

PHOTOMETRIC TESTING & EVALUATION TO IES LM-79-08Sample Tested
Zero M


Prepared for:


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**Technical Report Number
2686504-02**

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Program Description

Photometric and electrical testing of a “Zero M” replacement Lamp to IES LM-79-08.

Executive Summary

Sample Tested = **Zero M**
Mfg’r: **Lightart**

Luminous Efficacy* (Lumens/Watt)	Luminous Flux* (Lumens)	Input Power* (Watts)	Power Factor*
74.63	2174	29.13	0.965

CCT (K)*	CRI*	Stabilization Time (Light & Power)
2983	83.3	60 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:

3form: Zero M

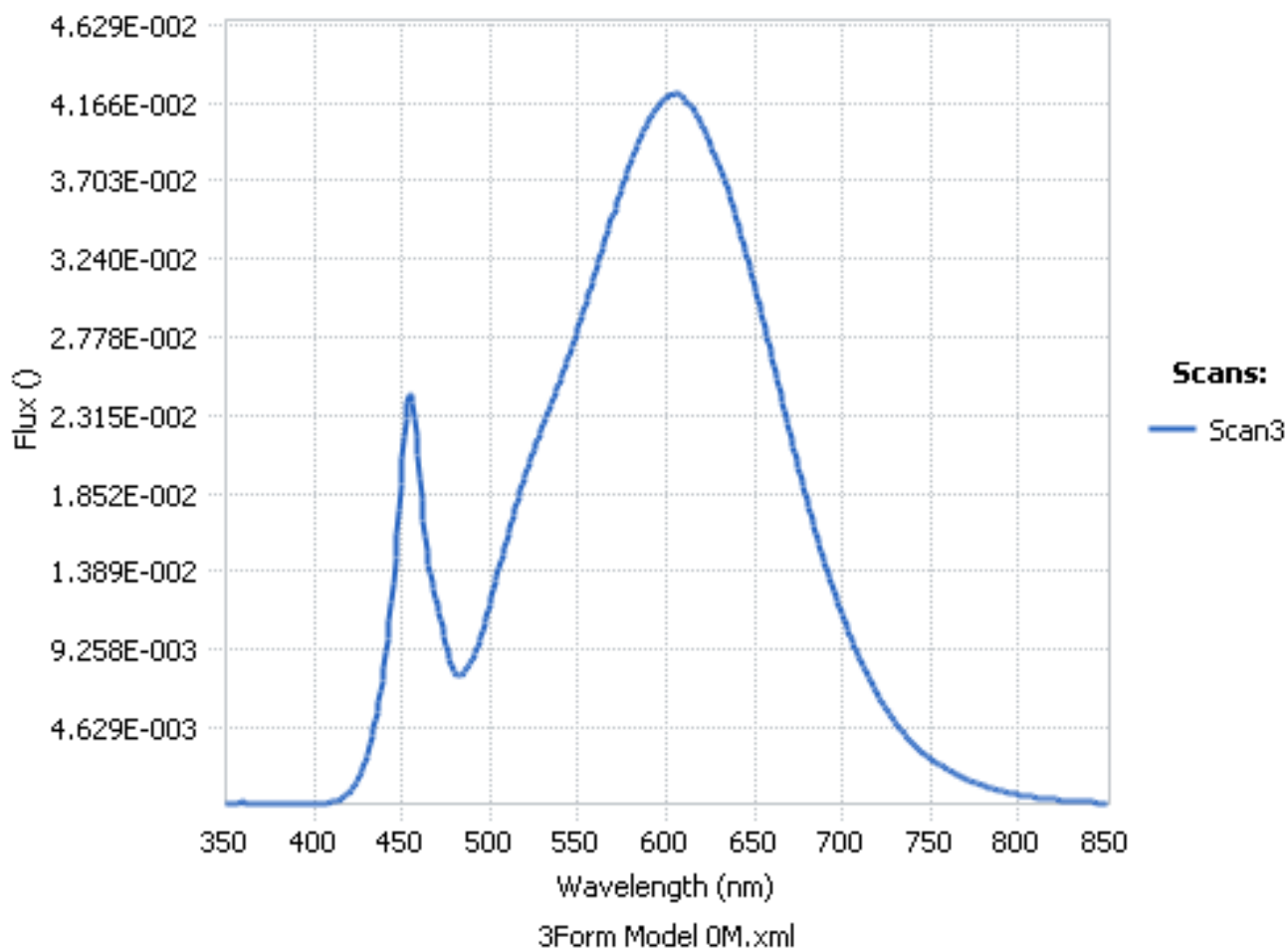


Zero M

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							
	Zero M							
	Integrating Sphere				Goniophotometer			
Luminous Efficacy (Lumens/Watt)	74.63				69.57			
Total Luminous Flux (Lumens)	2174				2047.36			
Total Radiant Flux (Watts)	7.064							
Correlated Color Temperature (CCT)	2983							
Color Rendering Index (CRI) (Ra)	83.3							
R1 thru R7 Value	81.5	90.1	96.3	80.2	80.6	86.1	86	
R8 thru R14 Value	65.6	22	76.2	77.4	65	83.3	97.8	
Chromaticity (Chroma x / Chroma y)	0.4382 / 0.4047							
Chromaticity (Chroma u / Chroma v)	0.2511 / 0.3479							
Chromaticity (Chroma u' / Chroma v')	0.2511 / 0.5218							
D _{uv} Value	0.00008							
Stabilization Time (Light and Power)	Approx. 60 minutes							
Total Run Time – Integrating Sphere	64 minutes							
Total Run Time – Goniophotometer	58 minutes							
Spacing Criteria	1.24 (0° – 180°) / 1.26 (90° – 270°)							
Scotopic/Photopic ratio $\Phi(v')/\Phi(v)$	1.316							
Electrical Input Results:	Sample Reference							
	Zero M							
	Integrating Sphere				Goniophotometer			
Input Power (Watts)	29.13				29.43			
Input Voltage (Volts AC)	120.0				120.24			
Input Current (Amps)	0.25				0.25			
Input Frequency (Hertz)	60.0				60.0			
Power Factor	0.965				0.965			
Total Harmonic Distortion (%THD V/A)	0.09 / 12.39							
Additional Information	Sample Reference							
	Zero M							
Ambient Temperature	24.1°C							
Integrating Sphere Detector	CDS 600 Spectroradiometer							
Absorption Correction used?	Yes							

Spectral Flux

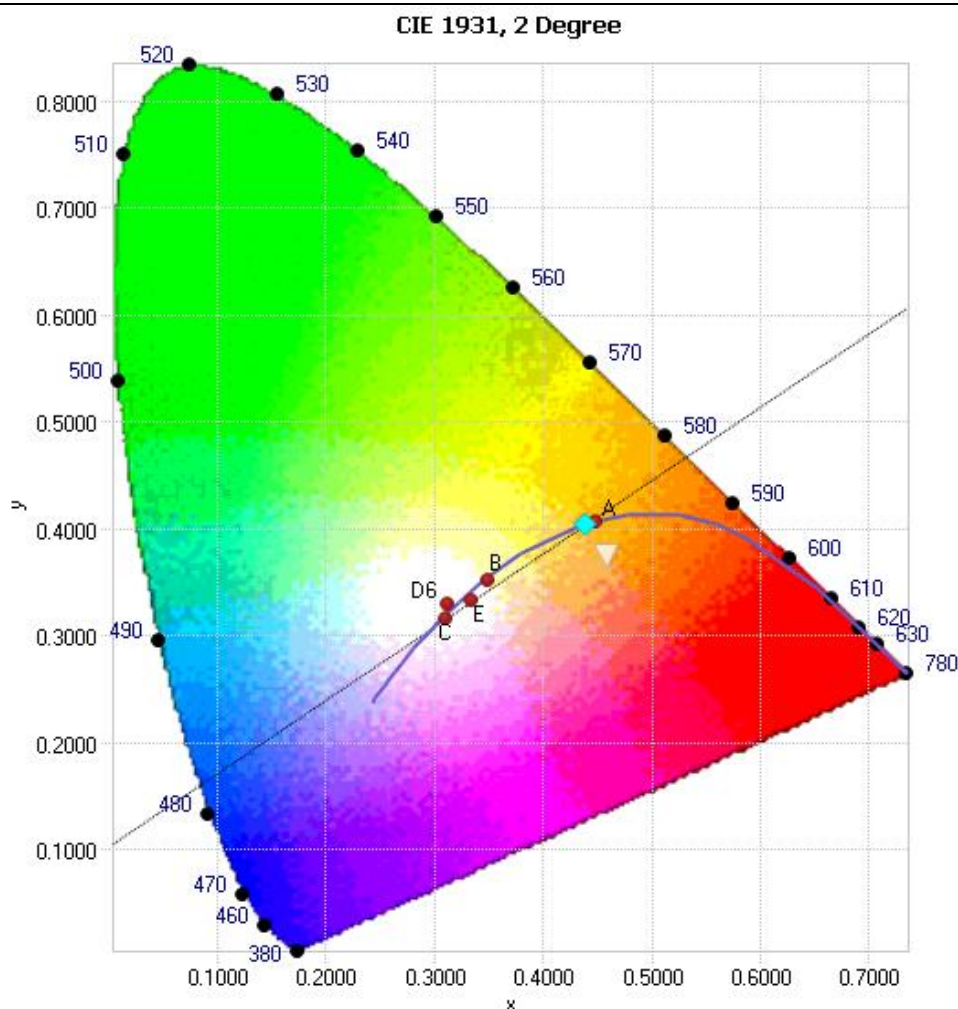
The following graph shows the spectral response curve of the radiant flux for the sample:



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):

$$x / y = 0.4382 / 0.4047$$

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

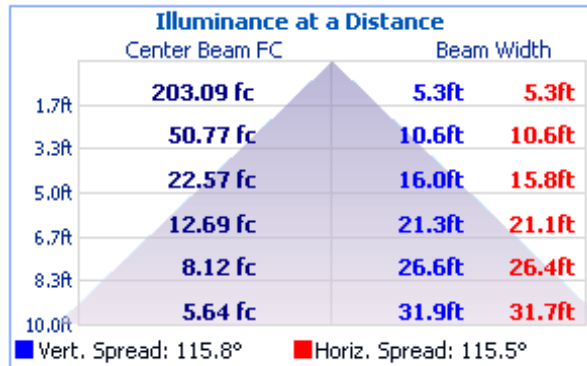
Test Results – Flux Distribution – Zonal Lumen Summary

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

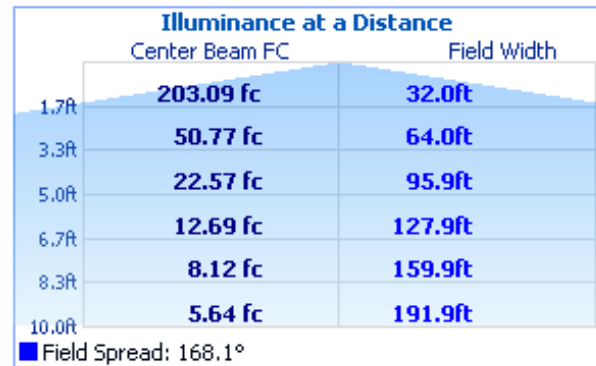
Zone	Lumens	% Total
0 - 10	53.4	2.60%
10 - 20	153	7.50%
20 - 30	230.2	11.20%
30 - 40	280.8	13.70%
40 - 50	294.2	14.40%
50 - 60	272.2	13.30%
60 - 70	219	10.70%
70 - 80	142.2	6.90%
80 - 90	54.7	2.70%
90-100	29.9	1.50%
100-110	52.7	2.60%
110-120	64.8	3.20%
120-130	60.7	3%
130-140	51.8	2.50%
140-150	39	1.90%
150-160	25.8	1.30%
160-170	17.4	0.80%
170-180	5.6	0.30%
Total	2047.4 LUMENS	
Zone		
0-60	415.9	20.30%
60-90	226.7	11.10%
0-90	1,699.60	83%
90-180	347.7	17%
0-180	2,047.40	100%

Test Results – Illuminance Plots

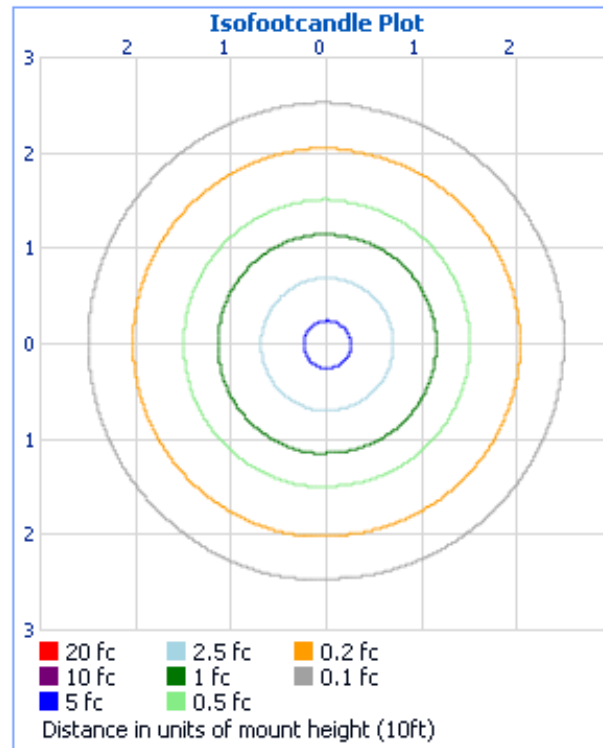
The following images depict the illuminance characteristics of the luminaire.



Beam Angle



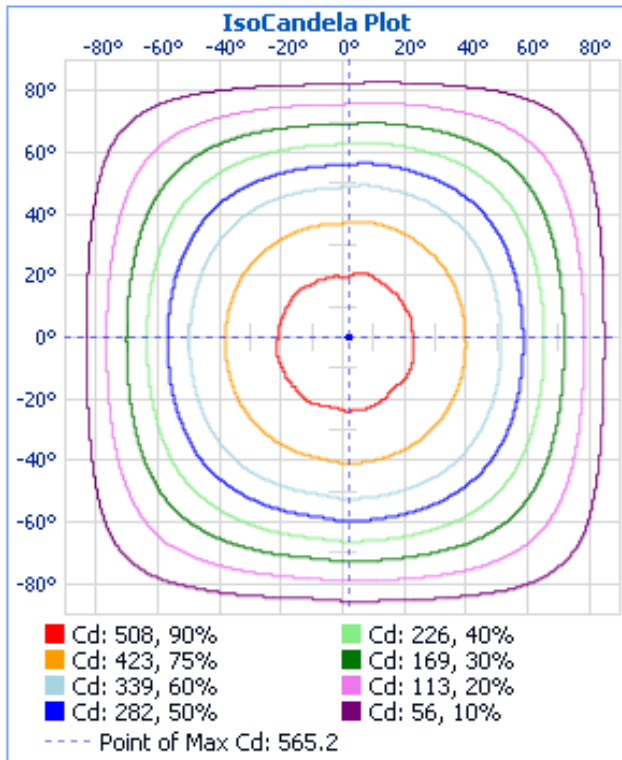
Field Angle



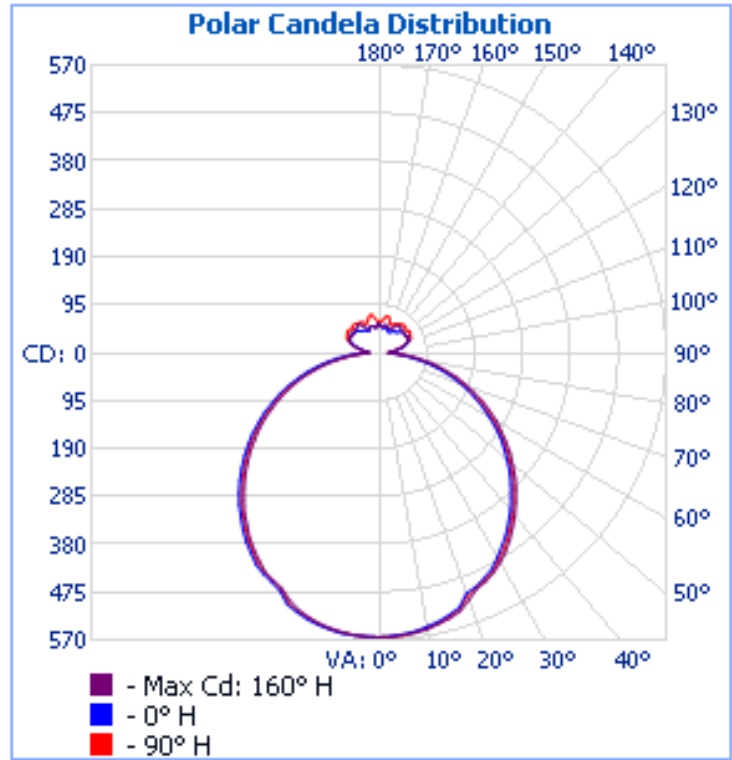
Illuminance Plot (Footcandles)

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

		80				70				50				30				10				0			
RCC %:		70	50	30	0	70	50	30	0	50	30	20	10	50	30	20	10	50	30	20	10	50	30	20	10
RW %:		70	50	30	0	70	50	30	0	50	30	20	10	50	30	20	10	50	30	20	10	50	30	20	10
RCR: 0		1.15	1.15	1.15	1.15	1.10	1.10	1.10	.83	1.02	1.02	1.02	.94	.94	.94	.86	.86	.86	.86	.86	.86	.86	.86	.86	.83
1		1.04	.99	.95	.91	1.00	.95	.91	.69	.88	.85	.82	.81	.79	.76	.75	.73	.75	.73	.71	.68	.71	.68	.68	.68
2		.94	.86	.79	.73	.90	.83	.76	.57	.76	.71	.67	.71	.67	.63	.65	.62	.59	.56	.56	.56	.56	.56	.56	.56
3		.86	.75	.67	.61	.82	.72	.65	.48	.67	.61	.56	.62	.57	.53	.57	.53	.50	.47	.47	.47	.47	.47	.47	.47
4		.78	.66	.58	.51	.75	.64	.56	.41	.59	.53	.47	.55	.49	.45	.51	.46	.42	.40	.40	.40	.40	.40	.40	.40
5		.72	.59	.50	.44	.69	.57	.49	.36	.53	.46	.41	.49	.43	.39	.46	.41	.37	.34	.34	.34	.34	.34	.34	.34
6		.66	.53	.44	.38	.63	.51	.43	.31	.48	.41	.35	.45	.38	.34	.41	.36	.32	.30	.30	.30	.30	.30	.30	.30
7		.61	.48	.39	.33	.59	.46	.38	.28	.43	.36	.31	.40	.34	.30	.38	.33	.28	.26	.26	.26	.26	.26	.26	.26
8		.57	.44	.35	.30	.55	.42	.34	.25	.40	.33	.28	.37	.31	.27	.35	.29	.25	.23	.23	.23	.23	.23	.23	.23
9		.53	.40	.32	.26	.51	.39	.31	.22	.36	.30	.25	.34	.28	.24	.32	.27	.23	.21	.21	.21	.21	.21	.21	.21
10		.50	.37	.29	.24	.48	.36	.28	.20	.34	.27	.23	.32	.26	.22	.30	.25	.21	.19	.19	.19	.19	.19	.19	.19

Effective Floor Cavity Reflectance: 20%

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	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564
2.5	563	563	562	563	563	564	563	564	564	563	564	564	565	564	565	565	565	564	564	564	564	563	564	564	563	563	563	564	564	565	563	563	563	563	563	563	564	563
5	560	560	560	560	561	561	561	560	561	562	562	562	562	562	562	562	562	564	562	564	562	563	563	564	563	563	563	562	563	562	563	563	562	562	562	563	561	560
7.5	557	556	557	557	556	557	559	558	558	558	558	558	559	560	560	560	560	560	562	560	562	562	560	560	562	561	560	559	559	559	559	559	559	559	559	559	557	
10	552	553	551	552	553	554	553	554	555	554	555	555	556	556	557	557	557	556	557	558	558	557	558	558	557	557	557	557	557	556	555	555	555	555	555	555	552	
12.5	546	545	546	545	546	547	547	547	547	549	549	550	550	550	550	550	550	552	553	554	553	553	553	554	553	553	553	551	551	551	551	550	551	550	550	548	546	
15	538	538	539	539	538	539	541	541	541	541	541	542	543	544	544	545	545	545	548	547	548	547	546	546	546	545	544	544	543	543	542	543	543	543	543	542	538	
17.5	530	530	528	529	531	532	532	533	534	533	535	535	536	536	537	537	537	537	540	540	539	539	540	539	538	537	537	538	537	536	535	535	533	534	534	534	530	
20	508	510	508	507	513	514	511	510	513	513	523	518	521	525	526	527	522	529	531	532	531	532	531	531	530	530	529	526	518	526	522	517	516	516	521	509	508	
22.5	502	501	502	502	502	503	503	504	504	504	505	505	506	507	513	507	507	512	513	515	512	508	507	513	513	506	507	506	505	504	505	504	505	505	505	502		
25	493	494	494	494	496	496	496	496	497	497	498	499	500	500	500	501	501	500	502	503	502	502	503	502	501	500	500	500	500	500	500	498	498	498	497	493		
27.5	484	483	484	483	484	485	486	486	487	489	489	490	490	490	491	492	492	493	496	496	495	496	495	495	495	491	493	491	491	490	490	491	489	489	489	484		
30	469	469	470	471	471	472	473	474	475	475	476	478	478	480	480	480	481	481	487	485	486	485	484	484	484	480	482	482	480	478	478	478	476	476	476	469		
32.5	454	455	454	455	457	457	458	459	460	461	462	463	465	464	466	467	467	472	472	472	471	472	471	469	469	467	466	466	466	465	462	463	463	462	461	454		
35	439	439	440	440	440	441	443	444	444	446	446	448	449	450	450	452	453	455	458	459	458	457	457	456	456	454	454	452	451	448	448	451	447	447	446	439		
37.5	423	424	423	424	424	426	427	428	429	430	431	433	432	435	437	435	436	435	443	443	443	441	441	441	440	439	437	437	435	435	434	430	431	431	430	423		
40	406	406	406	406	408	409	409	411	412	414	415	415	417	416	417	420	420	421	426	427	426	426	426	425	424	422	422	420	419	418	417	417	415	414	415	412	406	
42.5	388	388	389	390	390	390	393	393	394	395	397	399	397	401	402	402	402	403	410	410	410	409	408	407	408	405	405	403	402	400	399	399	398	398	396	388		
45	370	371	370	371	371	373	374	375	377	377	379	378	381	382	383	384	384	385	393	392	392	391	391	390	389	388	385	385	383	384	383	379	379	379	378	370		
47.5	352	351	352	352	353	353	355	356	357	359	360	360	363	362	363	367	367	368	374	374	373	374	373	372	371	368	369	367	367	362	362	364	361	361	360	352		
50	332	332	333	333	334	335	336	337	338	339	341	343	342	347	348	345	346	347	355	355	356	355	353	353	351	348	347	345	347	345	341	342	343	340	332			
52.5	313	313	312	313	314	315	315	317	320	320	321	320	326	324	324	328	328	328	336	335	335	335	335	335	332	332	331	329	328	326	324	324	322	321	322	320	313	
55	295	292	293	293	294	294	296	297	298	299	302	304	302	306	307	308	307	309	316	317	315	315	315	314	314	311	311	310	308	305	304	305	303	301	301	295		
57.5	273	273	272	273	274	275	275	276	279	280	280	281	285	285	285	286	287	288	297	296	296	295	295	294	292	293	289	288	286	287	286	282	283	281	281	273		
60	251	251	252	252	253	253	255	256	257	259	261	261	263	263	264	268	269	268	275	276	275	275	273	273	273	270	270	269	268	263	262	265	262	260	261	259	251	
62.5	230	230	231	231	232	232	235	236	237	238	240	242	240	244	246	246	246	247	256	255	255	253	253	252	252	250	248	246	244	245	245	240	241	240	239	230		
65	208	210	209	210	210	212	213	214	217	218	218	218	223	220	221	225	227	226	233	234	233	233	232	232	230	229	227	226	225	223	220	221	220	217	218	217	208	
67.5	188	188	188	188	190	190	192	193	194	195	199	201	197	203	202	203	203	205	213	213	212	211	211	210	210	207	206	206	202	200	200	199	196	198	196	188		
70	166	166	166	167	168	169	170	171	172	175	174	175	180	178	181	182	183	183	191	190	191	189	189	188	187	187	184	182	181	181	180	175	175	175	173	166		
72.5	145	145	145	145	146	147	149	150	151	152	155	156	156	158	157	161	162	163	168	169	168	168	168	167	166	163	163	162	160	155	154	159	155	155	153	145		
75	123	122	123	123	124	124	126	127	130	131	133	133	134	138	138	138	138	139	148	147	147	146	146	145	144	142	141	138	137	138	138	131	134	134	130	123		
77.5	100	100	101	101	102	103	104	105	106	109	109	110	115	112	114	118	118	119	125	125	124	125	124	123	122	120	119	117	115	112	110	113	108	109	109	100		
80	79	78	79	80	80	81	82	84	86	86	90	91	89	93	94	92	94	96	103	103	102	103	102	101	100	98	97	95	94	92	90	89	89	85	86	79		
82.5	57	57	57	58	59																																	

150	48	51	57	56	53	52	54	55	60	66	61	56	55	54	55	57	57	50	50	56	63	62	59	57	59	60	63	69	64	59	57	55	56	59	60	54	48
152.5	46	49	53	54	53	52	52	53	58	63	59	55	54	55	57	56	54	48	48	53	60	60	59	58	57	57	61	67	62	56	54	54	56	56	56	51	46
155	45	48	51	54	53	53	51	52	57	61	59	54	55	58	59	58	52	48	47	52	57	60	61	60	57	56	60	64	60	55	52	54	56	56	53	50	45
157.5	46	49	50	54	54	53	51	52	56	61	60	57	57	61	61	59	53	50	48	52	57	62	63	62	58	57	60	63	59	54	52	55	56	56	53	50	46
160	49	50	51	54	56	55	53	55	59	63	63	61	61	63	63	60	54	52	51	54	57	63	65	65	61	61	63	65	61	56	54	56	57	57	53	52	49
162.5	51	52	53	55	59	59	59	62	66	70	69	67	65	66	65	60	56	54	53	56	58	63	68	68	66	66	68	70	66	62	58	58	59	57	53	53	51
165	52	52	54	54	58	62	65	68	73	74	72	70	68	67	64	59	57	55	55	57	58	61	67	70	71	71	73	75	73	68	63	62	59	56	54	53	52
167.5	51	51	53	54	58	62	66	70	74	74	73	72	69	65	62	58	56	53	54	55	58	60	64	69	72	73	76	77	75	71	66	62	58	54	54	52	51
170	50	50	52	55	58	60	64	67	70	71	69	68	65	62	60	57	54	51	52	53	57	59	61	64	68	71	74	76	74	69	65	60	56	52	52	49	50
172.5	51	51	52	56	59	60	62	64	65	66	65	64	62	61	59	56	53	51	51	52	55	58	59	61	63	66	68	70	69	65	61	58	55	52	50	49	51
175	53	53	54	57	60	60	61	62	63	63	63	63	61	59	58	56	54	51	52	53	56	57	59	61	62	63	64	66	66	63	60	57	55	52	50	49	53
177.5	56	57	57	59	60	59	59	59	60	62	60	59	58	57	56	56	54	53	55	56	57	58	59	59	59	60	61	63	63	61	58	56	54	53	52	52	56
180	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57

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:

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.....

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

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	11/2014
Equipment List: Sphere D Equipment			
Description	Manufacturer and Model Number	CSA Instrument Reference Number	Calibration Due Date
Integrating Sphere 109"	Labsphere LMS760	SPH400	N/A
Spectroradiometer	Labsphere CDS1100	N/A	N/A
Auxiliary Lamp PSU	Labsphere LPS100	LPS100	N/A
Power Analyzer	Yokogawa WT210	PA111	1/2014
Regulated Power Supply	Chroma Instruments 61603	N/A	N/A

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