



PHOTOMETRIC TESTING & EVALUATION TO IES LM-79-08

Sample Tested
iPAR3827221N

Prepared for:

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Technical Report Number
30016741-LM79 (iPAR3827221N)

December 14, 2010

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A handwritten signature in black ink that reads "Bryan Cubitt".

Bryan Cubitt, Technical Team Leader

Approved by:

A handwritten signature in black ink that reads "Steven Longo".

Steven Longo, Technical Manager



Program Description

Photometric and electrical testing of an "IPAR3827221N" replacement lamp to IES LM-79-08.

Executive Summary

Sample Tested = IPAR3827221N

Luminous Efficacy* (Lumens/Watt)	Luminous Flux* (Lumens)	Input Power* (Watts)	Power Factor*
49.19	592.3	12.04	0.897

CCT (K)*	CRI*	Stabilization Time (Light & Power)
2780.5	83.1	45 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:

MSI SSL: iPAR3827221N



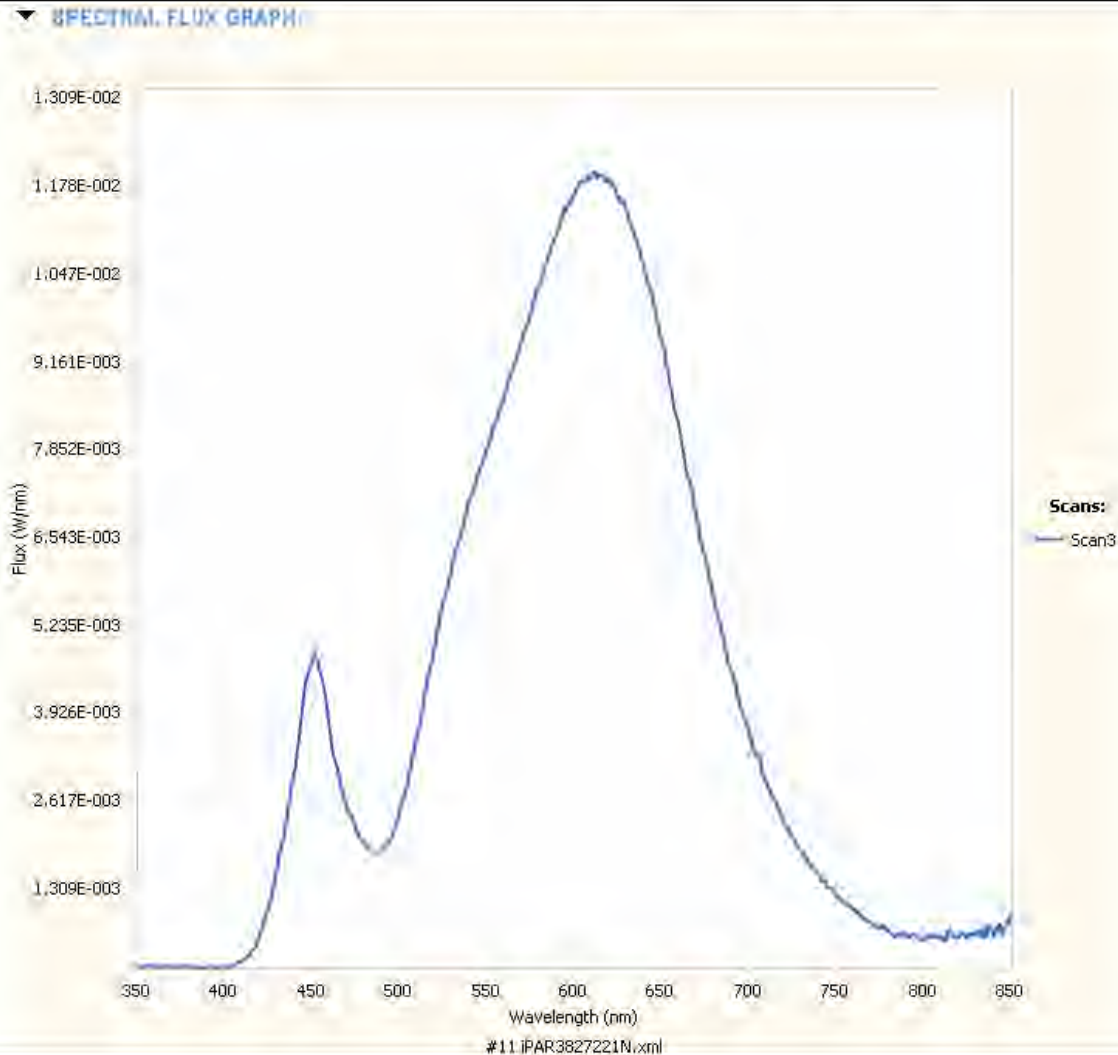
iPAR3827221N



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	
	IPAR3827221N	
	Integrating Sphere	Goniophotometer
Luminous Efficacy (Lumens/Watt)	49.19	48.56
Total Luminous Flux (Lumens)	592.3	582.7
Total Radiant Flux (Watts)	2.84	
Correlated Color Temperature (CCT)	2780.5	
Color Rendering Index (CRI)	83.1	
Chromaticity (Chroma x / Chroma y)	0.4515 / 0.4057	
Chromaticity (Chroma u / Chroma v)	0.2593 / 0.3495	
Chromaticity (Chroma u' / Chroma v')	0.2593 / 0.5242	
Duv Value	-0.00109	
Stabilization Time (Light and Power)	Approx. 45 minutes	
Total Run Time - Integrating Sphere	55 minutes	
Total Run Time - Goniophotometer	118 minutes	
Spacing Criteria	0.26 (0° - 180°) / 0.28 (90° - 270°)	
Electrical Input Results:	Sample Reference	
	IPAR3827221N	
	Integrating Sphere	Goniophotometer
Input Power (Watts)	12.04	12.08
Input Voltage (Volts AC)	120.8	120.8
Input Current (Amps)	0.111	0.112
Input Frequency (Hertz)	60.0	60.0
Power Factor	0.897	0.895
Total Harmonic Distortion (THD-V)	0.241%	
Additional Information	Sample Reference	
	IPAR3827221N	
Ambient Temperature	25.8°C	
Integrating Sphere Detector	CDS 600 Spectroradiometer	
Absorption Correction used?	Yes	

Spectral Flux

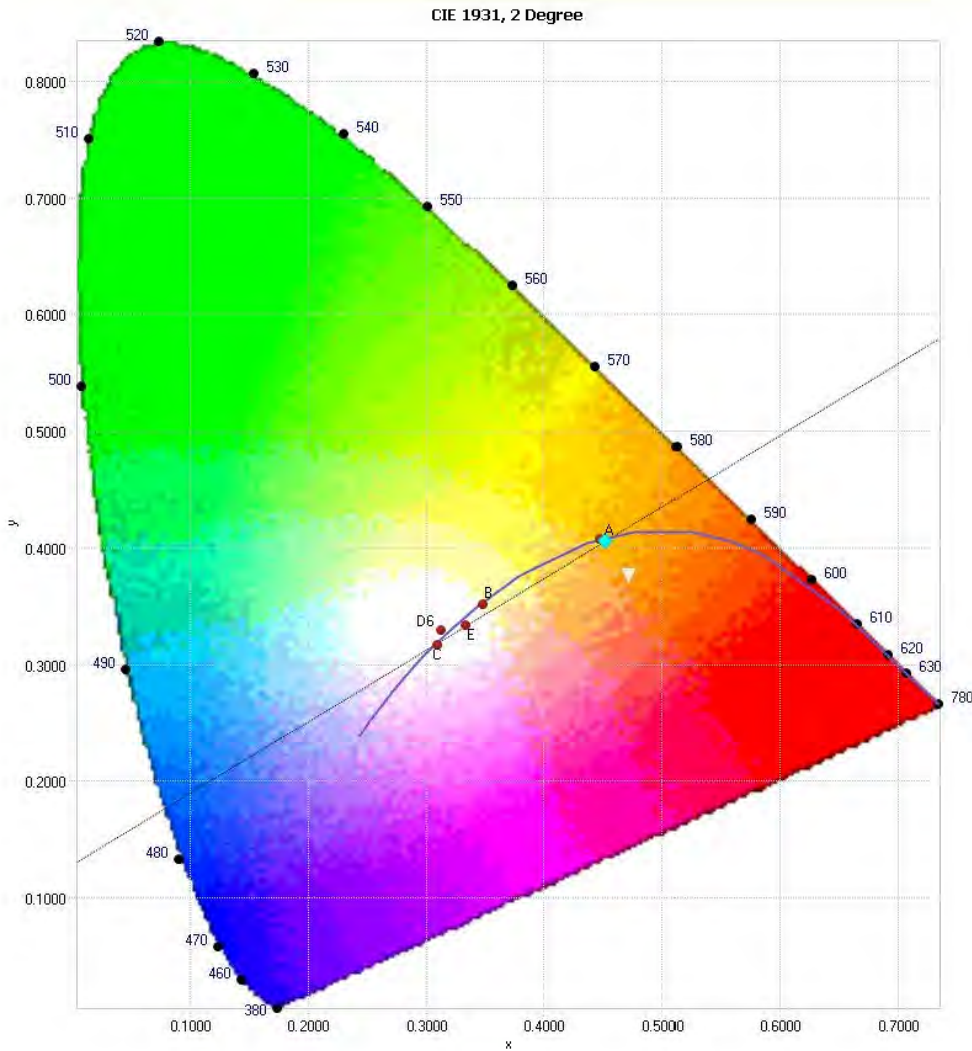
The following graph shows the spectral response curve of the radiant flux for the sample:



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 = 0.4515 / 0.4057

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:

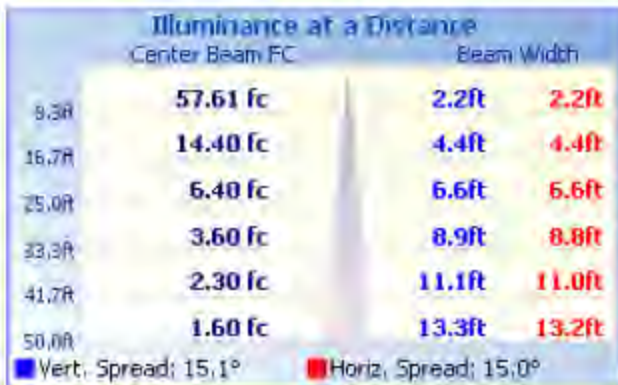
Zone	Lumens	% Total
0-10	223.8	38.4%
10-20	208.6	35.8%
20-30	54.6	9.4%
30-40	20.0	3.4%
40-50	18.7	3.2%
50-60	18.1	3.1%
60-70	15.5	2.7%
70-80	10.9	1.9%
80-90	3.4	0.6%
90-100	0.8	0.1%
100-110	0.9	0.2%
110-120	0.9	0.2%
120-130	1.3	0.2%
130-140	1.3	0.2%
140-150	1.4	0.2%
150-160	1.2	0.2%
160-170	0.9	0.2%
170-180	0.3	0.1%
Total	582.7 Lumens	100%

Zonal Lumen Summary

Zone	Lumens	% Lamp / Luminaire
0-60	543.9	93.3%
60-90	29.8	5.1%
70-100	15.1	2.6%
90-120	2.6	0.4%
0-90	573.7	98.5%
90-180	9.0	1.5%
0-180	582.7	100%

Test Results – Illuminance Plots

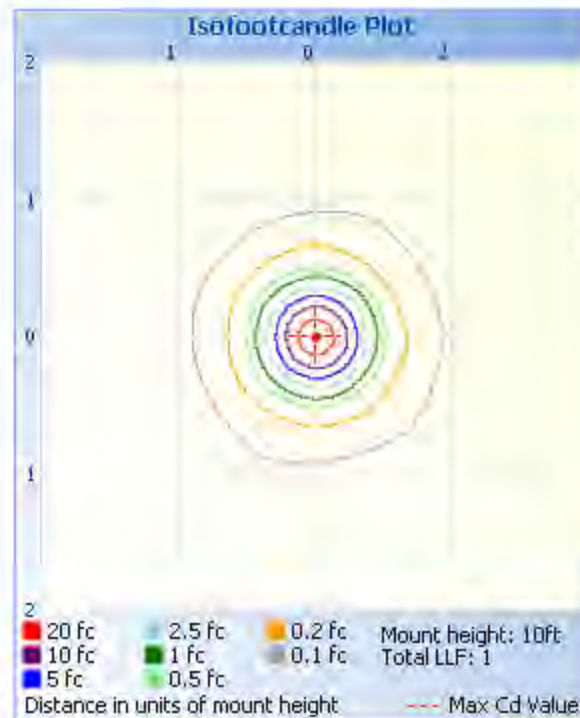
The following images depict the illuminance characteristics of the luminaire.



Beam Angle



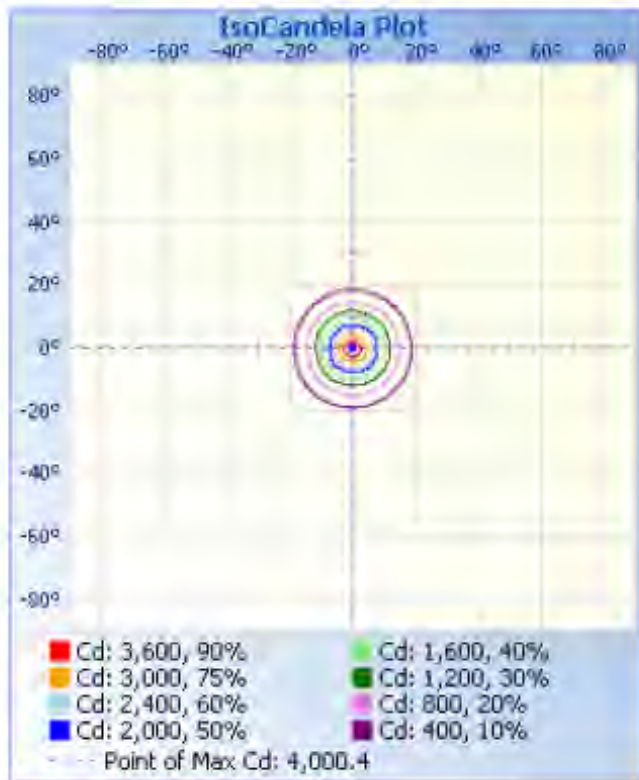
Field Angle



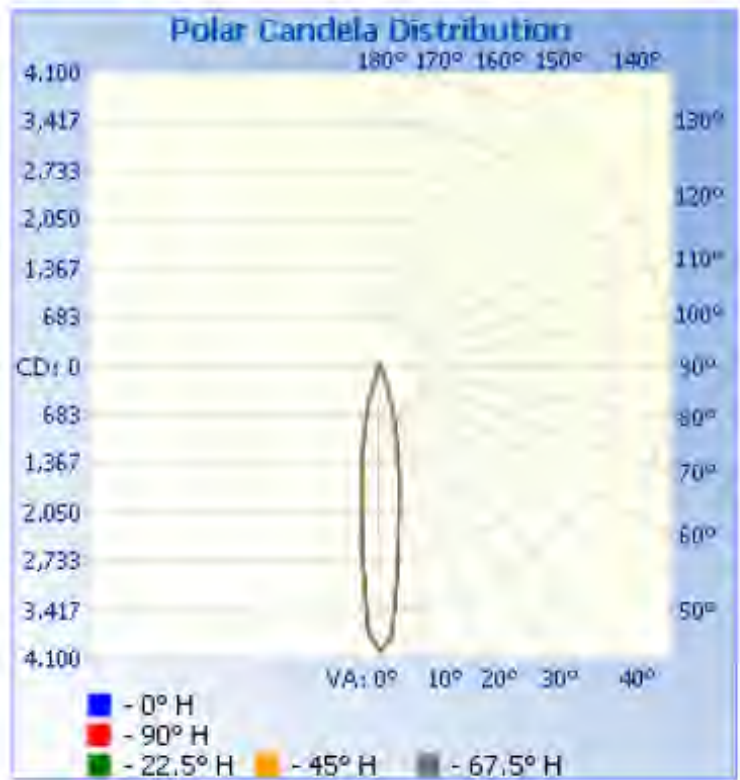
Illuminance Plot (Footcandles)

Test Results – Candela Plots

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



Isocandela Plot



Polar Candela Distribution



Test Results – Candela Tabulation

The following table provides the tabulated Candela measurements:

	0.8	32.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0	202.5	225.0	247.5	270.0	292.5	315.0	337.5	360.0
0.0	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
2.5	3764	3781	3796	3822	3821	3798	3775	3764	3746	3734	3708	3686	3693	3708	3725	3750	3754
5.0	2844	2858	2846	2865	2900	2873	2842	2818	2800	2778	2788	2790	2732	2733	2763	2810	2796
7.5	2906	2941	2927	2982	2934	2936	2970	2922	2921	1972	1960	2012	1953	1962	2028	2011	2004
10.0	1540	1534	1520	1569	1514	1557	1500	1484	1509	1479	1460	1509	1468	1466	1520	1492	1539
12.5	1119	1136	1102	1141	1093	1111	1133	1074	1081	1064	1045	1071	1029	1026	1079	1060	1112
15.0	744	732	742	791	748	756	769	736	762	737	694	715	692	705	744	708	742
17.5	489	483	488	510	497	503	504	489	483	478	470	470	485	486	478	473	488
20.0	315	320	302	308	309	319	323	309	300	280	284	286	279	276	293	294	315
22.5	181	183	178	174	181	180	184	175	171	164	173	166	159	165	172	171	181
25.0	103	105	93	99	102	100	105	102	102	91	103	96	91	96	101	99	103
27.5	59	62	54	60	62	54	62	62	63	35	64	38	37	39	61	36	39
30.0	41	42	40	42	45	38	43	42	48	41	44	42	41	45	46	40	40
32.5	35	36	35	35	37	32	34	35	39	35	35	36	34	35	35	34	35
35.0	30	30	32	31	32	30	33	31	33	31	33	30	32	30	30	30	30
37.5	28	28	29	29	29	29	28	28	30	28	29	28	29	28	28	28	28
40.0	25	25	28	27	27	26	26	28	27	26	27	26	27	26	26	27	25
42.5	24	24	27	23	23	24	23	27	23	24	24	23	24	23	24	27	24
45.0	24	23	26	23	24	23	24	26	24	23	24	24	24	23	24	26	24
47.5	23	23	23	24	24	23	23	25	23	22	22	24	23	22	23	23	23
50.0	22	21	23	23	23	22	22	23	22	22	22	21	23	21	21	24	22
52.5	20	20	22	23	22	21	21	22	21	21	20	22	20	21	20	24	20
55.0	20	20	21	22	21	20	19	20	20	20	19	20	19	20	19	22	20
57.5	19	19	21	20	20	19	18	20	20	19	18	18	18	19	19	21	19
60.0	18	18	20	19	19	19	18	18	19	19	18	17	17	18	18	19	18
62.5	17	17	19	17	17	17	16	18	18	18	17	16	16	17	17	18	17
65.0	15	15	17	16	16	15	15	16	16	16	15	14	14	15	16	16	15
67.5	14	14	16	14	15	14	14	15	15	14	14	13	13	14	14	15	14
70.0	13	13	14	13	13	12	12	13	14	14	13	12	12	14	13	13	13
72.5	11	12	13	12	12	11	11	12	12	12	12	11	11	12	12	12	11
75.0	10	11	11	10	10	10	10	11	11	11	10	9	10	11	10	11	10
77.5	8	9	10	9	9	9	8	10	10	9	8	7	8	9	9	9	8
80.0	7	7	8	8	8	7	7	8	8	8	8	8	7	7	8	7	7
82.5	5	6	6	6	6	5	5	5	5	4	5	4	4	5	4	5	5
85.0	3	4	4	3	3	3	3	3	3	2	3	2	2	3	2	2	3
87.5	1	2	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1
90.0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1



Test Results – Candela Tabulation

The following table provides the tabulated Candela measurements:

	8.5	28.5	48.5	67.5	98.5	112.5	132.5	157.5	186.5	222.5	225.5	247.5	276.5	292.5	312.5	337.5	368.5
82.5	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1
95	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
97.5	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
100	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
102.5	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
105	1	1	1	1	1	2	1	0	0	0	1	1	1	1	1	1	1
107.5	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
110	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
112.5	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
115	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
117.5	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1
120	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
122.5	2	1	1	1	1	1	1	1	0	1	2	1	1	1	2	1	2
125	2	1	2	2	1	2	2	1	0	1	2	1	1	2	2	1	2
127.5	2	2	2	2	1	2	2	1	0	2	2	2	2	2	2	2	2
130	2	2	2	2	2	2	2	1	0	2	2	2	2	2	2	2	2
132.5	2	2	2	2	2	2	2	1	0	2	2	2	2	2	3	2	2
135	2	2	2	2	2	2	2	1	0	1	2	2	2	2	2	2	2
137.5	2	2	2	2	2	2	2	0	0	1	1	2	2	2	3	2	2
140	2	2	2	2	2	2	3	0	0	1	1	3	2	2	3	2	2
142.5	3	2	2	2	2	3	2	0	0	1	2	3	2	2	3	2	3
145	3	2	2	3	1	1	2	0	0	0	2	4	3	2	3	3	3
147.5	3	3	2	3	4	4	1	0	0	0	2	3	3	3	4	3	3
150	3	3	3	4	4	1	1	0	0	0	2	3	3	3	4	3	4
152.5	4	3	3	4	4	4	1	0	0	0	2	3	3	3	4	4	4
155	4	4	3	4	4	3	1	0	0	1	3	3	3	4	4	4	4
157.5	4	4	4	4	3	2	1	1	0	1	2	3	3	4	4	4	4
160	4	4	4	4	4	2	1	1	1	1	2	3	4	4	4	4	4
162.5	5	4	4	4	4	2	2	1	1	1	2	3	4	4	4	5	5
165	5	4	4	3	4	2	2	1	1	2	2	3	3	4	4	5	5
167.5	5	4	4	3	3	3	2	2	2	2	2	3	3	4	4	5	5
170	5	4	4	4	3	3	3	2	2	2	3	3	3	4	4	5	5
172.5	4	4	4	4	3	3	3	3	2	2	3	3	3	4	4	4	4
175	4	4	4	4	2	3	3	3	3	3	3	3	3	4	4	4	4
177.5	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4
180	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0

**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 a 65-inch diameter sphere manufactured by Labsphere (Model# LMS650) which exhibits a "4 π 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 (Model# CDS600).

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 (model LPS 200). 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 120.0 Volt, 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 is calibrated using a frosted tungsten filament FDS/DZE lamp with the following specifications:

Manufacturer: General Electric
Part Number: CSB-110
Bulb Number: 108-A
Voltage: 24.0 Volts
Wattage: 150.0 Watts
Calibration Current: 4.799 Amperes
Luminous Intensity: 150.3 Candelas
Calibration Date: 4-14-2009 (NIST traceable)

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

Equipment List:

Description	Manufacturer and Model Number	OnSpeX Instrument Reference Number	Calibration Due Date
Integrating Sphere 65"	Labsphere LMS650	IS100	N/A
Spectroradiometer	Labsphere CDS600	CDS600	5-20-2011
Auxiliary Lamp PSU	Labsphere LPS200	LPS200	2-16-2011
Power Analyzer	Voltech PM1000+	PA110	4-27-2011
Power Analyzer	Yokogawa WT210	PA107	3-23-2011
Regulated Power Supply	California Instruments 1001P	AC100	N/A
Regulated Power Supply	Chroma Instruments 61602	AC300	N/A
Thermometer (Thermocouple)	Fluke 52	TH100	8-04-2011

All equipment is calibrated by TMI (Technical Maintenance, Inc.) ISO / IEC 17025-2005 Accredited (Cert. 1378.01) except: Labsphere CDS600 and Labsphere LPS200 which is calibrated by Labsphere, USA.