



Report: 70016524
Project: 70016524
Client: Man-D-Tec

PHOTOMETRIC TESTING & EVALUATION

Sample Tested
AEROBEAM PLATINUM (WARM WHITE)

Prepared for:

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**Technical Report Number
70016524**

December 5, 2014

Prepared by:

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

Mauricio Anderson, Project Manager

Approved by:

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

Jesse Whalen, Operations Manager

Program Description

Photometric and electrical testing of an “AEROBEAM PLATINUM (WARM WHITE)” fixture.

Executive Summary

Sample Tested = **AEROBEAM PLATINUM (WARM WHITE)**

Luminous Efficacy* (Lumens/Watt)	Luminous Flux* (Lumens)	Input Power* (Watts)	Power Factor*
104.9	658.1	6.271	1.00

CCT (K)*	CRI*	Stabilization Time (Light & Power)
3051.5	97.9	60 minutes

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

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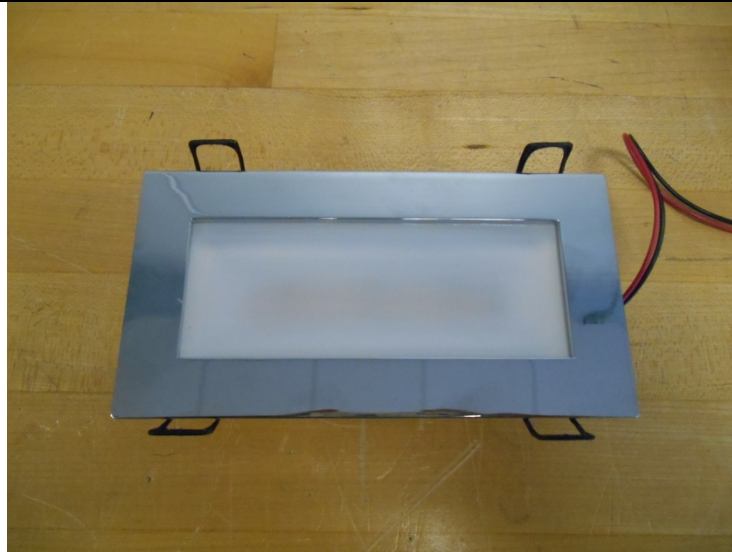
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Sample

The following sample was submitted for evaluation:

QSSI: AEROBEAM PLATINUM (WARM WHITE)

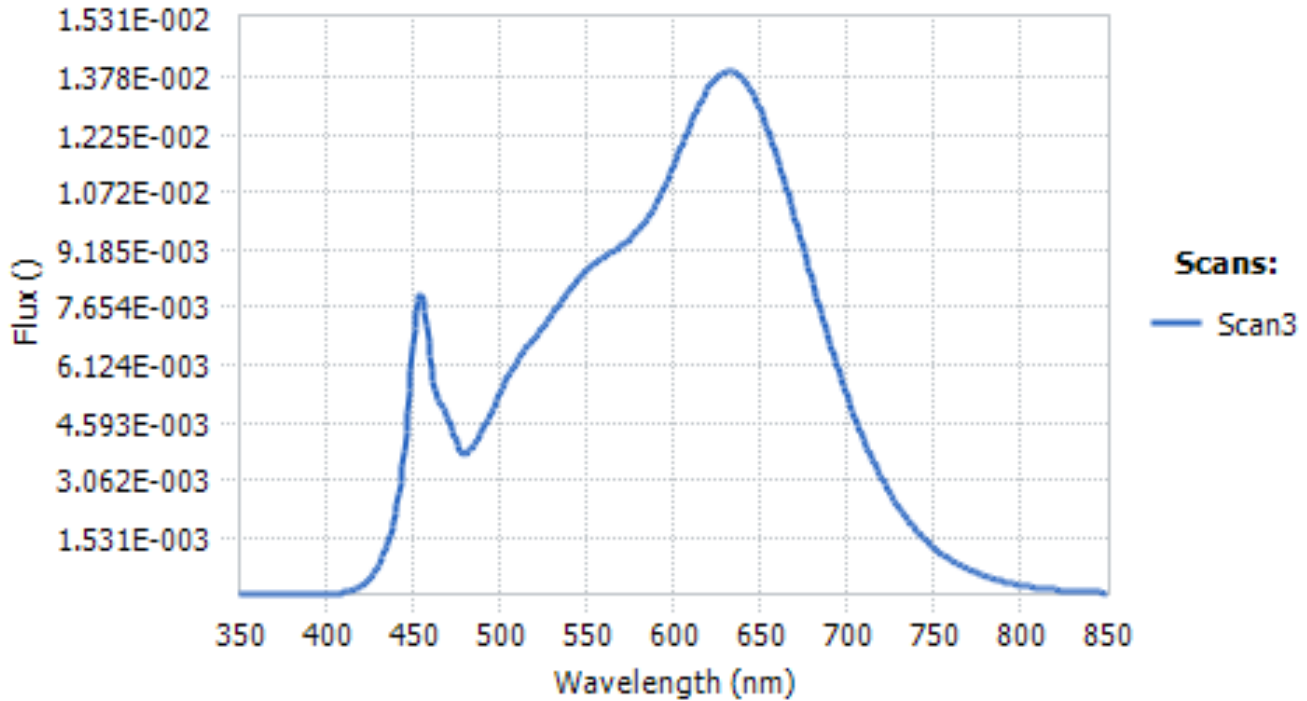


AEROBEAM PLATINUM (WARM WHITE)

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						
	AEROBEAM PLATINUM (WARM WHITE)						
	Integrating Sphere			Goniophotometer			
Luminous Efficacy (Lumens/Watt)	104.94			107.62			
Total Luminous Flux (Lumens)	658.1			674.94			
Total Radiant Flux (Watts)	2.46						
Correlated Color Temperature (CCT)	3051.5						
Color Rendering Index (CRI) (Ra)	97.9						
R1 thru R7 Value	98.4	98.6	98.2	99.6	98.6	96.3	96.9
R8 thru R14 Value	96.3	92.9	99.1	97.4	84.2	98.2	98.1
Chromaticity (Chroma x / Chroma y)	0.4300 / 0.3960						
Chromaticity (Chroma u / Chroma v)	0.2496 / 0.3447						
Chromaticity (Chroma u' / Chroma v')	0.2496 / 0.5171						
Duv Value	0.0023						
Stabilization Time (Light and Power)	Approx. 60 minutes						
Total Run Time – Integrating Sphere	64 minutes						
Total Run Time – Goniophotometer	89 minutes						
Spacing Criteria	1.16 (0° – 180°) / 1.06 (90° – 270°)						
Scotopic/Photopic ratio $\Phi(v')/\Phi(v)$	1.50						
Electrical Input Results:	Sample Reference						
	AEROBEAM PLATINUM (WARM WHITE)						
Input Power (Watts)	6.271						
Input Voltage (Volts AC)	8.958						
Input Current (Amps)	0.700						
Input Frequency (Hertz)	60.0						
Power Factor	1.00						
1Additional Information	Sample Reference						
	AEROBEAM PLATINUM (WARM WHITE)						
Ambient Temperature	24.8°C						
Integrating Sphere Detector	CDS 600 Spectroradiometer						
Absorption Correction used?	Yes						

Spectral Flux

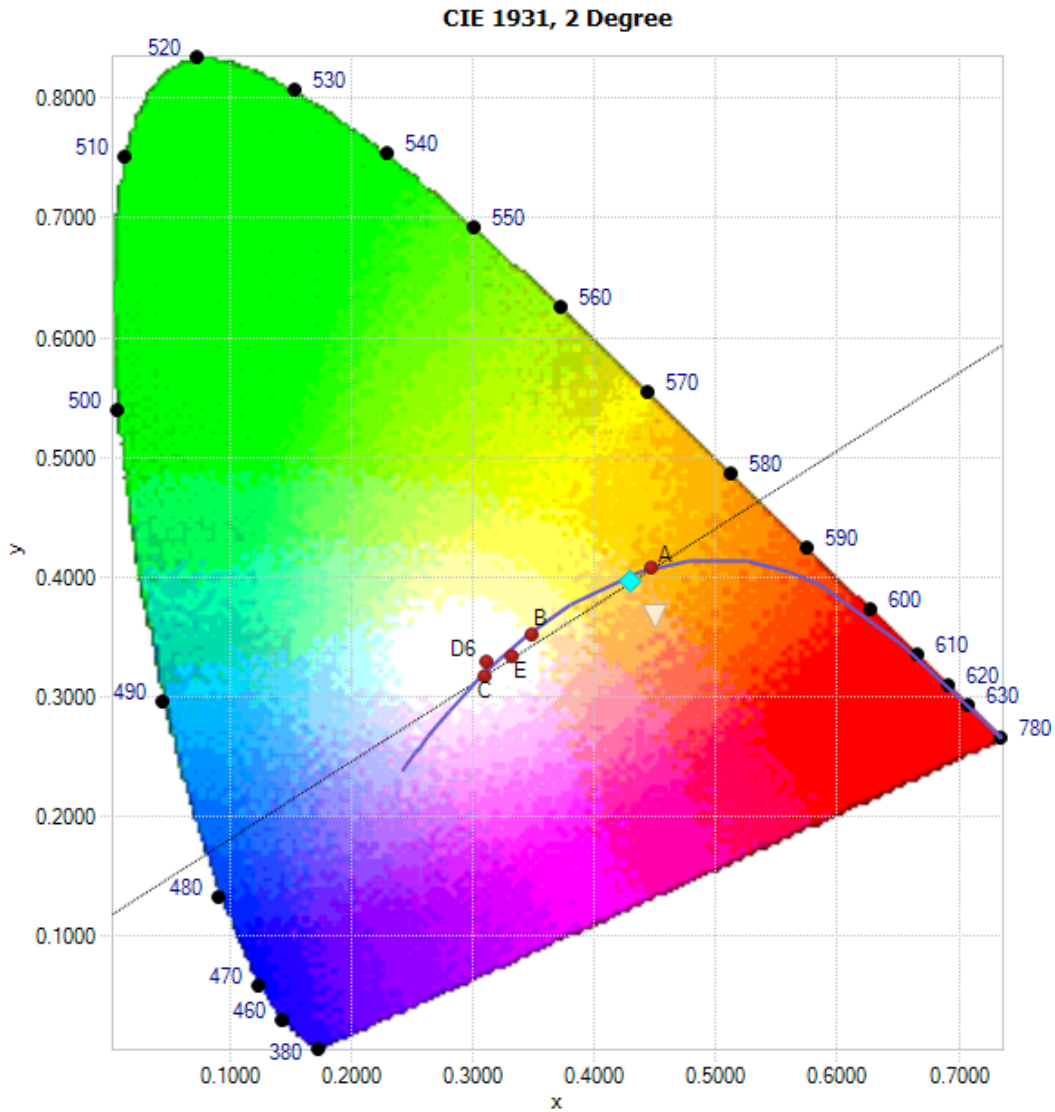
The following graph shows the spectral response curve of the radiant flux for the sample:



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):
 $x / y = 0.4300 / 0.3960$

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:

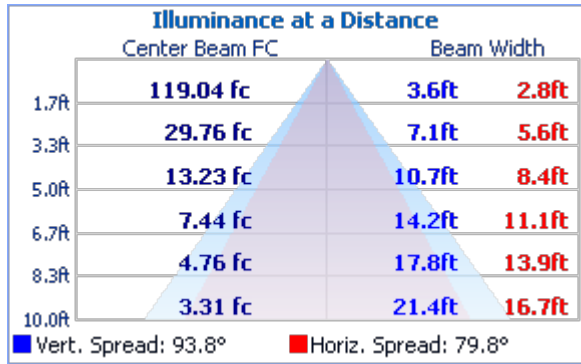
Zone	Lumens	% Total
0-10	31.0	4.6%
10-20	85.7	12.7%
20-30	121.3	18.0%
30-40	132.2	19.6%
40-50	119.9	17.8%
50-60	92.6	13.7%
60-70	60.1	8.9%
70-80	28.0	4.1%
80-90	4.2	0.6%
Total	675.0 LUMENS	100%

Zonal Lumen Summary

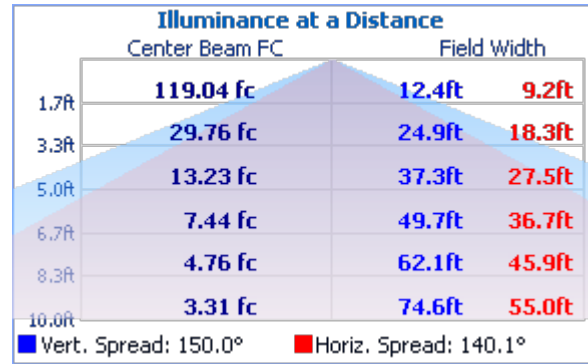
Zone	Lumens	%Luminaire
0-30	238.0	35.3%
0-40	370.2	54.9%
0-60	582.7	86.3%
60-90	92.3	13.7%
0-90	675.0	100%

Test Results – Illuminance Plots

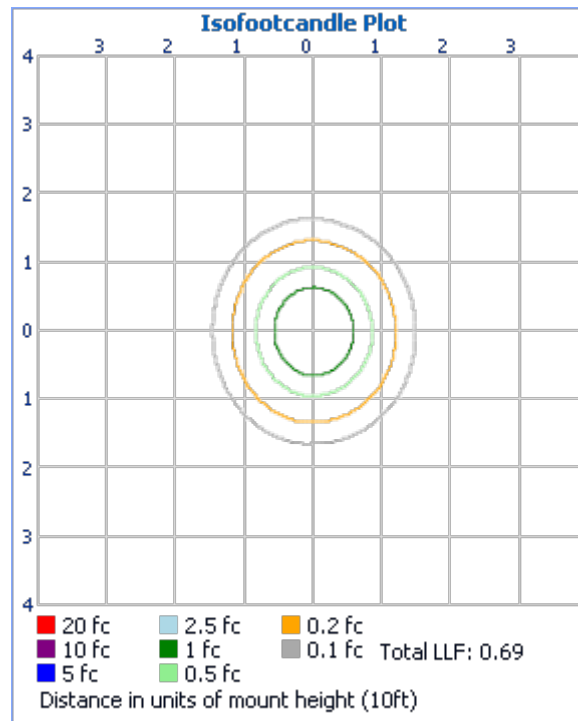
The following images depict the illuminance characteristics of the luminaire.



Beam Angle



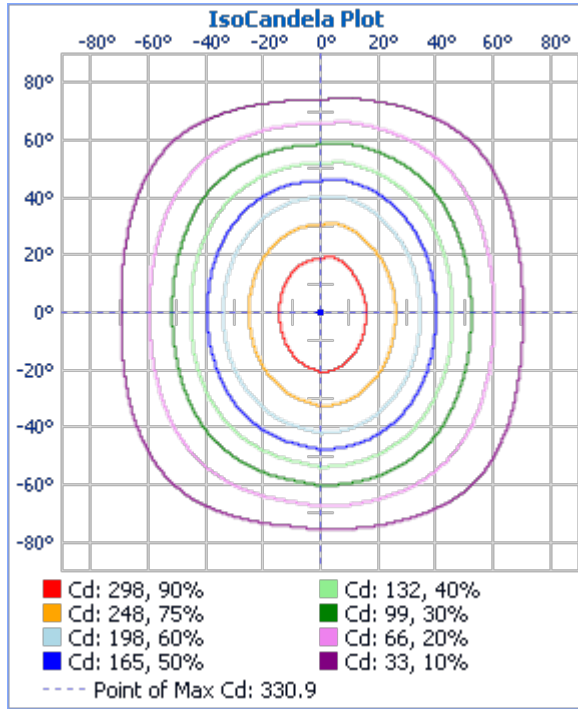
Field Angle



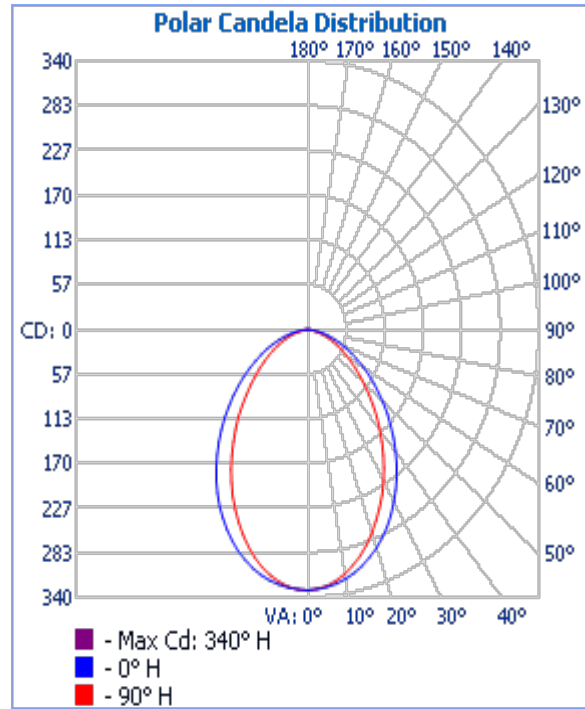
Illuminance Plot (Footcandles)

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	50	30	20	0
RCR: 0	1.19	1.19	1.19	1.19	1.16	1.16	1.16	1.00	1.11	1.11	1.11	1.06	1.06	1.06	1.02	1.02	1.02	1.00	1.00	1.00	1.00
1	1.10	1.06	1.02	.99	1.08	1.04	1.01	.88	1.00	.97	.94	.96	.94	.92	.92	.91	.89	.89	.89	.89	.87
2	1.01	.94	.88	.83	.99	.92	.87	.76	.89	.84	.80	.86	.82	.78	.83	.79	.77	.75	.75	.75	.75
3	.93	.84	.76	.71	.91	.82	.75	.66	.79	.74	.69	.77	.72	.68	.74	.70	.66	.64	.64	.64	.64
4	.86	.75	.67	.61	.84	.74	.66	.58	.71	.65	.60	.69	.64	.59	.67	.62	.58	.56	.56	.56	.56
5	.80	.68	.60	.53	.78	.67	.59	.51	.65	.58	.53	.63	.57	.52	.61	.56	.52	.50	.50	.50	.50
6	.74	.62	.53	.47	.72	.61	.53	.46	.59	.52	.47	.57	.51	.46	.56	.50	.46	.44	.44	.44	.44
7	.69	.56	.48	.42	.67	.55	.48	.41	.54	.47	.42	.53	.46	.42	.51	.46	.41	.39	.39	.39	.39
8	.64	.52	.44	.38	.63	.51	.43	.37	.50	.43	.38	.49	.42	.38	.47	.42	.37	.36	.36	.36	.36
9	.60	.48	.40	.35	.59	.47	.40	.34	.46	.39	.34	.45	.39	.34	.44	.38	.34	.32	.32	.32	.32
10	.57	.44	.37	.32	.56	.44	.37	.31	.43	.36	.32	.42	.36	.31	.41	.35	.31	.30	.30	.30	.30



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	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331		
2.5	329	329	330	330	330	330	330	329	329	329	330	330	330	330	330	330	330	331	329	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	
5	328	328	328	328	327	327	327	327	327	327	326	327	327	327	327	328	329	329	328	328	329	328	328	328	328	328	327	327	327	327	328	328	328	328	328	328	328	328	329	330	328
7.5	325	325	325	324	324	323	322	322	321	321	322	322	322	323	324	325	326	326	326	326	326	326	326	325	324	324	323	323	323	323	324	324	324	324	324	325	326	327	327	325	
10	321	321	321	320	319	318	317	316	315	315	314	316	316	317	319	320	321	322	323	323	322	322	322	321	319	318	317	316	316	317	318	318	319	320	321	322	323	324	321		
12.5	316	316	315	314	312	311	309	308	307	307	306	307	309	310	312	314	316	317	319	318	318	318	316	315	313	311	310	309	309	310	311	313	314	316	318	319	316				
15	310	310	309	307	305	303	301	299	298	297	297	299	300	302	304	307	310	311	313	312	312	310	308	305	303	302	300	300	300	301	303	305	307	310	312	313	310				
17.5	303	303	301	299	297	293	291	289	287	287	287	288	291	293	296	299	302	304	306	306	304	302	299	296	293	291	289	289	290	291	293	295	298	301	305	306	303				
20	295	295	293	291	287	283	280	278	275	275	275	277	279	282	286	290	294	296	299	298	296	293	290	286	283	280	279	278	278	280	282	285	288	292	296	298	295				
22.5	286	285	284	280	276	272	269	265	264	263	263	265	268	271	275	279	284	286	290	290	287	284	279	275	271	268	266	265	266	268	270	274	278	282	287	289	286				
25	276	275	273	269	265	260	257	253	251	250	250	252	255	259	263	268	273	276	280	279	277	273	268	263	259	255	253	252	253	255	258	262	266	271	276	280	276				
27.5	265	264	262	258	253	248	244	240	238	237	237	239	242	246	251	256	262	265	270	269	266	262	256	251	246	242	240	238	239	242	245	250	253	260	265	269	265				
30	253	253	250	246	240	235	231	226	224	223	224	225	229	233	239	244	250	254	259	258	254	249	244	238	233	228	226	224	225	228	231	236	239	248	253	258	253				
32.5	241	240	237	233	227	222	217	213	210	209	209	211	216	220	226	232	237	241	247	246	242	237	230	224	219	214	211	210	210	213	217	223	226	235	241	245	241				
35	228	228	225	219	214	208	202	198	195	194	195	197	201	206	212	218	224	228	234	233	229	223	217	210	204	199	196	194	195	198	203	208	212	221	227	232	228				
37.5	215	214	211	205	200	194	188	184	180	179	180	182	186	192	197	204	210	214	221	219	215	209	203	196	189	184	180	179	180	183	188	194	199	207	214	219	215				
40	201	201	197	192	186	179	174	169	166	164	165	167	172	178	184	190	196	200	207	206	202	196	189	181	175	170	165	165	165	168	174	180	185	194	200	205	201				
42.5	187	187	183	178	172	165	160	155	151	150	151	154	158	164	171	176	182	186	193	192	188	182	174	167	160	155	151	151	154	160	166	172	180	187	191	187					
45	173	172	169	164	158	152	146	141	137	136	137	140	145	150	156	162	168	173	179	178	173	168	161	153	146	141	137	136	137	140	145	151	158	166	172	177	173				
47.5	159	158	155	150	144	138	132	127	123	122	123	126	131	136	142	149	154	158	165	163	159	153	146	139	132	127	124	122	123	126	131	138	145	152	158	163	159				
50	145	144	141	136	131	125	119	114	111	109	109	112	117	123	129	135	140	144	151	149	146	140	133	126	119	114	111	109	110	113	118	124	132	138	145	149	145				
52.5	131	131	128	124	118	112	106	101	98	97	97	101	105	110	116	122	127	131	137	136	132	127	120	113	107	102	99	97	98	101	106	112	118	125	131	136	131				
55	119	118	115	111	105	100	95	90	87	86	87	89	93	98	104	109	114	118	124	123	119	114	108	101	95	91	88	86	87	90	94	100	106	113	118	123	119				
57.5	106	105	103	99	94	89	84	79	77	75	76	78	83	87	92	97	102	105	111	110	107	102	96	90	84	80	77	76	77	79	83	89	94	101	106	110	106				
60	94	93	91	87	83	78	73	70	67	66	66	68	72	76	81	86	90	93	98	97	94	90	85	79	74	70	67	66	67	69	72	78	83	89	94	97	94				
62.5	82	82	79	76	72	68	63	60	58	57	57	59	62	66	71	75	79	81	86	85	83	79	74	69	64	60	58	57	58	60	63	67	72	78	82	86	82				
65	71	71	69	66	62	58	54	51	49	48	49	50	53	57	60	65	68	70	75	74	71	68	63	59	55	51	49	49	49	51	54	58	62	67	71	74	71				
67.5	60	60	58	56	53	49	46	43	41	40	41	42	45	48	51	55	57	59	64	63	61	58	54	50	46	43	42	41	41	43	46	49	53	57	61	64	60				
70	50	50	48	46	44	41	38	35	34	33	33	34	37	39	42	45	48	50	54	53	51	48	45	41	38	35	34	34	34	35	38	41	44	48	51	53	50				
72.5	41	40	39	38	35	33	30	28	27	26	26	27	29	32	34	36	39	40	44	43	42	39	36	33	31	28	27	26	27	28	30	33	36	39	41	44	41				
75	31	31	30	29	27	25	23	21	20	20	20	20	22	24	26	28	30	31	35	34	33	30	28	25	23	21	20	20	21	23	25	28	31	33	34	31					
77.5	23	23	22	21	20	18	16	15	14	13	14	14	16	17	19	20	22	22	26	25	24	22	20	18	16	15	14	14	14	15	16	18	20	22	24	26	23				
80	16	15	15	14	13	11	10	9	8	8	8	9	10	11	12	13	14	15	17	17	17	16	15	14	12	10	9	9	9	10	11	13	15	17	18	16					
82.5	9	9	8	8	7	6	5	4	4	4	4	5	5	6	7	8	8	11	10	10	9	7	6	5	5	5	5	5	5	5	5	6	7	9	10	10	9				
85	3	3	3	3	2	2	2	2	2	2	1	2	1	2	2	3	3	5	4	4	4	2	2	2	2	2	2	2	2	2	2	3	4	5	3	0					
87.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				

Continued.....

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 “4π 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 1st 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.



Equipment List: Goniophotometer Type C (Mirror 1)			
Description	Manufacturer and Model Number	CSA Instrument Reference Number	Calibration Due Date
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	11/2015
Equipment List: Sphere C Equipment			
Description	Manufacturer and Model Number	CSA Instrument Reference Number	Calibration Due Date
Integrating Sphere 76"	Labsphere LMS760	SPH300	N/A
Spectroradiometer	Labsphere CDS1100	CDS1100C	N/A
Auxiliary Lamp PSU	Labsphere LPS100	LPS100	N/A
Power Analyzer	Yokogawa WT210	PA111	2/2015
Regulated Power Supply	Chroma Instruments 61603	AC302	N/A

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