0.12	0.12	0.12	0.12	0.07	0.08	0.08
150	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.40	0.39	0.39	0.39	0.40	0.34	0.34	0.34
155	0.17	0.17	0.17	0.17	0.17	0.15	0.15	0.15	0.66	0.66	0.65	0.65	0.65	0.61	0.61	0.61
160	0.04	0.04	0.04	0.05	0.05	0.02	0.02	0.02	0.77	0.76	0.76	0.76	0.76	0.75	0.75	0.75
165	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.71	0.71	0.71	0.71	0.73	0.73	0.72
170	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.54	0.53	0.53	0.53	0.57	0.57	0.56
175	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.27	0.27	0.27	0.26	0.33	0.32	0.32
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3200K, Goniometer:30 degree

Table--1 UNIT: cd

γ (DEG) \ C (DEG)	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5
0	1128	1127	1125	1123	1120	1122	1121	1118	1128	1127	1125	1123	1120	1122	1121	1118
5	1100	1104	1103	1100	1095	1091	1090	1083	1090	1085	1080	1078	1078	1082	1085	1087
10	974	978	979	983	980	972	966	956	955	944	934	937	945	952	961	965
15	709	714	721	729	727	717	708	696	693	684	669	667	672	687	700	704
20	327	335	345	350	350	342	332	323	320	315	310	307	309	312	314	326
25	74.0	78.1	81.3	83.4	83.1	79.3	75.1	71.9	63.2	63.6	63.6	63.0	58.3	51.3	51.2	58.3
30	6.20	8.25	8.76	9.24	9.51	9.05	8.29	8.11	7.05	7.66	8.24	8.27	7.08	5.93	5.32	5.54
35	2.86	3.03	3.17	3.07	2.95	2.76	2.65	2.80	3.08	3.35	3.44	3.35	3.05	2.77	2.61	2.68
40	2.18	2.30	2.39	2.35	2.32	2.14	2.06	2.13	2.25	2.37	2.39	2.32	2.21	2.09	2.06	2.11
45	1.84	1.92	1.98	1.98	2.00	1.85	1.76	1.81	1.88	1.95	1.94	1.90	1.84	1.78	1.78	1.80
50	1.59	1.65	1.68	1.65	1.69	1.62	1.55	1.57	1.61	1.63	1.62	1.57	1.56	1.55	1.55	1.57
55	1.37	1.39	1.42	1.39	1.44	1.40	1.36	1.37	1.37	1.38	1.35	1.33	1.33	1.33	1.34	1.34
60	1.13	1.16	1.19	1.15	1.19	1.16	1.15	1.14	1.12	1.12	1.10	1.08	1.08	1.08	1.10	1.11
65	0.88	0.93	0.94	0.90	0.91	0.86	0.86	0.85	0.83	0.84	0.81	0.81	0.79	0.80	0.82	0.85
70	0.64	0.67	0.71	0.69	0.71	0.64	0.61	0.61	0.59	0.58	0.57	0.56	0.53	0.54	0.56	0.59
75	0.23	0.24	0.26	0.24	0.24	0.23	0.21	0.21	0.23	0.22	0.21	0.20	0.19	0.21	0.23	0.22
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
105	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
115	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
135	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
140	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
145	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.15	0.16	0.16	0.16	0.15	0.15	0.14
150	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.30
155	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.47	0.47	0.47	0.47	0.47	0.47	0.46	0.46
160	0.13	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.58	0.58	0.58	0.58	0.57	0.57	0.57	0.57
165	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.10	0.57	0.57	0.57	0.56	0.56	0.56	0.56	0.56
170	0.10	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.50	0.50	0.50	0.49	0.49	0.49	0.49	0.49
175	0.10	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.38	0.39	0.38	0.37	0.37	0.37	0.37	0.37
180	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22

3200K, Goniometer:50 degree

Table--1 UNIT: cd

γ (DEG) \ C (DEG)	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5			
0	431	432	432	428	429	429	428	429	431	432	432	428	429	429	428	429			
5	427	428	429	428	428	427	426	427	426	425	425	421	422	422	421	423			
10	412	413	413	418	417	416	413	412	407	403	404	396	398	399	401	401			
15	375	379	380	389	388	384	380	377	368	364	365	352	355	356	360	363			
20	322	323	324	338	338	334	327	323	308	305	304	290	291	296	300	304			
25	248	250	253	269	266	263	256	251	234	232	229	212	215	219	224	229			
30	168	170	172	187	187	183	177	170	154	152	152	137	139	142	146	151			
35	101	103	104	116	116	113	109	103	90.8	89.6	89.5	79.7	81.1	82.6	84.7	88.7			
40	53.8	55.1	57.5	65.3	64.3	62.1	58.3	56.3	46.7	44.3	44.2	38.5	40.0	40.6	41.1	44.0			
45	19.4	21.0	23.1	29.8	28.6	26.5	23.6	22.2	16.3	14.8	15.0	12.4	13.5	13.7	13.9	14.7			
50	5.14	5.01	5.39	8.16	8.24	7.57	6.58	5.93	4.21	3.67	3.74	3.34	3.73	3.74	3.70	3.88			
55	1.75	1.66	1.70	2.39	2.58	2.31	2.04	1.93	1.54	1.42	1.46	1.45	1.59	1.57	1.50	1.53			
60	0.94	0.92	0.97	1.21	1.30	1.16	1.06	1.03	0.89	0.86	0.87	0.87	0.94	0.93	0.87	0.87			
65	0.62	0.63	0.68	0.82	0.87	0.77	0.72	0.69	0.62	0.63	0.63	0.61	0.65	0.64	0.60	0.57			
70	0.45	0.48	0.58	0.71	0.78	0.68	0.65	0.62	0.51	0.53	0.49	0.32	0.35	0.37	0.37	0.36			
75	0.04	0.06	0.06	0.12	0.11	0.09	0.08	0.06	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00			
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
105	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
110	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
115	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
135	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
140	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00			
145	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07	0.08	0.08	0.08	0.07	0.07			
150	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.14			
155	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.21	0.21	0.21	0.22	0.22	0.21	0.21	0.21			
160	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25			
165	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.27	0.27	0.26	0.26	0.26	0.26	0.26	0.26			
170	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26			
175	0.16	0.16	0.16	0.15	0.14	0.14	0.14	0.14	0.25	0.25	0.25	0.24	0.24	0.24	0.24	0.24			
180	0.22	0.22	0.22	0.21	0.20	0.20	0.21	0.20	0.22	0.22	0.21	0.20	0.20	0.20	0.20	0.20			

7. Photo of Sample

Figure 1 Overview

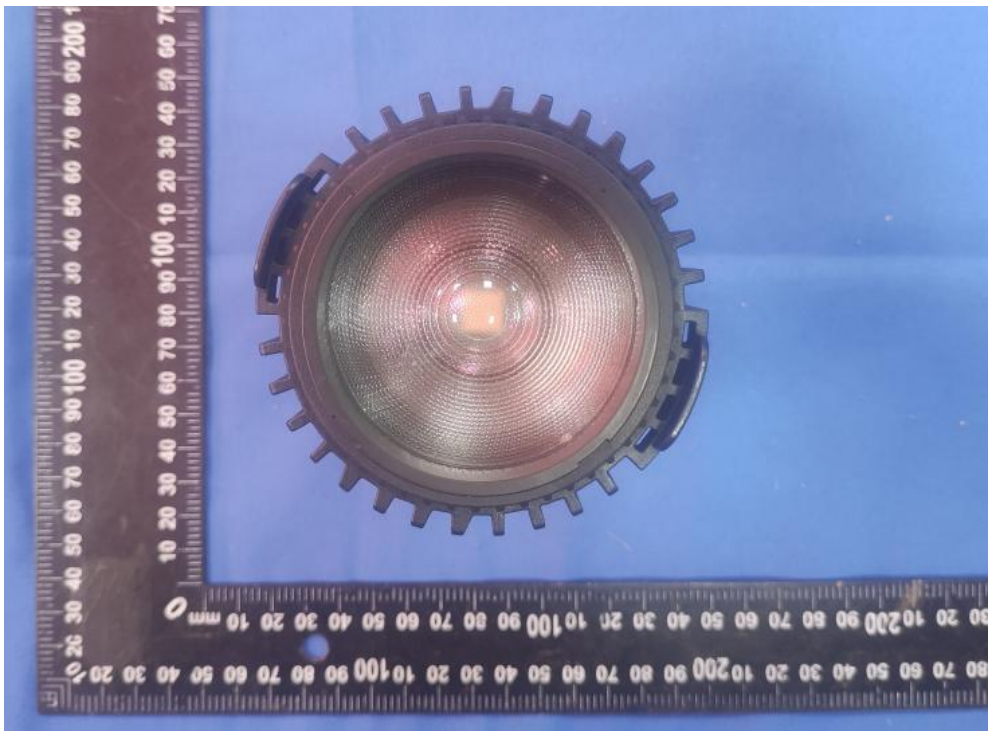


Figure 2 Overview

---End of Report---