PHOTOMETRIC TESTING & EVALUATION TO IES LM-79-08

Sample Tested

Aero Beam Warm White

Prepared for:

Man-D-Tec
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Phone: 480-998-0325

Technical Report Number
2662601-02

September 17, 2013

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Program Description

Photometric and electrical testing of a "Aero Beam Warm White" replacement fixture to IES LM-79-08.

Executive Summary

Sample Tested = **Aero Beam Warm White**

Luminous Efficacy* (Lumens/Watt)	Luminous Flux* (Lumens)	Input Power* (Watts)	Power Factor*
90.44	572.5	6.33	1

CCT (K)*	CRI*	Stabilization Time (Light & Power)
3031.8	80	30 minutes

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

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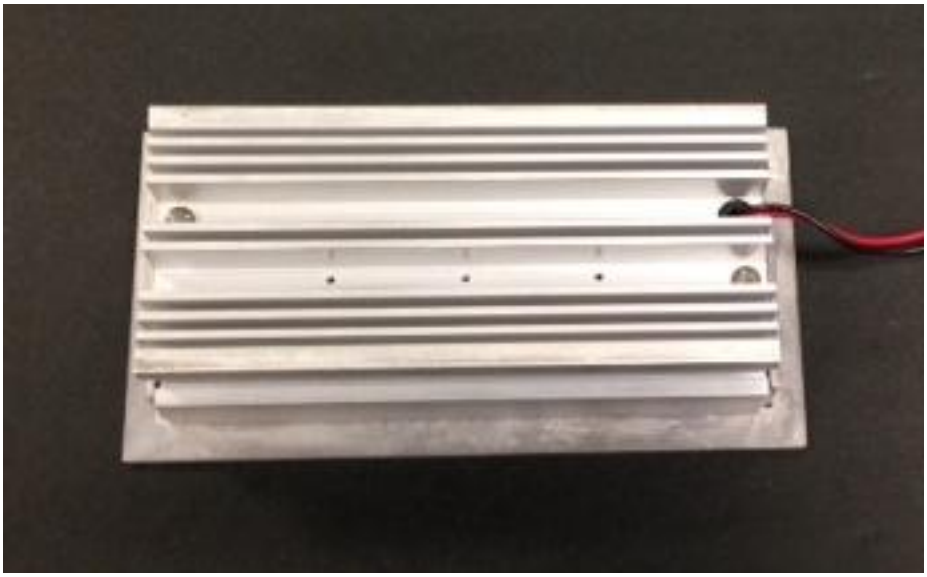
Sample
The following sample was submitted for evaluation:
Man-D-Tec: Aero Beam Warm White
Aero Beam Warm White



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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% (in accordance with IES LM-79-08).

Key Photometric Results	**Sample Reference**						
	Aero Beam Warm White						
	Integrating Sphere				**Goniophotometer**		
Luminous Efficacy (Lumens/Watt)	**90.44**				**95.36**		
Total Luminous Flux (Lumens)	**572.5**				**605.52**		
Total Radiant Flux (Watts)	**1.811**						
Correlated Color Temperature (CCT)	**3031.8**						
Color Rendering Index (CRI) (Ra)	**80**						
R1 thru R7 Value	**77.8**	**85.6**	**92.7**	**79.4**	**77.2**	**80.5**	**85**
R8 thru R14 Value	**61.9**	**7.9**	**66.6**	**76.9**	**63**	**78.8**	**95.5**
Chromaticity (Chroma x / Chroma y)	**0.4350 / 0.4042**						
Chromaticity (Chroma u / Chroma v)	**0.2493 / 0.3474**						
Chromaticity (Chroma u' / Chroma v')	**0.2493 / 0.5212**						
D_{uv} Value	**0.00034**						
Stabilization Time (Light and Power)	**Approx. 30 minutes**						
Total Run Time – Integrating Sphere	**34 minutes**						
Total Run Time – Goniophotometer	**103 minutes**						
Spacing Criteria	**1.16 (0° – 180°) / 1.06 (90° – 270°)**						
Scotopic/Photopic ratio Φ(v')/Φ(v)	**1.280**						

Electrical Input Results:	**Sample Reference**	
	Aero Beam Warm White	
	Integrating Sphere	**Goniophotometer**
Input Power (Watts)	**6.33**	**6.35**
Input Voltage (Volts DC)	**10.0**	**9.05**
Input Current (Amps)	**0.70**	**0.70**
Input Frequency (Hertz)	**0**	**0**
Power Factor	**1.00**	**1.00**
Total Harmonic Distortion (%THD V/A)	**N/A**	

Additional Information	**Sample Reference**
	Aero Beam Warm White
Ambient Temperature	**24.9°C**
Integrating Sphere Detector	**CDS 600 Spectroradiometer**
Absorption Correction used?	**Yes**

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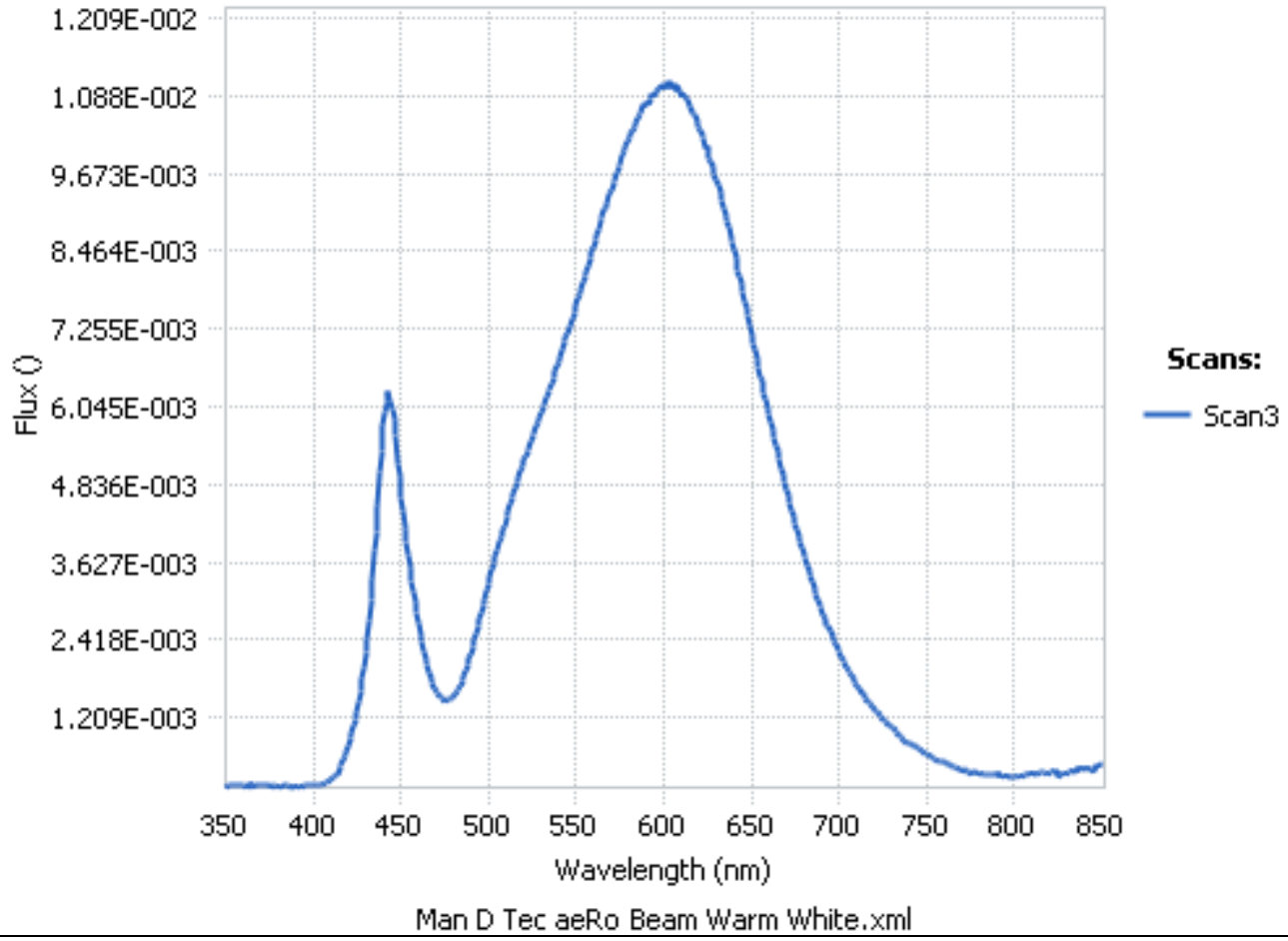
Spectral Flux

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).

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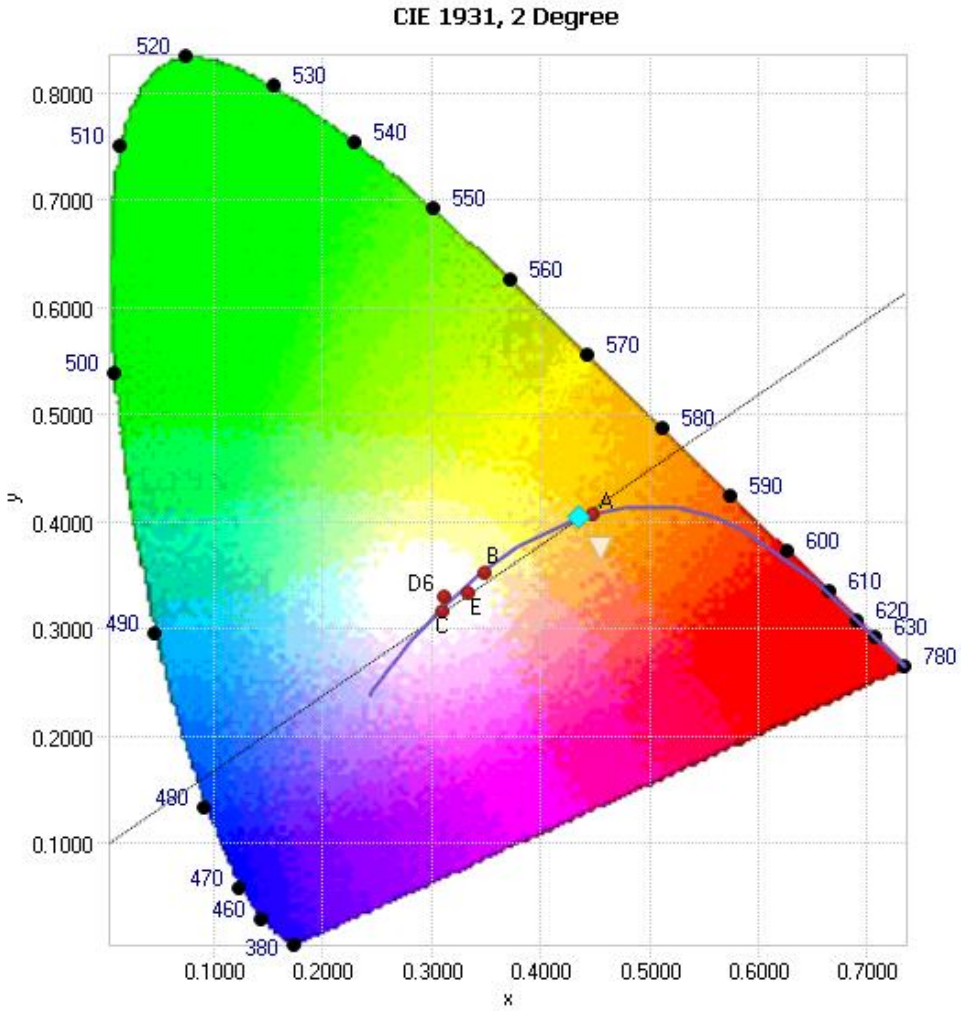
Chromaticity Diagram

The following image shows the chromaticity diagram for the sample:



Tristimulus values (from page 6):
x / y = 0.4350 / 0.4042

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

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Test Results – Flux Distribution – Zonal Lumen Summary		
The following table depicts the zonal lumen distribution for the sample:		
Zone	**Lumens**	**% Total**
0 - 10	**27.3**	**4.50%**
10 - 20	**75.7**	**12.50%**
20 - 30	**107.6**	**17.80%**
30 - 40	**117.7**	**19.40%**
40 - 50	**107.1**	**17.70%**
50 - 60	**83.5**	**13.80%**
60 - 70	**55**	**9.10%**
70 - 80	**26.5**	**4.40%**
80 - 90	**5.3**	**0.90%**
Total	**605.5 LUMENS**	
Zone		
0-30	**210.5**	**34.80%**
0-40	**328.2**	**54.20%**
0-60	**518.8**	**85.70%**
60-90	**86.7**	**14.30%**
0-90	**605.5**	**100%**

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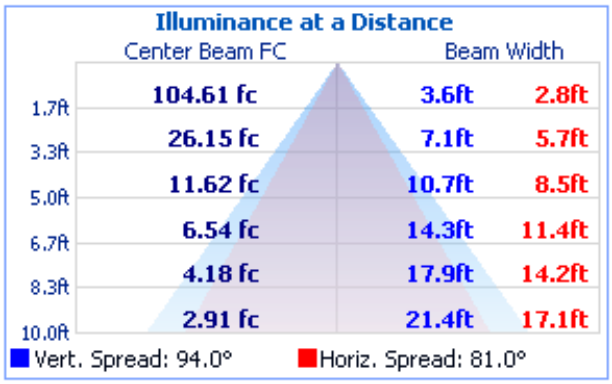
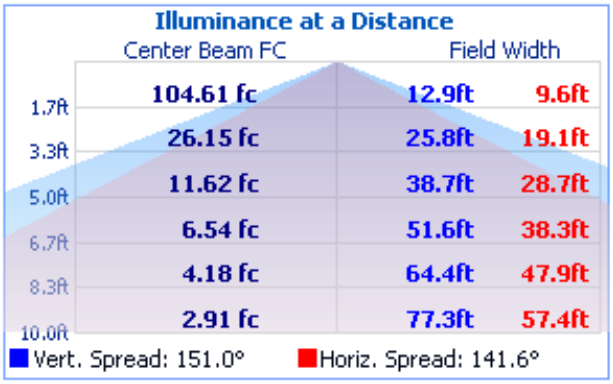
Test Results – Illuminance Plots

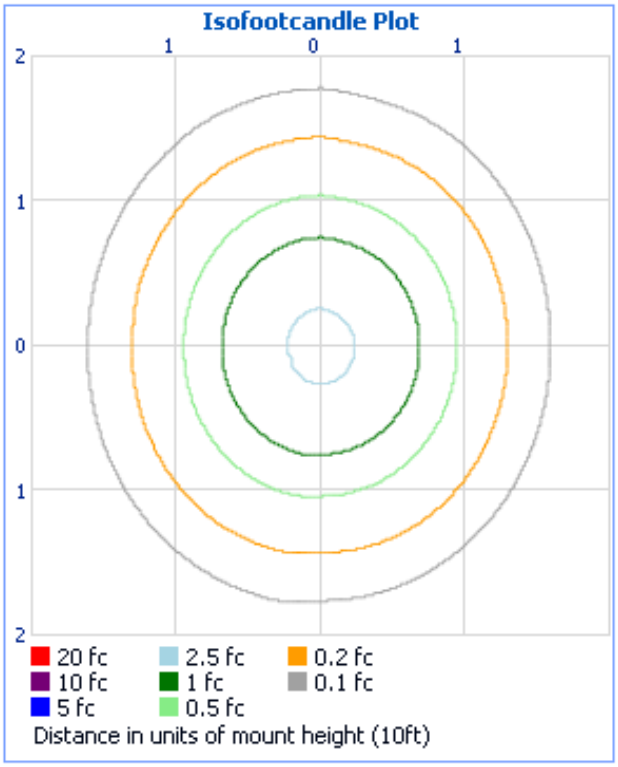
The following images depict the illuminance characteristics of the luminaire.



Beam Angle



Field Angle



Illuminance Plot (Footcandles)

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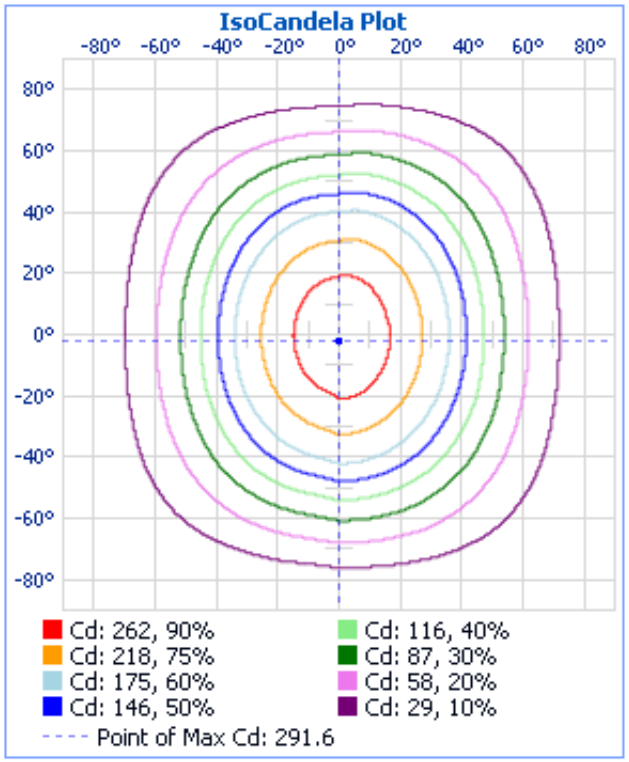
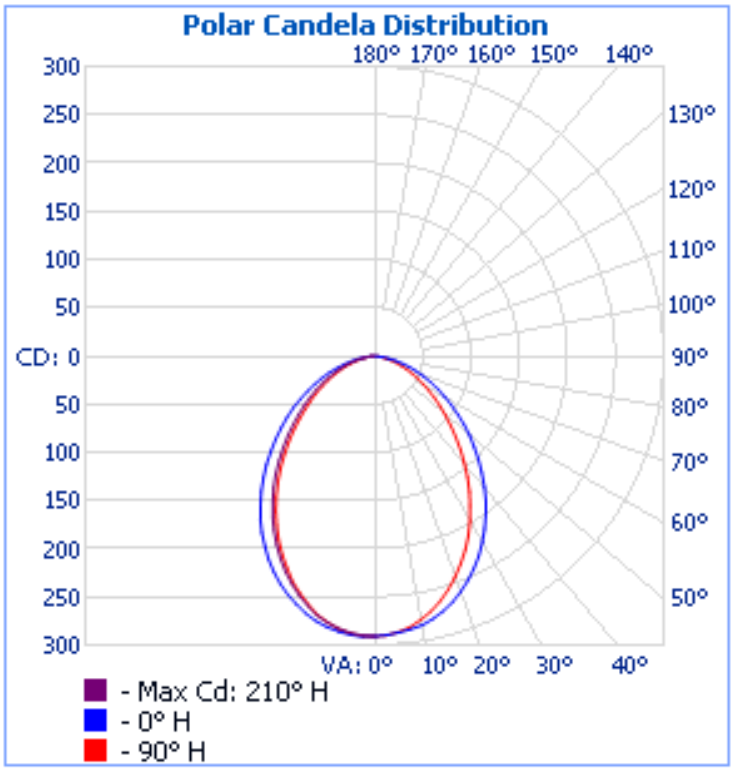
Test Results – Candela Plots

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	1.19	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	1.10	1.06	1.02	.99	1.07	1.04	1.00	.87	.99	.97	.94	.96	.93	.91	.92	.90	.89	.87
2	1.01	.94	.88	.83	.99	.92	.86	.75	.88	.84	.80	.85	.81	.78	.82	.79	.76	.74
3	.93	.83	.76	.70	.91	.82	.75	.65	.79	.73	.68	.76	.71	.67	.74	.70	.66	.64
4	.86	.75	.67	.61	.84	.73	.66	.57	.71	.65	.59	.69	.63	.59	.67	.62	.58	.56
5	.79	.67	.59	.53	.77	.66	.59	.51	.64	.57	.52	.62	.56	.52	.61	.55	.51	.49
6	.74	.61	.53	.47	.72	.60	.52	.45	.59	.52	.46	.57	.51	.46	.55	.50	.46	.44
7	.69	.56	.48	.42	.67	.55	.47	.41	.54	.47	.41	.52	.46	.41	.51	.45	.41	.39
8	.64	.51	.43	.38	.63	.51	.43	.37	.49	.42	.37	.48	.42	.37	.47	.41	.37	.35
9	.60	.47	.40	.34	.59	.47	.39	.34	.46	.39	.34	.45	.38	.34	.44	.38	.34	.32
10	.56	.44	.36	.31	.55	.43	.36	.31	.42	.36	.31	.42	.35	.31	.41	.35	.31	.29

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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	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291	291
2.5	290	291	291	291	291	290	290	290	290	290	290	285	289	289	289	290	290	290	291	291	291	292	291	291	291	291	291	291	290	279	290	290	290	290	290	290	290
5	288	289	289	289	288	288	288	288	287	287	287	287	287	287	287	288	288	288	290	290	290	290	290	290	289	289	289	289	288	276	288	288	288	289	289	289	288
7.5	286	286	286	286	285	285	284	283	283	283	283	283	283	284	284	285	285	285	288	288	288	288	287	286	286	286	286	285	285	273	285	285	286	286	286	287	286
10	283	283	283	282	281	280	279	278	278	278	277	278	278	279	280	281	282	282	285	285	285	284	284	283	282	281	281	280	280	270	281	281	282	283	284	284	283
12.5	279	278	278	277	275	274	273	272	271	271	271	271	272	273	274	276	277	278	281	282	281	280	279	277	276	275	275	275	275	268	276	276	277	279	280	280	279
15	274	273	272	271	269	267	265	264	263	263	263	264	265	266	268	269	271	272	276	276	275	274	272	270	269	268	267	266	267	265	268	270	271	273	274	274	274
17.5	268	267	265	263	261	259	257	255	254	254	254	255	256	259	261	263	265	266	270	270	269	267	265	262	261	259	259	258	258	259	260	262	264	266	268	269	268
20	260	259	258	255	253	250	248	245	244	244	244	246	247	250	252	255	257	258	263	263	261	259	257	254	252	250	249	249	249	250	251	254	256	259	261	262	260
22.5	252	251	249	247	243	240	237	235	234	233	234	235	237	240	243	247	249	251	256	255	253	251	248	245	242	240	239	238	239	240	242	245	247	250	253	254	252
25	243	242	240	237	233	230	227	224	223	222	223	224	227	230	233	237	240	242	247	247	244	242	238	235	231	230	228	227	227	229	232	234	238	241	244	246	243
27.5	234	233	230	227	222	219	215	212	211	210	211	213	215	219	223	227	230	232	238	237	235	231	227	224	220	218	216	216	216	218	220	224	227	231	235	237	234
30	223	222	219	216	211	207	203	200	198	198	198	200	204	208	212	216	219	222	228	227	224	221	216	212	209	206	204	203	204	206	209	213	217	221	224	226	223
32.5	212	211	208	204	200	195	190	187	185	184	185	188	191	196	200	205	209	211	218	216	214	209	205	201	197	193	191	191	191	194	197	201	205	210	213	216	212
35	201	200	197	192	188	182	178	175	172	171	172	175	179	183	188	193	197	200	207	205	202	198	193	188	184	180	179	178	179	181	185	189	193	199	202	205	201
37.5	190	188	185	180	175	170	165	161	159	158	159	162	166	171	176	181	185	188	194	194	190	186	181	176	171	168	165	165	166	168	172	177	182	186	190	193	190
40	177	176	173	168	163	157	152	148	146	145	146	149	153	158	164	169	173	176	183	181	178	174	168	163	159	155	152	152	153	156	160	164	169	174	179	181	177
42.5	164	163	160	156	150	144	139	135	133	132	133	136	141	146	152	156	161	164	171	170	166	161	156	150	146	142	139	139	140	143	147	152	157	162	166	169	164
45	152	151	148	144	138	132	127	123	120	119	120	123	128	134	139	145	149	152	159	157	154	149	144	138	133	129	127	126	127	130	134	139	145	150	154	157	152
47.5	140	139	136	132	126	120	115	110	108	107	109	111	116	122	127	132	137	140	146	145	141	137	131	126	121	118	114	114	115	118	122	127	133	138	142	145	140
50	129	127	124	120	114	108	103	99	97	96	97	100	105	110	116	121	125	128	134	133	130	125	120	114	110	107	103	102	103	106	111	116	121	126	130	133	129
52.5	117	115	113	108	103	97	92	88	86	86	86	89	94	99	104	109	114	116	122	121	118	114	108	103	98	96	92	91	92	95	99	105	110	114	118	121	117
55	105	104	101	98	92	87	82	79	76	76	76	79	83	88	94	98	102	105	111	109	107	102	97	93	88	86	82	81	82	85	89	94	99	103	107	109	105
57.5	94	93	91	87	82	77	72	69	67	66	67	70	74	78	83	88	92	94	100	99	96	92	87	83	78	75	73	72	73	76	80	84	89	93	96	99	94
60	84	83	81	77	72	68	64	60	58	58	59	61	65	68	74	78	81	83	89	88	85	83	77	73	69	66	64	63	64	66	70	74	78	82	86	88	84
62.5	74	73	71	67	63	59	55	53	51	50	51	53	56	60	64	68	71	73	78	78	75	73	68	63	60	57	55	55	55	58	61	65	69	72	76	78	74
65	64	63	61	58	54	51	47	45	43	43	44	45	48	51	55	59	62	64	69	68	65	64	59	55	51	49	47	47	48	50	52	56	60	63	66	68	64
67.5	55	54	52	49	46	43	40	38	37	36	37	38	40	43	46	50	53	55	59	58	56	54	50	47	44	41	40	40	40	42	45	48	51	54	56	58	55
70	46	45	44	41	39	35	33	31	30	29	30	32	33	35	38	41	44	45	50	49	47	45	42	39	36	34	33	33	33	35	37	40	43	46	48	49	46
72.5	38	37	36	33	31	29	26	25	24	24	24	25	26	28	30	33	35	36	40	40	39	37	34	32	30	28	27	26	27	28	30	33	35	38	39	41	38
75	29	29	28	26	24	22	20	19	18	18	18	19	20	21	23	25	27	28	32	31	30	29	27	25	23	21	21	20	21	22	24	26	28	30	31	32	29
77.5	22	21	21	20	18	16	15	14	13	13	13	14	14	15	16	17	19	20	24	23	23	22	21	19	17	16	15	15	15	16	18	19	21	23	24	24	22
80	14	14	14	13	12	11	10	9	9	8	9	9	9	10	10	11	12	14	17	16	16	15	14	13	12	11	10	10	11	11	12	13	15	16	17	17	14
82.5	8	8	8	7	7	6	5	5	5	5	5	5	5	5	6	6	7	8	10	10	10	9	8	8	7	7	6	6	6	7	7	8	9	10	10	10	8
85	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	5	5	5	5	4	4	4	4	4	4	4	4	4	4	5	5	5	4
87.5	2	2	1	1	1	1	1	1	2	1	2	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
90	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Continued……

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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:

Manufacturer: Sylvania
Model# 75Q/CL-28V
Voltage = 28.0 Volt
Wattage = 75.0 Watts
Calibration Current = 2.679 Amperes
Luminous Flux = 1538.8 Lumens
Calibration Date = 8-18-2005 (calibrated by Labsphere – NIST traceable).

Continued…..

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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.

CSA is an accredited Test Laboratory (TL-430)
to IESNA LM79-08 by IAS (International Accreditation Service)
National Voluntary Laboratory Accreditation Program (NVLAP)200732-0

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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	N/A	N/A
Regulated Power Supply	Chroma Instruments 61602	N/A	N/A
Power Analyzer	Yokogawa WT210	POA400	11/2013

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	CDS600C	N/A
Auxiliary Lamp PSU	Labsphere LPS100	LPS100	N/A
Power Analyzer	Yokogawa WT210	PA112	1/2014
Regulated Power Supply	Chroma Instruments 61603	AC302	N/A

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

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