



Report: 70085442 - 1  
Project: 70085442  
Client: Lightart

## PHOTOMETRIC TESTING & EVALUATION

Sample Tested  
**LA2- Hex**

**LightArt**

4770 Ohio Ave S. SuiteA  
Seattle, WA 98134

Phone: 206-890-0995

**Technical Report Number**  
**70085442 - 1**

August 15, 2016

**Prepared by:**

A handwritten signature in black ink, appearing to read 'M. Anderson'.

Mauricio Anderson, Project Manager

**Approved by:**

A handwritten signature in black ink, appearing to read 'J. Whalen'.

Jesse Whalen, Operations Manager

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government

## Program Description

Photometric and electrical testing of a “LA2- Hex” replacement fixture

## Executive Summary

Sample Tested = **LA2- Hex**

Luminous Efficacy* (Lumens/Watt)	Luminous Flux* (Lumens)	Input Power* (Watts)	Power Factor*
92.37	5364	58.07	0.9910

CCT (K)*	CRI*	Stabilization Time (Light & Power)
2985	82.35	60 minutes

\* The above results are recorded / derived from measurements made using an Integrating Sphere

**TABLE OF CONTENTS**

Sample.....	4
Test Results.....	5
Spectral Flux .....	6
Chromaticity Diagram .....	7
Flux Distribution – Zonal Lumen Summary.....	8
Illuminance Plots .....	9
Candela Plots .....	10
Candela Tabulation .....	11
Photometric Testing Information.....	12
Equipment List:.....	14

### Sample

The following sample was submitted for evaluation:

**Lightart: LA2- Hex**



**LA2- Hex**

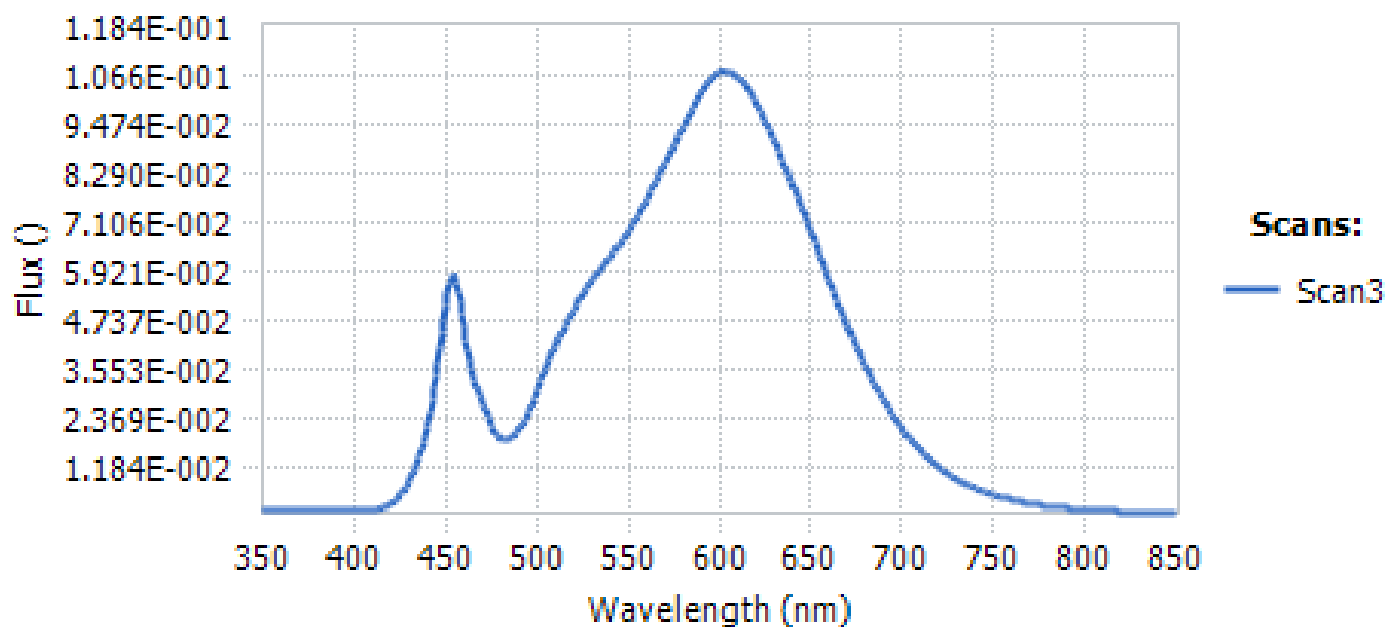
**Test Results –**

The following results were measured after stabilization of the sample in the **Integrating Sphere** (unless otherwise stated). Stability is reached when the variation of 3 readings of light output and electrical power, taken 15 minutes apart, is less than 0.50%.

Key Photometric Results	Sample Reference	
	LA2- Hex	
	Integrating Sphere	Goniophotometer
Luminous Efficacy (Lumens/Watt)	92.37	90.59
Total Luminous Flux (Lumens)	5364	5260.97
Total Radiant Flux (Watts)	16.72	
Correlated Color Temperature (CCT)	2985	
Color Rendering Index (CRI) (Ra)	82.53	
R9 Value	11.4	
Chromaticity (Chroma x / Chroma y)	0.4386 / 0.4059	
Chromaticity (Chroma u / Chroma v)	0.2509 / 0.3482	
Chromaticity (Chroma u' / Chroma v')	0.2509 / 0.5223	
D <sub>uv</sub> Value	0.0003	
Stabilization Time (Light and Power)	Approx. 60 minutes	
Total Run Time – Integrating Sphere	64 minutes	
Total Run Time – Goniophotometer	67 minutes	
Spacing Criteria	1.32 (0° – 180°) / 1.30 (90° – 270°)	
Scotopic/Photopic ratio $\Phi(v')/\Phi(v)$	1.31	
Electrical Input Results:	Sample Reference	
	LA2- Hex	
Input Power (Watts)	58.07	
Input Voltage (Volts AC)	120.05	
Input Current (Amps)	0.48816	
Input Frequency (Hertz)	60.0	
Power Factor	0.9910	
Total Harmonic Distortion (%THD V/A)	0.08 / 5.58	
Additional Information	Sample Reference	
	LA2- Hex	
Ambient Temperature	24.9°C	
Integrating Sphere Detector	CDS-1100 Spectroradiometer	
Absorption Correction used?	Yes	

## Spectral Flux

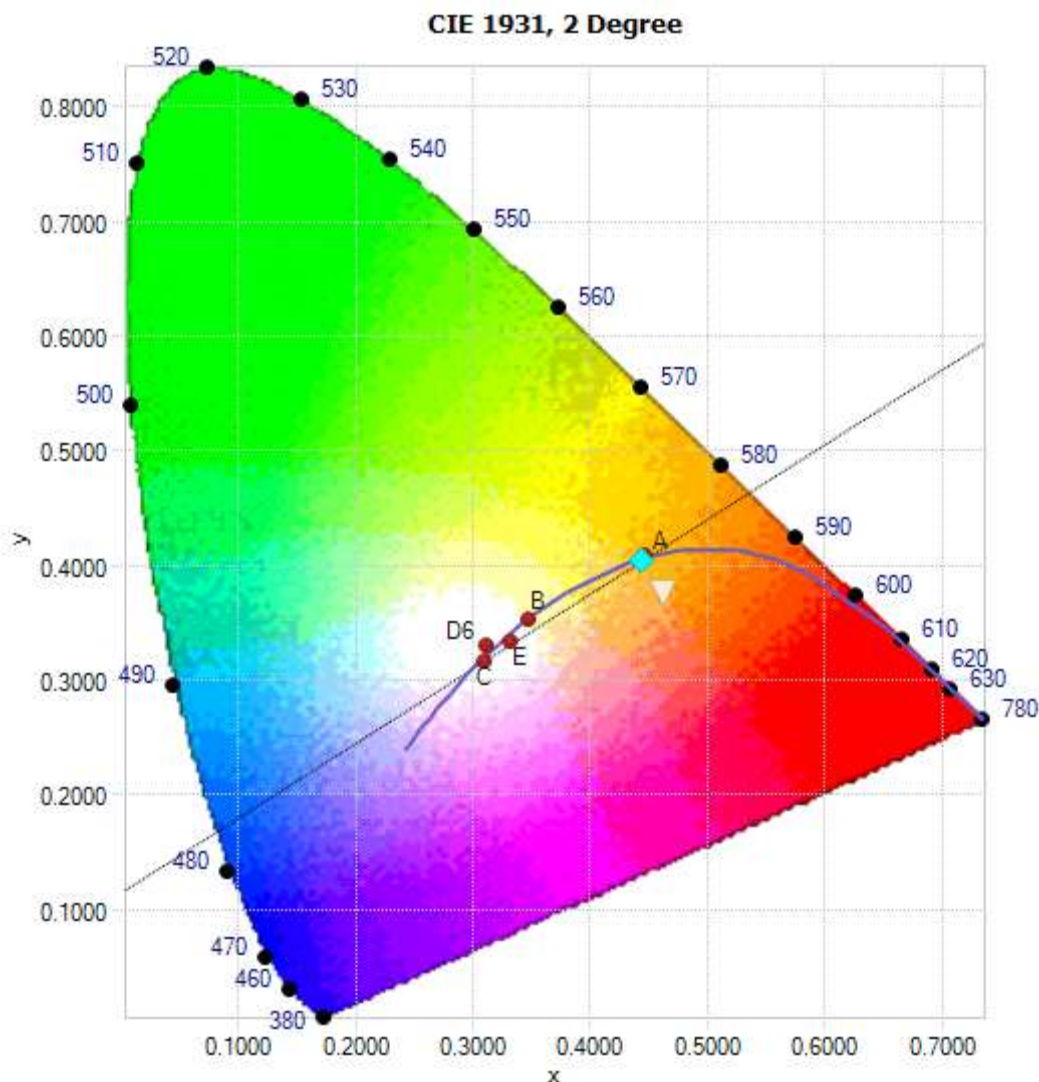
The following graph shows the spectral response curve of the radiant flux for the sample:



**Spectral response of the Radiant Flux**  
(350nm to 850nm – calibrated range of the Spectroradiometer).

## Chromaticity Diagram

The following image shows the chromaticity diagram for the sample:



**Tristimulus values (from page 6):**

**$x / y = 0.4386 / 0.4059$**

The locations on the diagram of the tristimulus coordinates are indicated by the blue diamond.

**Test Results – Flux Distribution – Zonal Lumen Summary**

The following table depicts the zonal lumen distribution for the sample:

<b>Zone</b>	<b>Lumens</b>	<b>% Total</b>
<b>0-10</b>	<b>124.2</b>	<b>2.4%</b>
<b>10-20</b>	<b>358.7</b>	<b>6.8%</b>
<b>20-30</b>	<b>550.3</b>	<b>10.5%</b>
<b>30-40</b>	<b>674.4</b>	<b>12.8%</b>
<b>40-50</b>	<b>716.9</b>	<b>13.6%</b>
<b>50-60</b>	<b>674.8</b>	<b>12.8%</b>
<b>60-70</b>	<b>555.9</b>	<b>10.6%</b>
<b>70-80</b>	<b>380.4</b>	<b>7.2%</b>
<b>80-90</b>	<b>168.9</b>	<b>3.2%</b>
<b>90-100</b>	<b>106.4</b>	<b>2%</b>
<b>100-110</b>	<b>139.2</b>	<b>2.60%</b>
<b>110-120</b>	<b>156.1</b>	<b>3%</b>
<b>120-130</b>	<b>158.1</b>	<b>3%</b>
<b>130-140</b>	<b>150.7</b>	<b>2.90%</b>
<b>140-150</b>	<b>139.5</b>	<b>2.70%</b>
<b>150-160</b>	<b>112.8</b>	<b>2.10%</b>
<b>160-170</b>	<b>70.2</b>	<b>1.30%</b>
<b>170-180</b>	<b>23.5</b>	<b>0.40%</b>
<b>Total</b>	<b>5261.0 LUMENS</b>	<b>100%</b>

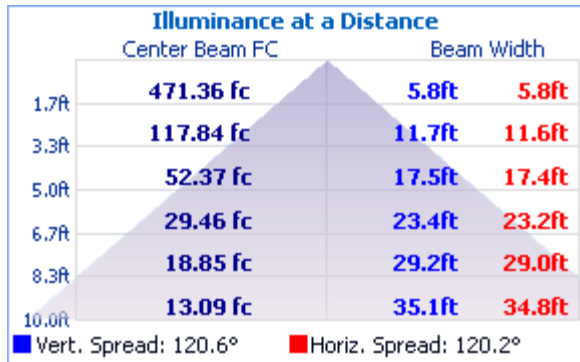
**Zonal Lumen Summary**

<b>Zone</b>	<b>Lumens</b>	<b>% Luminaire</b>
<b>0-30</b>	<b>1,033.1</b>	<b>19.6%</b>
<b>0-40</b>	<b>1,707.5</b>	<b>32.5%</b>
<b>0-60</b>	<b>3,099.3</b>	<b>58.9%</b>
<b>60-90</b>	<b>1,105.2</b>	<b>21%</b>
<b>70-100</b>	<b>655.7</b>	<b>12.5%</b>
<b>90-120</b>	<b>401.8</b>	<b>7.6%</b>
<b>0-90</b>	<b>4,204.5</b>	<b>79.9%</b>
<b>90-180</b>	<b>1,056.6</b>	<b>20.1%</b>
<b>0-180</b>	<b>5,261.0</b>	<b>100%</b>

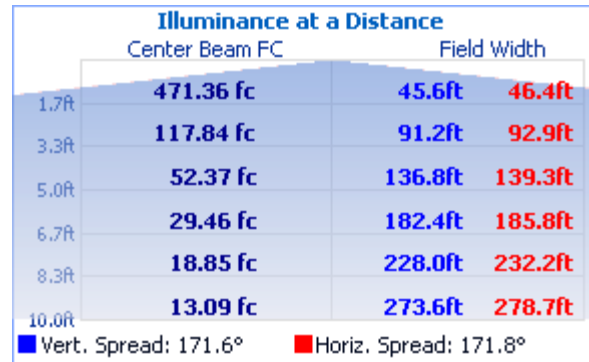


## Test Results – Illuminance Plots

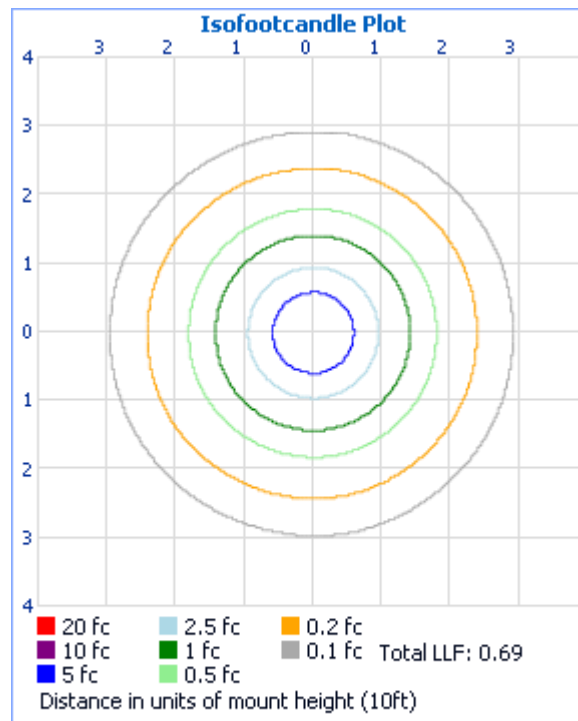
The following images depict the illuminance characteristics of the luminaire.



Beam Angle



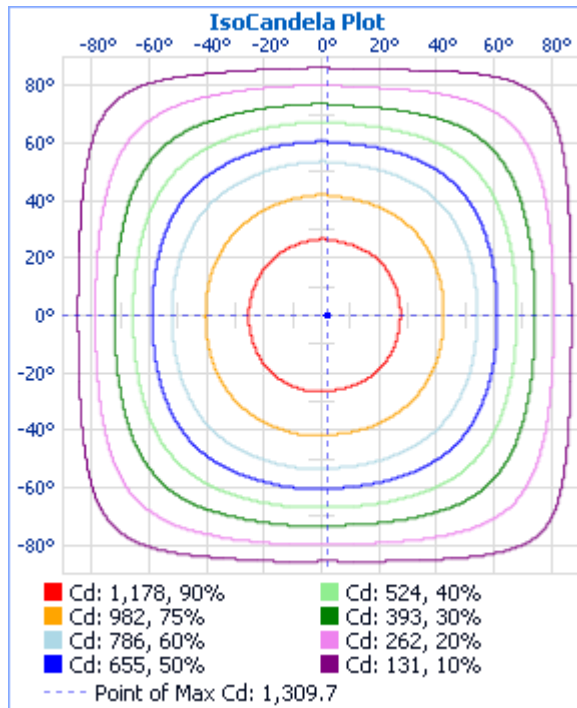
Field Angle



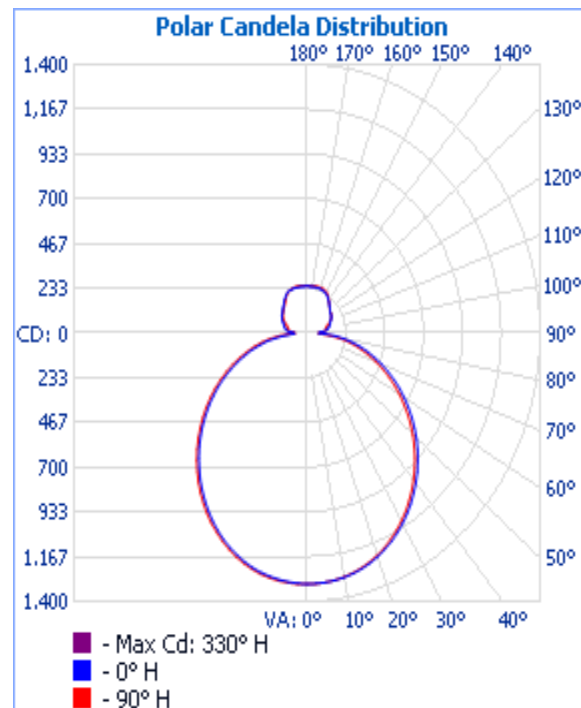
Illuminance Plot (Footcandles)

## Test Results – Candela Plots

The following images depict the luminous intensity distribution characteristics of the luminaire.



Isocandela Plot



Polar Candela Distribution

## Coefficients Of Utilization - Zonal Cavity Method

Effective Floor Cavity Reflectance: 20%

RCC %:	80				70				50			30			10			0
RW %:	70	50	30	0	70	50	30	0	50	30	20	50	30	20	50	30	20	0
RCR: 0	1.14	1.14	1.14	1.14	1.09	1.09	1.09	.80	1.00	1.00	1.00	.91	.91	.91	.84	.84	.84	.80
1	1.03	.98	.94	.89	.98	.94	.90	.65	.86	.83	.80	.79	.76	.74	.72	.70	.68	.65
2	.93	.85	.78	.72	.89	.81	.75	.54	.74	.69	.65	.68	.64	.60	.62	.59	.56	.53
3	.85	.74	.66	.59	.81	.71	.63	.45	.65	.59	.54	.60	.55	.50	.55	.51	.47	.44
4	.77	.65	.56	.50	.74	.63	.54	.39	.58	.51	.45	.53	.47	.43	.49	.44	.40	.37
5	.71	.58	.49	.42	.67	.56	.47	.33	.51	.44	.39	.47	.41	.37	.43	.39	.35	.32
6	.65	.52	.43	.37	.62	.50	.42	.29	.46	.39	.34	.43	.37	.32	.39	.34	.30	.28
7	.60	.47	.38	.32	.58	.45	.37	.26	.42	.35	.30	.39	.33	.28	.36	.31	.27	.24
8	.56	.43	.34	.29	.53	.41	.33	.23	.38	.31	.26	.35	.29	.25	.33	.28	.24	.22
9	.52	.39	.31	.25	.50	.38	.30	.21	.35	.28	.24	.33	.27	.23	.30	.25	.21	.19
10	.49	.36	.28	.23	.47	.35	.27	.19	.32	.26	.21	.30	.24	.20	.28	.23	.19	.18



## Test Results – Candela Tabulation

The following table provides the tabulated Candela measurements:

Candela Table - Type C																																								
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360			
0	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	
2.5	1307	1308	1309	1309	1308	1308	1307	1307	1308	1308	1308	1307	1307	1308	1309	1309	1308	1306	1307	1308	1308	1308	1308	1308	1308	1308	1309	1309	1309	1308	1308	1309	1309	1309	1309	1309	1309	1309	1309	1307
5	1305	1305	1305	1306	1305	1304	1303	1304	1304	1304	1304	1304	1304	1304	1305	1306	1305	1305	1302	1304	1304	1305	1305	1305	1305	1305	1305	1307	1307	1307	1306	1305	1306	1307	1306	1306	1305	1305	1305	1305
7.5	1300	1300	1301	1301	1300	1299	1298	1299	1299	1299	1299	1298	1298	1299	1300	1301	1301	1301	1297	1298	1299	1301	1300	1301	1300	1301	1302	1303	1302	1302	1301	1302	1302	1302	1302	1302	1302	1301	1301	1301
10	1293	1293	1294	1293	1292	1291	1290	1290	1291	1291	1291	1290	1290	1291	1292	1293	1293	1293	1289	1290	1292	1293	1293	1293	1293	1294	1295	1296	1296	1295	1295	1295	1296	1296	1295	1295	1296	1295	1293	
12.5	1283	1283	1284	1284	1282	1281	1280	1280	1280	1280	1280	1279	1279	1280	1281	1283	1283	1283	1279	1280	1282	1283	1283	1284	1284	1285	1286	1287	1287	1287	1286	1286	1286	1287	1286	1285	1284	1283		
15	1271	1271	1271	1271	1269	1268	1267	1266	1267	1267	1267	1266	1266	1267	1269	1270	1270	1270	1266	1268	1269	1270	1271	1271	1272	1273	1274	1275	1275	1275	1274	1275	1275	1274	1273	1272	1271			
17.5	1257	1256	1256	1255	1253	1252	1251	1250	1251	1251	1250	1250	1250	1251	1253	1254	1255	1255	1250	1251	1253	1255	1255	1256	1257	1258	1260	1260	1262	1260	1260	1261	1260	1259	1258	1256	1257			
20	1240	1239	1238	1238	1236	1234	1233	1232	1232	1232	1232	1232	1233	1233	1235	1237	1237	1238	1232	1233	1234	1236	1237	1238	1240	1241	1242	1243	1244	1244	1243	1244	1244	1243	1242	1241	1239	1240		
22.5	1221	1219	1218	1217	1215	1213	1212	1211	1211	1211	1211	1210	1212	1212	1214	1214	1216	1217	1211	1212	1214	1215	1216	1218	1220	1221	1222	1222	1224	1224	1225	1224	1225	1223	1222	1220	1218	1221		
25	1199	1197	1195	1194	1192	1190	1188	1187	1187	1187	1186	1188	1188	1189	1190	1193	1193	1194	1188	1189	1191	1192	1193	1195	1197	1199	1199	1200	1202	1202	1202	1202	1201	1199	1197	1196	1199			
27.5	1174	1172	1170	1168	1166	1165	1163	1162	1161	1161	1159	1162	1163	1163	1164	1166	1167	1169	1161	1163	1163	1166	1167	1170	1172	1173	1174	1174	1176	1177	1178	1177	1177	1174	1172	1171	1171			
30	1147	1145	1142	1140	1138	1136	1134	1134	1132	1133	1131	1132	1134	1135	1136	1138	1139	1140	1133	1135	1136	1137	1139	1142	1144	1145	1146	1148	1149	1150	1150	1150	1148	1146	1145	1143	1141			
32.5	1118	1116	1112	1110	1107	1106	1104	1103	1101	1102	1100	1102	1104	1105	1106	1108	1108	1111	1102	1104	1105	1107	1109	1112	1114	1115	1117	1118	1119	1121	1121	1122	1120	1117	1115	1115	1114			
35	1086	1084	1080	1077	1075	1073	1071	1069	1068	1068	1067	1068	1070	1071	1072	1073	1075	1078	1070	1072	1073	1074	1076	1079	1082	1083	1084	1086	1087	1089	1090	1090	1088	1084	1083	1082	1080			
37.5	1052	1050	1047	1043	1040	1039	1037	1035	1033	1033	1032	1034	1036	1037	1039	1041	1042	1044	1034	1037	1038	1040	1041	1045	1047	1049	1052	1052	1053	1056	1056	1056	1054	1051	1050	1048	1052			
40	1017	1014	1010	1006	1004	1002	1001	998	995	995	994	997	999	1000	1001	1002	1005	1009	998	1001	1001	1004	1005	1009	1012	1013	1016	1016	1018	1019	1021	1022	1020	1015	1012	1012	1017			
42.5	980	977	972	968	966	964	964	960	958	956	957	958	960	963	964	964	966	969	959	961	963	964	966	971	973	976	978	978	980	982	983	982	979	977	976	975	980			
45	940	937	932	928	925	924	923	920	917	916	915	919	921	922	923	924	926	929	920	922	923	924	927	931	935	937	939	939	941	944	945	945	942	938	937	935	940			
47.5	900	897	891	886	884	882	881	877	874	872	873	876	878	880	881	880	884	887	879	880	881	882	884	888	892	895	897	897	899	902	905	902	900	896	895	893	900			
50	858	854	849	843	840	840	839	835	831	830	830	833	836	837	837	839	841	844	835	837	838	839	842	847	851	854	855	855	857	861	863	862	858	854	853	851	858			
52.5	813	810	805	799	796	795	794	791	787	784	784	787	789	791	792	792	794	799	791	792	794	794	797	802	806	810	810	809	813	817	819	817	814	809	808	806	813			
55	769	765	760	753	751	749	748	745	741	737	739	742	744	746	747	747	750	753	743	747	747	748	752	757	761	764	765	764	768	772	773	772	768	765	763	763	769			
57.5	721	718	712	708	703	701	701	697	693	690	693	694	697	699	698	700	702	706	698	701	701	703	705	711	716	718	719	719	722	727	728	727	724	718	717	715	721			
60	674	670	666	661	655	654	653	650	646	642	644	646	648	650	649	649	652	657	649	651	652	654	657	663	667	670	671	671	675	679	678	677	673	669	669	667	674			
62.5	627	622	617	611	607	606	605	602	597	593	595	598	599	602	601	602	604	609	601	603	604	606	609	615	620	622	622	623	627	630	632	628	622	620	620	627				
65	577	573	568	561	559	557	555	552	548	543	545	547	549	550	551	550	553	558	549	553	554	555	557	563	569	572	573	574	577	580	581	580	575	572	570	569	577			
67.5	527	524	517	512	508	505	505	501	496	493	493	497	498	501	500	501	504	508	498	503	504	507	509	515	521	523	525	525	528	530	532	533	532	522	521	520	527			
70	476	473	466	462	458	455	453	450	445	442	442	446	447	449	449	449	452	457	448	451	452	454	456	462	468	470	471	474	476	478	480	479	476	472	468	468	476			
72.5	426	423	417	412	407	406	404	401	395	393	392	395	397	399	398	399	402	406	397	401	403	405	409	415	419	422	422	423	425	428	429	428	425	421	419	417	426			
75	377	373	367	363	357	355	353	351	346	343	344	347	349	348	350	351	357	348	350	353	355	358	363	367	370	370	373	376	378	379	379	376	371	369	366	377				
77.5	326	322	318	313	309	305	303	301	297	296	293	293	295	296	295	299	301	305	295	299	302	306	309	313	317	319	322	324	324	325	327	325	324	319	318	316	326			
80	276	271																																						

### Photometric Testing Information

The sample was evaluated for photometric and electrical characteristics using an integrating sphere and a goniophotometer, each located in purpose-built, temperature and humidity-controlled, draft free environments.

The integrating sphere is by Labsphere which exhibits a “ $4\pi$  geometry” configuration according to IES LM-79-08 and is applicable for all types of LED products (directional and non-directional light projections). Its spectroradiometer is an array-type detector manufactured and calibrated by Labsphere.

The integrating sphere uses self-absorption correction to eliminate errors due to mismatches between the standard reference lamp and the test samples being measured. The auxiliary lamp used to perform this task is a halogen type lamp powered by a calibrated *Lamp Power Supply* manufactured and calibrated by Labsphere. Ambient temperature (for photometric analysis) is measured using a “J-Type” thermocouple located inside the integrating sphere at the same height as the sample under test and not more than 1 meter in horizontal distance away from the sample. The thermocouple is located behind the baffle of the photo detector in order to eliminate any direct optical radiation from the sample under test.

#### Luminaire Stabilization.

The sample was placed inside the integrating sphere and powered by a regulated and conditioned Voltage alternating current supply. The correlated color temperature, color rendering index, chromaticity coordinates and electrical power measurements contained in this report are the numeric **averages** of the three readings upon which stabilization is verified. The stabilization times shown on the results pages of this report denote the time of the 1<sup>st</sup> measurement (of the 3 consecutive readings) since this is the minimum time that the sample is assumed to have taken to reach stabilization.

The integrating sphere is calibrated using a quartzline halogen lamp with the following specifications:

Sphere D	Sphere B & C
Manufacturer: Sylvania	Sylvania
Model# 75Q/CL-28V	796
Voltage = 28.0 Volt	12.0 Volt
Wattage = 75.0 Watts	32.0 Watts
Calibration Current = 2.679 Amperes	2.600Amperes
Luminous Flux = 1538.8 Lumens	554.0 Lumens
Calibration Date = 8-18-2005	11-13-2013
(calibrated by Labsphere – NIST traceable).	

Continued.....

**Photometric Testing Information (continued)**

The goniophotometer Mayer Engineering Type C is calibrated using a frosted tungsten filament FDS/DZE lamp with the following specifications:

Manufacturer: GE  
Part Number: DZE 88  
Bulb Number: 114-A  
Voltage: 16.59 Volts DC reference  
Calibration Current: 4.810 Amperes  
Luminous Intensity: 154.7 Candelas  
Calibration Date: 7/12/12 (NIST traceable)

Manufacturer: GE  
Part Number: DZE 88  
Bulb Number: 114-B  
Voltage: 16.61 Volts DC reference  
Calibration Current: 4.819 Amperes  
Luminous Intensity: 150.6 Candelas  
Calibration Date: 7/12/12 (NIST traceable)

Manufacturer: GE  
Part Number: DZE 88  
Bulb Number: 114-C  
Voltage: 16.66 Volts DC reference  
Calibration Current: 4.815 Amperes  
Luminous Intensity: 155.4 Candelas  
Calibration Date: 7/12/12 (NIST traceable)

A Yokogawa WT210 Power Analyzer was used to measure all electrical characteristics of the sample.

<b>Equipment List: Goniophotometer Type C (Mirror 1)</b>			
<b>Description</b>	<b>Manufacturer and Model Number</b>	<b>CSA Instrument Reference Number</b>	<b>Calibration Due Date</b>
Optometer	Gigahertz Optik P9801	N/A	N/A
Regulated Power Supply	Chroma Instruments 61602P-80-60	DCP401	N/A
Regulated Power Supply	Chroma Instruments 61602	DCP301	N/A
Power Analyzer	Yokogawa WT210	POA400	11/2016
<b>Equipment List: Sphere D Equipment</b>			
<b>Description</b>	<b>Manufacturer and Model Number</b>	<b>CSA Instrument Reference Number</b>	<b>Calibration Due Date</b>
Integrating Sphere 109"	Labsphere LMS760	SPH400	N/A
Spectroradiometer	Labsphere CDS1100	CDS1100C	N/A
Auxiliary Lamp PSU	Labsphere LPS100	LPS100	N/A
Power Analyzer	Yokogawa WT210	PA111	2/2017
Regulated Power Supply	Chroma Instruments 61603	AC302	N/A

All equipment is calibrated to ISO / IEC 17025-2005 guidelines.