PHOTOMETRIC TESTING & EVALUATION TO IES LM-79-08

Sample Tested
iMR1630230N-UUT3

Prepared for:

Rakesh Reddy

MSI SSL
1342 S Powerline Rd.
Deerfield Beach FL, 33442

Phone: 425-420-7080

Technical Report Number
30019342

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Prepared by:

Clayton Magerfleisch, Senior Technician

Approved by:

Jesse Whalen, Product Group Manager

Program Description

Photometric and electrical testing of an "iMR1630230N-UUT3" replacement lamp to IES LM-79-08.

Executive Summary

Sample Tested = iMR1630230N-UUT3

Luminous Efficacy* (Lumens/Watt)	Luminous Flux* (Lumens)	Input Power* (Watts)	Power Factor*
79.79	354.3	4.440	0.563

CCT (K)*	CRI*	Stabilization Time (Light & Power)
3016.7	81	36 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 – **iMR1630230N-UUT3**

iMR1630230N-UUT3

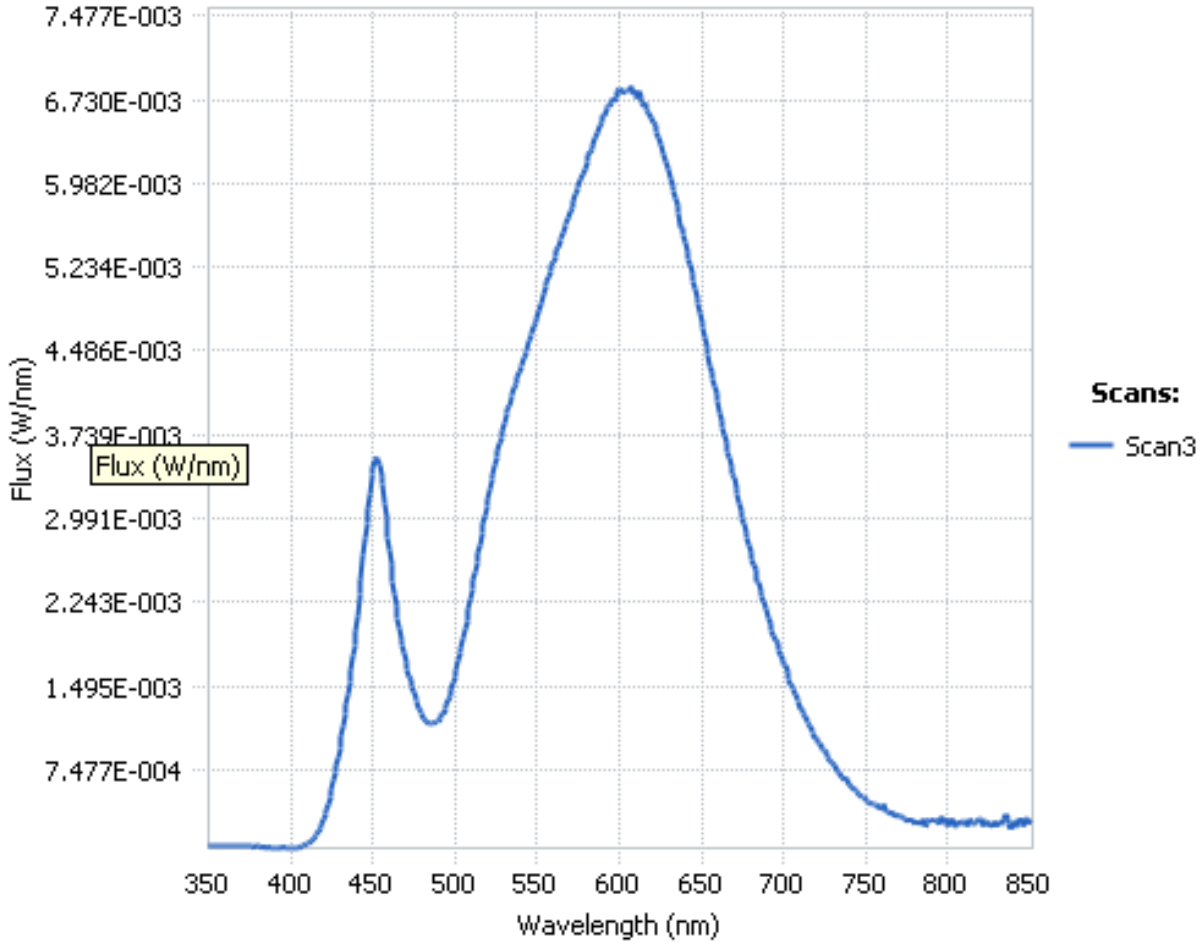
Test Results –

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**	
	iMR1630230N-UUT3	
	Integrating Sphere	**Goniophotometer**
Luminous Efficacy (Lumens/Watt)	**79.79**	**77.69**
Total Luminous Flux (Lumens)	**354.3**	**341.85**
Total Radiant Flux (Watts)	**4.440**	
Correlated Color Temperature (CCT)	**3016.7**	
Color Rendering Index (CRI)	**81**	
R9 Value	**14.7**	
Chromaticity (Chroma x / Chroma y)	**0.4352 / 0.4027**	
Chromaticity (Chroma u / Chroma v)	**0.2500 / 0.3471**	
Chromaticity (Chroma u' / Chroma v')	**0.2500/ 0.5206**	
D_{uv} Value	**-0.00028**	
Stabilization Time (Light and Power)	**Approx. 47 minutes**	
Total Run Time – Integrating Sphere	**51 minutes**	
Total Run Time – Goniophotometer	**112 minutes**	
Spacing Criteria	**0.38 (0° – 180°) / 0.40 (90° – 270°)**	
Electrical Input Results:	**Sample Reference**	
	iMR1630230N-UUT3	
	Integrating Sphere	**Goniophotometer**
Input Power (Watts)	**4.440**	**4.4**
Input Voltage (Volts AC)	**12.0**	**12.0**
Input Current (Amps)	**0.656**	**0.665**
Input Frequency (Hertz)	**60.0**	**60.0**
Power Factor	**0.563**	**0.551**
Additional Information	**Sample Reference**	
	iMR1630230N-UUT3	
Ambient Temperature	**25.3°C**	
Integrating Sphere Detector	**CDS 600 Spectroradiometer**	
Absorption Correction used?	**Yes**	

Spectral Flux

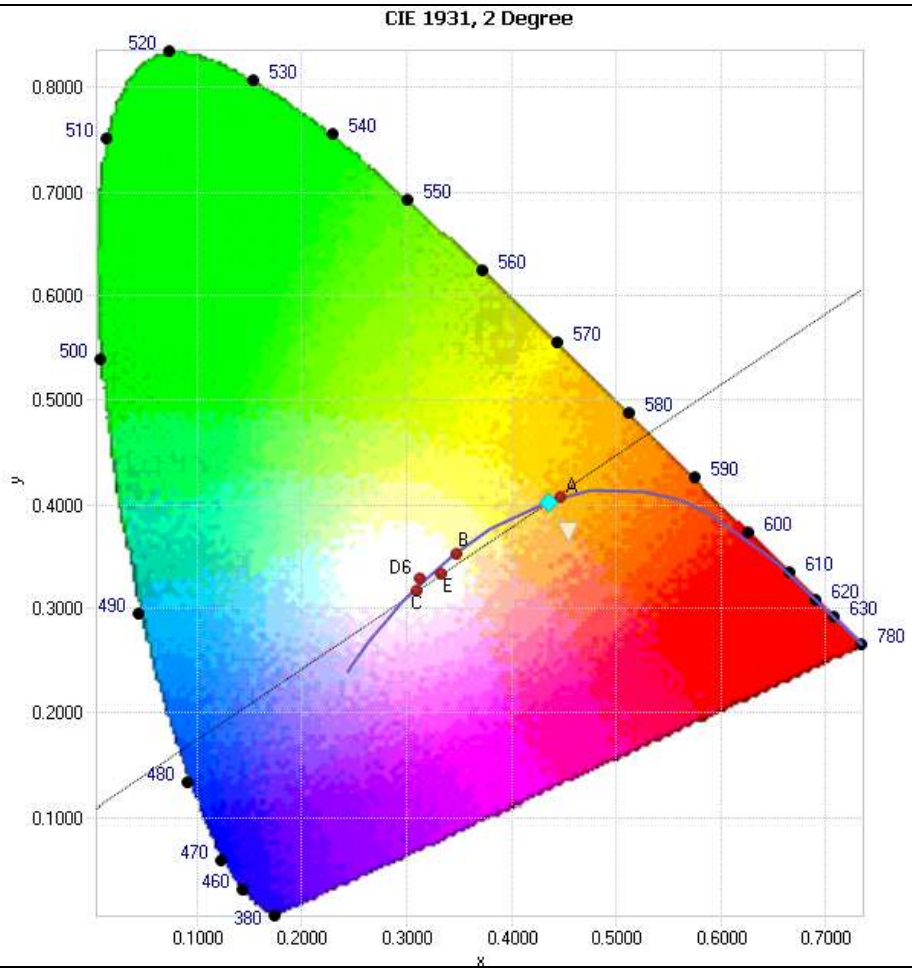
The following graph shows the spectral response curve of the radiant flux for the sample:



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 = 0.4352 / 0.4027

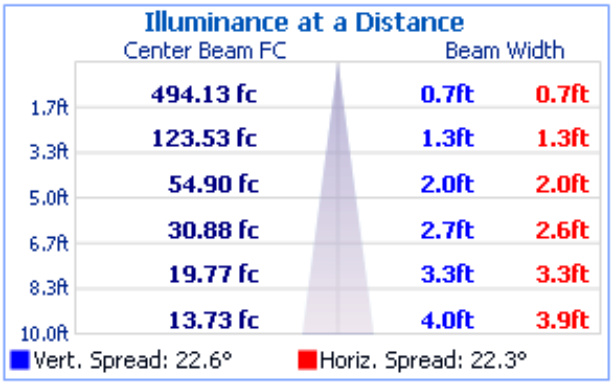
The locations on the diagram of the tristimulus coordinates are indicated by the blue diamond.

Test Results – Flux Distribution – Zonal Lumen Summary		
The following table depicts the zonal lumen distribution for the sample:		
Zone	**Lumens**	**% Total**
0 - 10	**102.9**	**30.10%**
10 - 20	**110.9**	**32.40%**
20 - 30	**51.1**	**14.90%**
30 - 40	**28.9**	**8.40%**
40 - 50	**17.7**	**5.20%**
50 - 60	**11.8**	**3.50%**
60 - 70	**8**	**2.30%**
70 - 80	**4.4**	**1.30%**
80 - 90	**1.6**	**0.50%**
90 - 100	**0.7**	**0.20%**
100 - 110	**0.6**	**0.20%**
110 - 120	**0.7**	**0.20%**
120 - 130	**0.6**	**0.20%**
130 - 140	**0.4**	**0.10%**
140 - 150	**0.4**	**0.10%**
160 - 170	**0.5**	**0.10%**
170 - 180	**0.5**	**0.10%**
Total	**341.85 Lumens**	**100%**

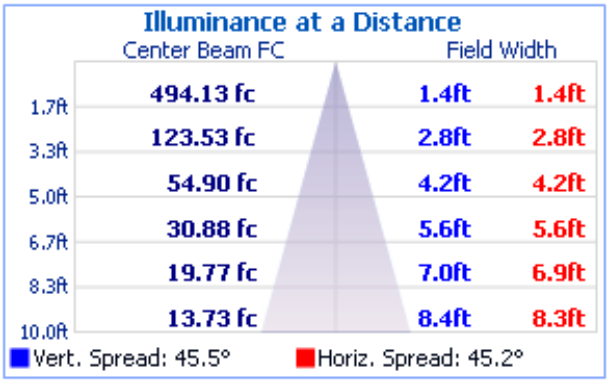
Zonal Lumen Summary		
Zone	**Lumens**	**% Lamp / Luminaire**
0 - 60	**323.3**	**94.6 %**
60 - 90	**14.1**	**4.1 %**
0 - 90	**337.4**	**98.7 %**
90 - 180	**4.4**	**1.3 %**
0 - 180	**341.9**	**100 %**

Test Results – Illuminance Plots

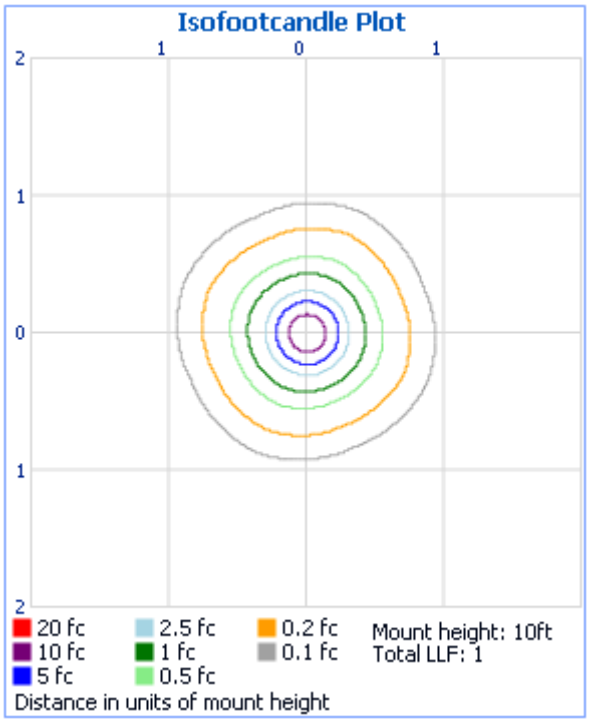
The following images depict the illuminance characteristics of the luminaire.



Beam Angle



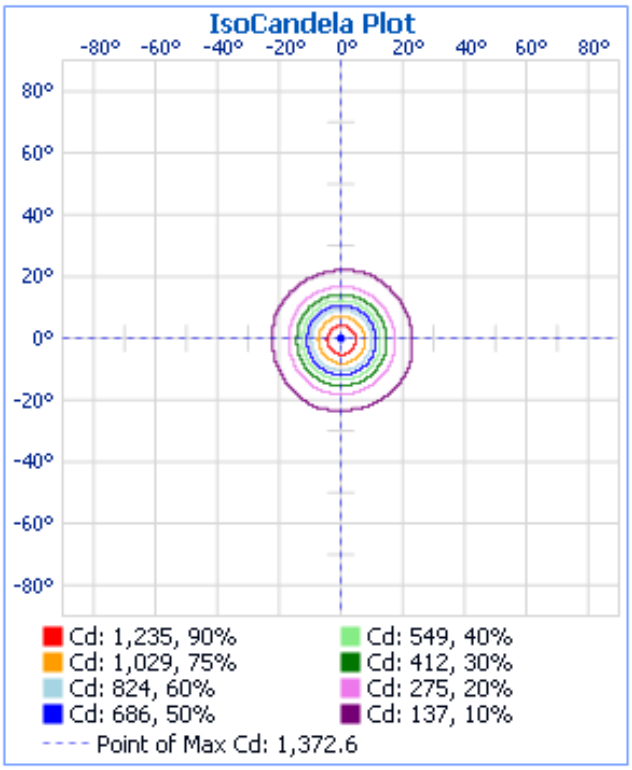
Field Angle



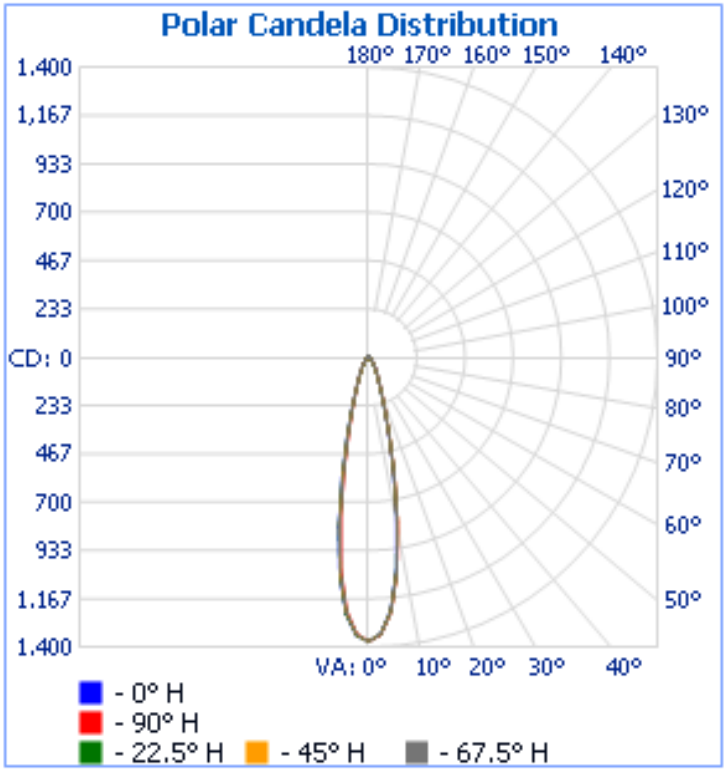
Illuminance Plot (Footcandles)

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:

	0.0	22.5	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	1373	1373	1373	1373	1373	1373	1373	1373	1373	1373	1373	1373	1373	1373	1373	1373	1373
2.5	1336	1338	1340	1341	1342	1344	1345	1345	1345	1344	1342	1340	1337	1336	1334	1334	1335
5.0	1227	1231	1233	1236	1237	1240	1242	1246	1247	1245	1239	1234	1228	1223	1221	1223	1226
7.5	1034	1040	1046	1047	1050	1055	1062	1067	1069	1063	1056	1045	1033	1022	1024	1027	1033
10.0	786	794	801	804	806	814	822	830	832	823	810	798	780	769	770	777	785
12.5	551	559	565	567	569	577	585	593	593	585	571	558	542	534	535	541	550
15.0	373	378	382	383	382	389	397	404	405	399	390	381	371	362	360	362	367
17.5	251	252	255	257	258	261	270	279	281	277	271	267	259	250	248	250	251
20.0	179	177	180	184	183	182	191	199	199	195	194	194	188	179	179	181	179
22.5	133	130	134	137	136	134	141	148	147	143	144	147	141	134	134	137	133
25.0	103	98	102	107	105	103	108	115	113	108	110	115	109	102	103	108	103
27.5	81	76	80	85	83	80	85	92	89	84	87	91	86	80	82	86	81
30.0	65	60	63	69	67	64	68	74	71	67	70	74	69	63	65	69	65
32.5	53	48	51	57	54	51	55	61	58	54	57	61	56	51	53	56	52
35.0	43	39	42	47	45	42	45	51	48	44	47	51	46	42	44	46	43
37.5	36	33	35	39	37	35	38	42	40	37	39	42	39	35	36	39	36
40.0	30	27	29	33	31	29	32	36	33	31	33	36	32	29	30	32	30
42.5	25	23	25	28	26	24	27	30	28	26	28	30	27	24	25	27	25
45.0	21	20	21	23	22	21	23	25	24	22	24	25	23	21	22	23	21
47.5	18	17	18	20	19	18	20	22	20	19	20	22	20	18	19	19	18
50.0	16	15	16	17	16	16	17	18	18	17	18	18	17	16	16	17	16
52.5	14	14	14	15	14	14	15	16	15	15	15	16	15	14	14	15	14
55.0	12	12	12	13	13	13	13	14	14	13	14	14	13	13	13	13	12
57.5	11	11	11	12	11	11	12	12	12	12	12	13	12	12	11	12	11
60.0	10	10	10	10	10	10	10	11	11	11	11	11	11	10	10	10	10
62.5	9	9	9	9	9	9	9	10	10	9	10	10	9	9	9	9	9
65.0	8	8	8	8	8	8	8	8	8	8	8	9	8	8	8	8	8
67.5	7	7	7	7	7	7	7	7	7	7	7	8	7	7	7	7	7
70.0	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
72.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
75.0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
77.5	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3	3
80.0	2	3	3	3	3	3	3	3	3	3	2	2	3	3	3	2	2
82.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
85.0	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
87.5	1	1	1	1	1	1	1	1	0	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

Continued…..

Test Results – Candela Tabulation Cont.

	0.0	22.5	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
92.5	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
95.0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
97.5	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0
100.0	0	1	1	1	0	1	1	0	0	1	1	1	1	1	1	1	0
102.5	0	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0
105.0	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1
107.5	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1
110.0	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
115.0	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	0	1	1	1	1	1	1	1
120.0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
122.5	1	1	1	1	0	1	1	0	0	0	1	1	1	1	1	1	1
125.0	1	1	1	1	0	1	1	0	0	0	1	1	1	1	1	1	1
127.5	1	1	1	1	0	1	1	0	0	0	0	1	0	1	1	1	1
130.0	1	1	1	0	0	1	0	0	0	0	0	1	0	1	1	1	1
132.5	1	1	1	0	0	1	0	0	0	0	0	1	0	1	1	1	1
135.0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1
137.5	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1
140.0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1
142.5	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1
145.0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1
147.5	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1
150.0	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1
152.5	2	1	1	1	1	1	0	1	1	1	1	1	1	1	1	2	2
155.0	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
157.5	2	2	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
160.0	2	2	2	1	1	1	1	1	1	1	1	1	1	1	2	2	2
162.5	2	2	2	2	1	1	1	1	1	1	1	2	2	2	2	2	2
165.0	2	2	2	2	2	2	1	1	1	1	2	2	2	2	2	2	2
167.5	2	2	2	2	2	2	2	1	1	2	2	2	2	2	2	2	2
170.0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
172.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
175.0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
177.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
180.0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	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 76-inch diameter sphere manufactured by Labsphere (Model# LMS760) 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 (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 12.0 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).

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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.

CSA is an accredited Test Laboratory (TL-430)
to IESNA LM79-08 by IAS
(International Accreditation Service)

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Equipment List:

Description	Manufacturer and Model Number	CSA Instrument Reference Number	Calibration Due Date
Integrating Sphere 76”	Labsphere LMS760	SPH200	N/A
Spectroradiometer	Labsphere CDS600	CDS600	5/2012
Auxiliary Lamp PSU	Labsphere LPS200	LPS200	2/2012
Power Analyzer	Yokogawa WT210	PA111	1/2012
Power Analyzer	Yokogawa WT210	PA108	5/2012
Regulated Power Supply	Chroma Instruments 61603	AC303	N/A
Regulated Power Supply	Chroma Instruments 61602	AC301	N/A
Thermometer (Thermocouple)	Fluke 52	TH100	8/2011

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