

PRELIMINARY



## Soraa Internal Report: IES LM79-08

Test results reported for:

Part Number: SM16-09-36D-927-03

**Soraa MR16, GU5.3/12V, 2700K, 95CRI, 9W, 36degree**

### Relevant Standards

IES LM-79

ANSI C78.377

IES PR-16

Soraa Lamp Lab

## 1.0 Description of test sample

Customer reference ID	SM16-09-36D-927-03
Manufacturer reference ID	SM16-09-36D-927-03
Lamp description	Vivid 2700K 95CRI 9W 36 degree
Rated voltage	12V
Rated power	9W
Nominal CCT	2700K



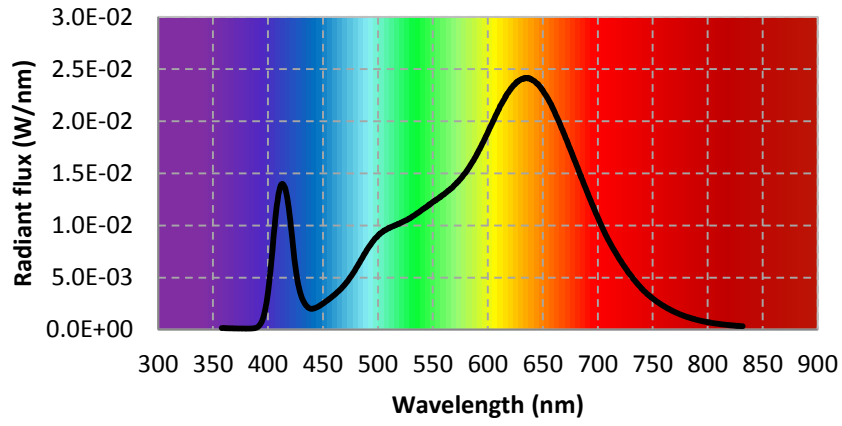
## 2.0 Results - Sphere Measurements

Test conditions	
Orientation	Horizontal
Stabilization time (min)	50-55
Correction factor applied	Self absorption correction
Sphere geometry	65" Sphere
	95% coating reflectance
	2pi geometry
Ambient temperature (°C)	25±1

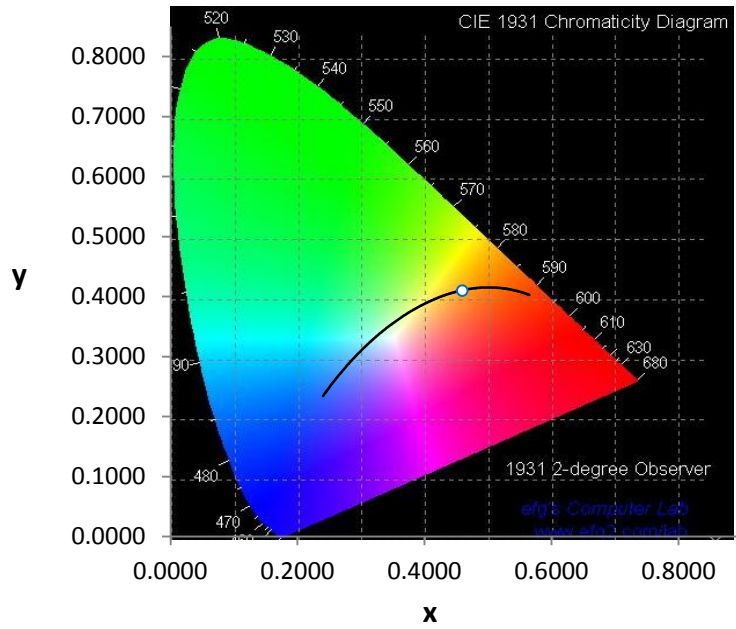
Instrument				
	Instrument	Manufacture	Model	
Photometric	Spectrometer	Instrument systems	CAS 140T	
	Integrating sphere	Labsphere	65"	
	Standard lamp	Labsphere	CSFS-1400 lamp	
Electrical instrument	Power supply for standard lamp	Labsphere	LPS-150-0268	
	Power supply for aux lamp	Labsphere	LPS-100-0833	
	Power supply for test lamps	APT	Variplus 105	
	Power meter for test lamps	Chroma	66202	
Thermometer	Digital multimeter	YOKOGAWA	TY720	

Measurement results				
	Photometric		Electrical	
Total lumen (lm)	458		Input voltage (V)	12.0
Luminous efficacy (lm/W)	51		Current (A)	0.820
Chromaticity coordinates	$u' = 0.2630$		Power (W)	9.0
	$v' = 0.5270$		pf	0.915
	$x = 0.4600$			
	$y = 0.4097$			
CCT (K)	2700			
CRI	96			
R9	93			
Duv				

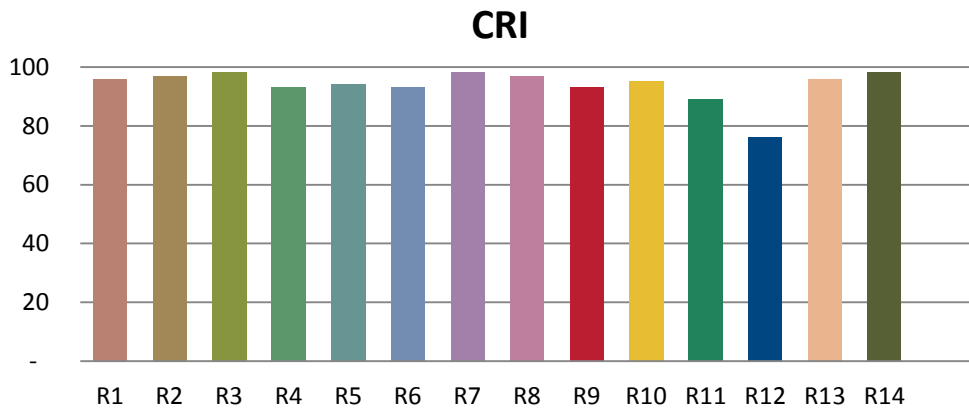
### Spectral power distribution



### Chromaticity on CIE1931



CRI	
R1	96
R2	97
R3	98
R4	93
R5	94
R6	93
R7	98
R8	97
R9	93
R10	95
R11	89
R12	76
R13	96
R14	98
Ra	96



Spectral Power Distribution									
WL (nm)	SPD(W/nm)	WL (nm)	SPD(W/nm)	WL (nm)	SPD(W/nm)	WL (nm)	SPD(W/nm)	WL (nm)	SPD(W/nm)
380	1.01E-04	421	9.75E-03	462	3.49E-03	503	9.30E-03	544	1.18E-02
381	1.00E-04	422	8.80E-03	463	3.60E-03	504	9.36E-03	545	1.18E-02
382	1.04E-04	423	7.78E-03	464	3.68E-03	505	9.45E-03	546	1.19E-02
383	1.05E-04	424	6.78E-03	465	3.79E-03	506	9.53E-03	547	1.20E-02
384	1.03E-04	425	5.98E-03	466	3.88E-03	507	9.57E-03	548	1.21E-02
385	1.10E-04	426	5.25E-03	467	3.99E-03	508	9.64E-03	549	1.22E-02
386	1.20E-04	427	4.61E-03	468	4.11E-03	509	9.69E-03	550	1.23E-02
387	1.29E-04	428	4.12E-03	469	4.23E-03	510	9.74E-03	551	1.23E-02
388	1.43E-04	429	3.66E-03	470	4.36E-03	511	9.80E-03	552	1.24E-02
389	1.76E-04	430	3.31E-03	471	4.47E-03	512	9.84E-03	553	1.25E-02
390	2.16E-04	431	3.01E-03	472	4.61E-03	513	9.89E-03	554	1.25E-02
391	2.89E-04	432	2.78E-03	473	4.75E-03	514	9.92E-03	555	1.26E-02
392	3.93E-04	433	2.58E-03	474	4.90E-03	515	9.97E-03	556	1.27E-02
393	5.32E-04	434	2.41E-03	475	5.05E-03	516	1.00E-02	557	1.27E-02
394	7.12E-04	435	2.29E-03	476	5.20E-03	517	1.01E-02	558	1.29E-02
395	9.49E-04	436	2.17E-03	477	5.36E-03	518	1.01E-02	559	1.29E-02
396	1.28E-03	437	2.09E-03	478	5.52E-03	519	1.01E-02	560	1.30E-02
397	1.72E-03	438	2.04E-03	479	5.68E-03	520	1.02E-02	561	1.31E-02
398	2.23E-03	439	2.01E-03	480	5.87E-03	521	1.03E-02	562	1.32E-02
399	2.83E-03	440	2.00E-03	481	6.04E-03	522	1.03E-02	563	1.32E-02
400	3.57E-03	441	2.03E-03	482	6.22E-03	523	1.04E-02	564	1.33E-02
401	4.47E-03	442	2.04E-03	483	6.39E-03	524	1.04E-02	565	1.34E-02
402	5.44E-03	443	2.08E-03	484	6.59E-03	525	1.05E-02	566	1.35E-02
403	6.49E-03	444	2.13E-03	485	6.75E-03	526	1.05E-02	567	1.36E-02
404	7.57E-03	445	2.17E-03	486	6.93E-03	527	1.06E-02	568	1.37E-02
405	8.84E-03	446	2.23E-03	487	7.13E-03	528	1.07E-02	569	1.38E-02
406	9.90E-03	447	2.30E-03	488	7.29E-03	529	1.07E-02	570	1.39E-02
407	1.10E-02	448	2.37E-03	489	7.46E-03	530	1.07E-02	571	1.40E-02
408	1.19E-02	449	2.43E-03	490	7.66E-03	531	1.08E-02	572	1.41E-02
409	1.26E-02	450	2.50E-03	491	7.82E-03	532	1.09E-02	573	1.42E-02
410	1.32E-02	451	2.57E-03	492	7.97E-03	533	1.10E-02	574	1.43E-02
411	1.37E-02	452	2.66E-03	493	8.11E-03	534	1.10E-02	575	1.45E-02
412	1.39E-02	453	2.73E-03	494	8.27E-03	535	1.11E-02	576	1.46E-02
413	1.40E-02	454	2.80E-03	495	8.42E-03	536	1.12E-02	577	1.47E-02
414	1.39E-02	455	2.90E-03	496	8.54E-03	537	1.13E-02	578	1.49E-02
415	1.37E-02	456	2.97E-03	497	8.70E-03	538	1.13E-02	579	1.50E-02
416	1.34E-02	457	3.05E-03	498	8.80E-03	539	1.14E-02	580	1.51E-02
417	1.29E-02	458	3.14E-03	499	8.89E-03	540	1.15E-02	581	1.53E-02
418	1.23E-02	459	3.23E-03	500	9.02E-03	541	1.16E-02	582	1.54E-02
419	1.16E-02	460	3.30E-03	501	9.14E-03	542	1.16E-02	583	1.56E-02
420	1.07E-02	461	3.39E-03	502	9.21E-03	543	1.17E-02	584	1.57E-02

Spectral Power Distribution									
WL (nm)	SPD(W/nm)	WL (nm)	SPD(W/nm)	WL (nm)	SPD(W/nm)	WL (nm)	SPD(W/nm)	WL (nm)	SPD(W/nm)
585	1.59E-02	626	2.37E-02	667	1.94E-02	708	8.95E-03	749	3.07E-03
586	1.61E-02	627	2.38E-02	668	1.91E-02	709	8.75E-03	750	2.98E-03
587	1.62E-02	628	2.39E-02	669	1.89E-02	710	8.55E-03	751	2.91E-03
588	1.65E-02	629	2.39E-02	670	1.86E-02	711	8.35E-03	752	2.84E-03
589	1.66E-02	630	2.40E-02	671	1.83E-02	712	8.16E-03	753	2.75E-03
590	1.68E-02	631	2.41E-02	672	1.81E-02	713	7.97E-03	754	2.68E-03
591	1.70E-02	632	2.41E-02	673	1.78E-02	714	7.78E-03	755	2.61E-03
592	1.72E-02	633	2.41E-02	674	1.76E-02	715	7.60E-03	756	2.54E-03
593	1.74E-02	634	2.41E-02	675	1.73E-02	716	7.44E-03	757	2.46E-03
594	1.76E-02	635	2.41E-02	676	1.71E-02	717	7.24E-03	758	2.39E-03
595	1.79E-02	636	2.41E-02	677	1.68E-02	718	7.08E-03	759	2.33E-03
596	1.80E-02	637	2.41E-02	678	1.65E-02	719	6.89E-03	760	2.26E-03
597	1.83E-02	638	2.41E-02	679	1.62E-02	720	6.74E-03	761	2.21E-03
598	1.85E-02	639	2.41E-02	680	1.60E-02	721	6.58E-03	762	2.14E-03
599	1.87E-02	640	2.40E-02	681	1.57E-02	722	6.41E-03	763	2.07E-03
600	1.89E-02	641	2.39E-02	682	1.55E-02	723	6.25E-03	764	2.03E-03
601	1.92E-02	642	2.39E-02	683	1.52E-02	724	6.08E-03	765	1.97E-03
602	1.94E-02	643	2.38E-02	684	1.49E-02	725	5.95E-03	766	1.90E-03
603	1.96E-02	644	2.37E-02	685	1.46E-02	726	5.79E-03	767	1.86E-03
604	1.98E-02	645	2.36E-02	686	1.44E-02	727	5.64E-03	768	1.80E-03
605	2.01E-02	646	2.35E-02	687	1.41E-02	728	5.48E-03	769	1.75E-03
606	2.03E-02	647	2.34E-02	688	1.38E-02	729	5.34E-03	770	1.69E-03
607	2.05E-02	648	2.32E-02	689	1.36E-02	730	5.22E-03	771	1.64E-03
608	2.07E-02	649	2.31E-02	690	1.33E-02	731	5.08E-03	772	1.61E-03
609	2.10E-02	650	2.30E-02	691	1.30E-02	732	4.92E-03	773	1.56E-03
610	2.11E-02	651	2.28E-02	692	1.28E-02	733	4.81E-03	774	1.51E-03
611	2.14E-02	652	2.26E-02	693	1.25E-02	734	4.67E-03	775	1.46E-03
612	2.16E-02	653	2.25E-02	694	1.23E-02	735	4.54E-03	776	1.42E-03
613	2.18E-02	654	2.23E-02	695	1.20E-02	736	4.42E-03	777	1.38E-03
614	2.20E-02	655	2.21E-02	696	1.18E-02	737	4.29E-03	778	1.33E-03
615	2.21E-02	656	2.19E-02	697	1.15E-02	738	4.18E-03	779	1.30E-03
616	2.24E-02	657	2.17E-02	698	1.13E-02	739	4.07E-03	780	1.27E-03
617	2.25E-02	658	2.15E-02	699	1.10E-02	740	3.93E-03		
618	2.27E-02	659	2.13E-02	700	1.08E-02	741	3.84E-03		
619	2.28E-02	660	2.11E-02	701	1.05E-02	742	3.71E-03		
620	2.30E-02	661	2.08E-02	702	1.03E-02	743	3.63E-03		
621	2.31E-02	662	2.06E-02	703	1.01E-02	744	3.52E-03		
622	2.33E-02	663	2.04E-02	704	9.83E-03	745	3.42E-03		
623	2.34E-02	664	2.01E-02	705	9.61E-03	746	3.33E-03		
624	2.35E-02	665	1.99E-02	706	9.39E-03	747	3.25E-03		
625	2.36E-02	666	1.96E-02	707	9.14E-03	748	3.17E-03		

### 3.0 Results - Goniometric Measurements

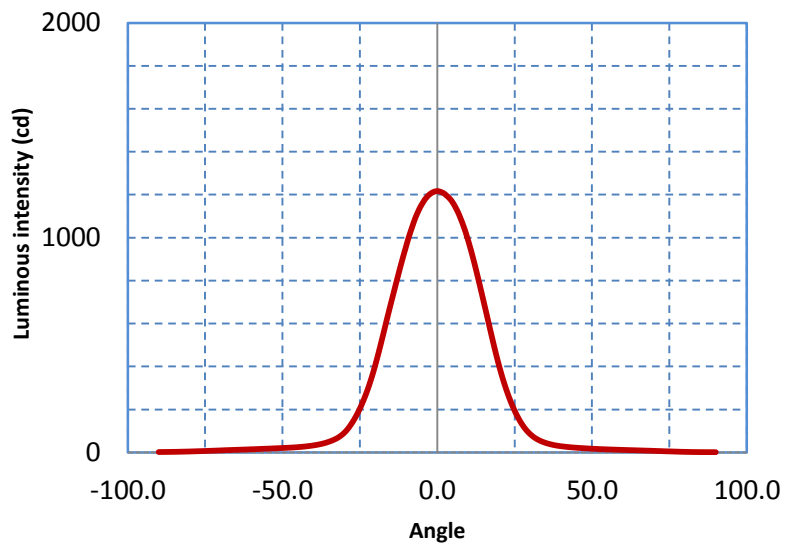
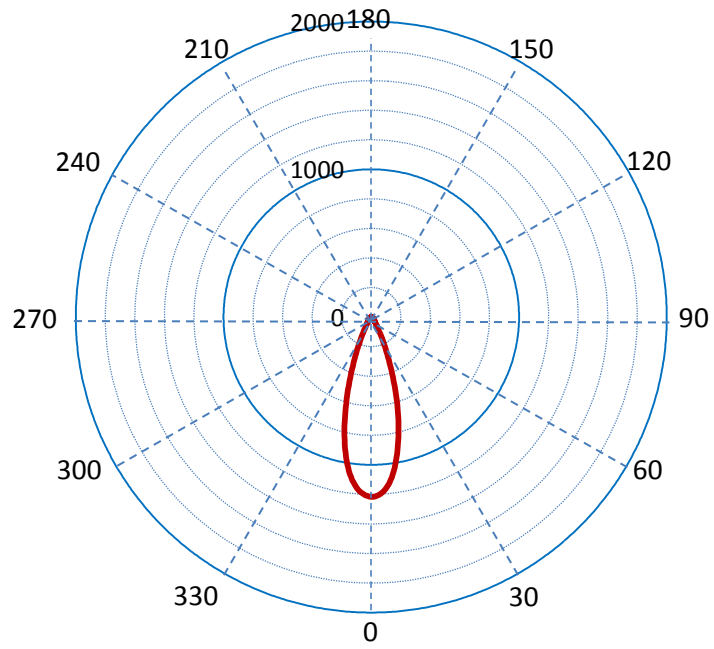
Test conditions	
Goniometer distance (m)	1
Temperature (°C)	25±1
Stabilization time (min)	50

Instrument				
	Instrument	Manufacture	Model	
Photometric	Photometer and color meter	Minolta	CL-200A	
Electrical instrument	Power supply for test lamps	APT	Variplus 105	
	Power meter for test lamps	Chroma	66202	
Thermometer	Digital multimeter	YOKOGAWA	TY720	

Measurement results				
Photometric			Electrical	
Central beam candle power(cd)	1217		Input voltage (V)	12.0
Beam Angle (°)	33		Current (A)	0.820
Field Angle (°)	57		Power (W)	9.0
Chromaticity coordinates	u'= 0.2630		pf	0.9150
	v'= 0.5270			
	x = 0.4600			
	y = 0.4097			
CCT (K)	2700			



### Luminous intensity distribution

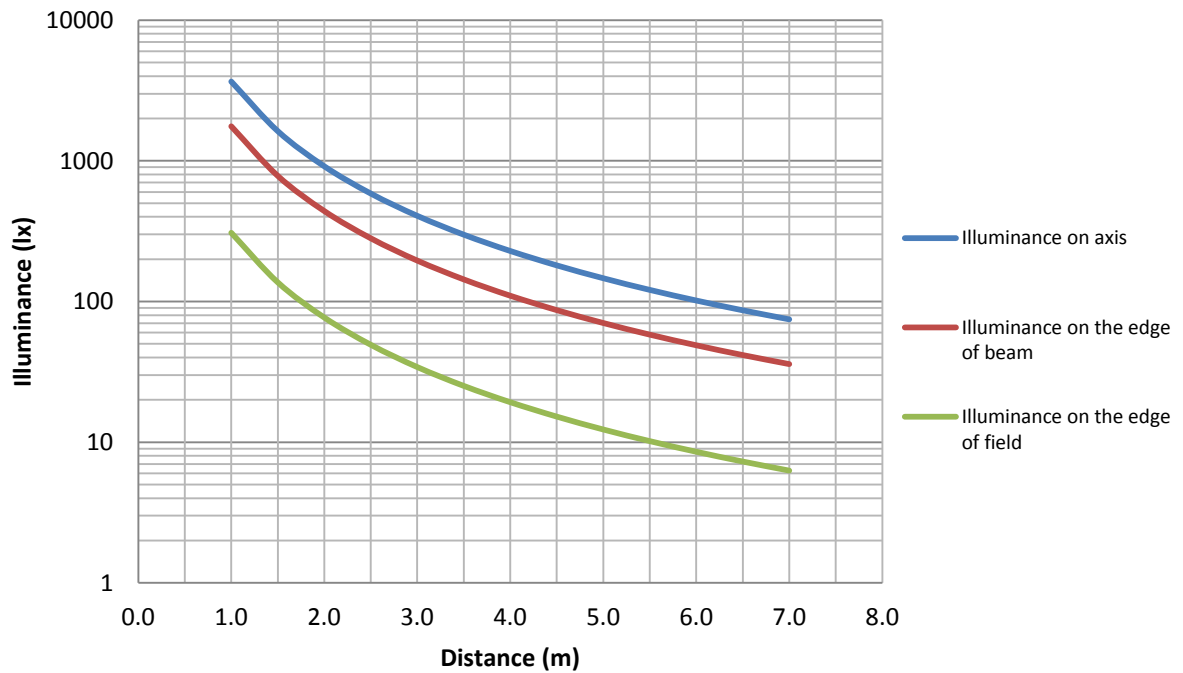


Zonal Lumen Tabulation					
Zones (°)	Lumens	%lamp	Zones (°)	Lumens	%lamp
0-5	28.3	6.2%	45-50	7.7	1.7%
5-10	76.9	16.8%	50-55	6.6	1.5%
10-15	99.6	21.7%	55-60	5.9	1.3%
15-20	88.9	19.4%	60-65	5.1	1.1%
20-25	58.8	12.8%	65-70	4.2	0.9%
25-30	32.0	7.0%	70-75	3.0	0.7%
30-35	17.3	3.8%	75-80	1.9	0.4%
35-40	11.4	2.5%	80-85	1.0	0.2%
40-45	9.0	2.0%	85-90	0.6	0.1%
Total lumen					458

Accumulated Zonal Lumen Tabulation					
Zones (°)	Lumens	%lamp	Zones (°)	Lumens	%lamp
0-5	28.3	6.2%	0-50	430.1	93.8%
0-10	105.3	23.0%	0-55	436.7	95.3%
0-15	204.9	44.7%	0-60	442.6	96.6%
0-20	293.9	64.1%	0-65	447.7	97.7%
0-25	352.6	76.9%	0-70	451.8	98.6%
0-30	384.7	83.9%	0-75	454.9	99.2%
0-35	401.9	87.7%	0-80	456.8	99.7%
0-40	413.4	90.2%	0-85	457.7	99.9%
0-45	422.4	92.1%	0-90	458.4	100.0%

Center and edge illuminance, beam and field diameter					
Distance (m)	E on axis (lx)	Beam D(m)	E on the edge of beam (lx)	Field D(m)	E on the edge of field (lx)
1.0	3657	0.33	1758	0.7	308
1.5	1626	0.49	781	1.0	137
2.0	914	0.65	440	1.4	77
2.5	585	0.81	281	1.7	49
3.0	406	0.98	195	2.1	34
3.5	299	1.14	144	2.4	25
4.0	229	1.30	110	2.8	19
4.5	181	1.47	87	3.1	15
5.0	146	1.63	70	3.5	12
5.5	121	1.79	58	3.8	10
6.0	102	1.95	49	4.2	9
6.5	87	2.12	42	4.5	7
7.0	75	2.28	36	4.9	6
7.5	65	2.44	31	5.2	5
8.0	57	2.61	27	5.6	5
8.5	51	2.77	24	5.9	4
9.0	45	2.93	22	6.3	4
9.5	41	3.09	19	6.6	3
10.0	37	3.26	18	7.0	3

### Beam illuminance vs. distance



### Luminous Intensity Distribution

Angle (°C)	CP (cd)	Angle (°C)	CP (cd)	Angle (°C)	CP (cd)	Angle (°C)	CP (cd)	Angle (°C)	CP (cd)
-90.0	1.8	-69.5	9.6	-49.0	21.2	-28.5	117.2	-8.0	1054.7
-89.5	1.9	-69.0	9.9	-48.5	21.5	-28.0	127.3	-7.5	1075.8
-89.0	1.9	-68.5	10.2	-48.0	21.8	-27.5	138.1	-7.0	1094.7
-88.5	2.0	-68.0	10.5	-47.5	22.3	-27.0	149.8	-6.5	1111.6
-88.0	2.1	-67.5	10.8	-47.0	22.7	-26.5	162.1	-6.0	1127.4
-87.5	2.1	-67.0	11.1	-46.5	23.1	-26.0	175.2	-5.5	1142.2
-87.0	2.2	-66.5	11.3	-46.0	23.5	-25.5	189.2	-5.0	1154.9
-86.5	2.3	-66.0	11.5	-45.5	24.0	-25.0	204.2	-4.5	1166.5
-86.0	2.4	-65.5	11.7	-45.0	24.6	-24.5	220.0	-4.0	1178.1
-85.5	2.5	-65.0	12.0	-44.5	25.1	-24.0	236.6	-3.5	1186.5
-85.0	2.6	-64.5	12.2	-44.0	25.7	-23.5	254.3	-3.0	1194.9
-84.5	2.7	-64.0	12.4	-43.5	26.4	-23.0	272.8	-2.5	1201.3
-84.0	2.8	-63.5	12.8	-43.0	27.1	-22.5	292.5	-2.0	1206.5
-83.5	3.1	-63.0	13.0	-42.5	27.8	-22.0	313.3	-1.5	1210.8
-83.0	3.2	-62.5	13.3	-42.0	28.7	-21.5	335.5	-1.0	1213.9
-82.5	3.4	-62.0	13.5	-41.5	29.6	-21.0	358.3	-0.5	1216.0
-82.0	3.5	-61.5	13.8	-41.0	30.6	-20.5	382.6	0.0	1217.1
-81.5	3.7	-61.0	14.0	-40.5	31.5	-20.0	408.2	0.5	1216.0
-81.0	3.9	-60.5	14.3	-40.0	32.6	-19.5	434.7	1.0	1213.9
-80.5	4.0	-60.0	14.7	-39.5	33.7	-19.0	462.0	1.5	1210.8
-80.0	4.3	-59.5	14.9	-39.0	35.0	-18.5	490.1	2.0	1207.6
-79.5	4.5	-59.0	15.2	-38.5	36.3	-18.0	518.7	2.5	1202.3
-79.0	4.7	-58.5	15.5	-38.0	37.8	-17.5	547.7	3.0	1196.0
-78.5	5.0	-58.0	15.7	-37.5	39.3	-17.0	577.1	3.5	1189.7
-78.0	5.3	-57.5	16.0	-37.0	41.1	-16.5	606.7	4.0	1182.3
-77.5	5.5	-57.0	16.3	-36.5	42.9	-16.0	635.6	4.5	1173.8
-77.0	5.7	-56.5	16.7	-36.0	45.0	-15.5	664.2	5.0	1163.3
-76.5	5.9	-56.0	16.9	-35.5	47.2	-15.0	692.6	5.5	1151.7
-76.0	6.2	-55.5	17.2	-35.0	49.7	-14.5	720.8	6.0	1138.0
-75.5	6.4	-55.0	17.5	-34.5	52.3	-14.0	748.8	6.5	1124.3
-75.0	6.6	-54.5	17.8	-34.0	55.2	-13.5	776.9	7.0	1108.5
-74.5	7.0	-54.0	18.0	-33.5	58.2	-13.0	804.8	7.5	1090.5
-74.0	7.2	-53.5	18.4	-33.0	61.6	-12.5	832.4	8.0	1072.6
-73.5	7.4	-53.0	18.7	-32.5	65.3	-12.0	859.8	8.5	1052.6
-73.0	7.7	-52.5	19.0	-32.0	69.5	-11.5	886.6	9.0	1032.5
-72.5	7.9	-52.0	19.3	-31.5	74.2	-11.0	912.7	9.5	1009.3
-72.0	8.2	-51.5	19.6	-31.0	79.4	-10.5	938.1	10.0	986.1
-71.5	8.4	-51.0	19.8	-30.5	85.3	-10.0	963.0	10.5	960.8
-71.0	8.8	-50.5	20.1	-30.0	92.0	-9.5	988.2	11.0	935.5
-70.5	9.1	-50.0	20.6	-29.5	99.5	-9.0	1011.4	11.5	908.1
-70.0	9.4	-49.5	20.9	-29.0	107.9	-8.5	1033.6	12.0	880.6

### Luminous Intensity Distribution

Angle (°C)	CP (cd)	Angle (°C)	CP (cd)	Angle (°C)	CP (cd)	Angle (°C)	CP (cd)		
12.5	851.6	33.0	55.9	53.5	14.9	74.0	5.2		
13.0	822.4	33.5	52.5	54.0	14.6	74.5	5.0		
13.5	792.8	34.0	49.6	54.5	14.3	75.0	4.7		
14.0	762.7	34.5	46.8	55.0	14.0	75.5	4.5		
14.5	732.1	35.0	44.3	55.5	13.8	76.0	4.3		
15.0	701.4	35.5	42.1	56.0	13.6	76.5	4.0		
15.5	670.7	36.0	40.0	56.5	13.3	77.0	3.8		
16.0	639.8	36.5	38.1	57.0	13.1	77.5	3.6		
16.5	608.8	37.0	36.4	57.5	12.9	78.0	3.4		
17.0	577.9	37.5	34.7	58.0	12.7	78.5	3.1		
17.5	547.1	38.0	33.3	58.5	12.3	79.0	2.8		
18.0	516.5	38.5	32.0	59.0	12.1	79.5	2.7		
18.5	486.2	39.0	30.8	59.5	11.9	80.0	2.5		
19.0	457.1	39.5	29.7	60.0	11.6	80.5	2.4		
19.5	429.1	40.0	28.7	60.5	11.4	81.0	2.2		
20.0	401.9	40.5	27.8	61.0	11.2	81.5	2.1		
20.5	376.0	41.0	27.0	61.5	11.0	82.0	1.9		
21.0	351.3	41.5	26.2	62.0	10.8	82.5	1.8		
21.5	327.8	42.0	25.4	62.5	10.5	83.0	1.7		
22.0	305.4	42.5	24.7	63.0	10.3	83.5	1.7		
22.5	284.1	43.0	24.0	63.5	10.1	84.0	1.6		
23.0	263.9	43.5	23.3	64.0	9.9	84.5	1.5		
23.5	245.0	44.0	22.8	64.5	9.7	85.0	1.4		
24.0	227.1	44.5	22.3	65.0	9.5	85.5	1.4		
24.5	210.1	45.0	21.7	65.5	9.3	86.0	1.3		
25.0	194.2	45.5	21.2	66.0	9.0	86.5	1.3		
25.5	179.2	46.0	20.7	66.5	8.8	87.0	1.2		
26.0	165.2	46.5	20.2	67.0	8.5	87.5	1.2		
26.5	151.9	47.0	19.8	67.5	8.3	88.0	1.2		
27.0	139.6	47.5	19.4	68.0	8.1	88.5	1.2		
27.5	128.4	48.0	19.0	68.5	7.9	89.0	1.1		
28.0	118.0	48.5	18.5	69.0	7.7	89.5	1.1		
28.5	108.6	49.0	18.0	69.5	7.4	90.0	1.1		
29.0	100.1	49.5	17.6	70.0	7.2				
29.5	92.4	50.0	17.3	70.5	6.9				
30.0	85.3	50.5	16.9	71.0	6.6				
30.5	79.0	51.0	16.6	71.5	6.4				
31.0	73.3	51.5	16.1	72.0	6.1				
31.5	68.2	52.0	15.8	72.5	5.9				
32.0	63.6	52.5	15.5	73.0	5.6				
32.5	59.5	53.0	15.2	73.5	5.4				