



**PHOTOMETRIC TESTING & EVALUATION TO IES LM-79-08**

Sample Tested  
**EnduraLED MR16 2700K P**

Prepared for:

**Anne Ye**

Philips (China) Investment Co.,Ltd  
Philips Innovation Campus Shanghai  
No.2.Building  
No.9, Lane 888, Tian Lin Road, 200233, Shanghai, China

Phone: +86-21-2412 8569  
Fax: +86-21-5445 1520

**Technical Report Number**  
30013197

January 12, 2010

**Prepared by:**

Clayton Magerfleisch, Project Technician

**Approved by:**

Bryan Cubitt, Technical Team Leader



U.S. Department of Energy

**Lighting Facts<sup>cm</sup> Uniform LM-79 Reporting Template**



**Laboratory Information**

Name of test lab	OnSpeX		
Date of test report	January 12, 2010		
Test report number	30013197		
Laboratory contact name	Steve Longo		
Laboratory contact signature*	<i>Steve Longo</i>		

\* By signing this form, the signatory is attesting that the information on the form is correct and the same as on the original, complete test report(s). The signatory also attests that all of the results on this form were measured entirely in accordance with IES LM-79-08.

**Product Information**

Manufacturer	Philips		
Brand name	EnduraLED MR16 2700K P		
Model number	929000158204 (12NC no.)		
SKU (if available)	046677408756		
Type of luminaire (for integral lamps, list base type and lamp type)	MR16 Replacement (GU5.3 Base)		
Luminaire aperture (downlights)	1.25	in.	
Luminaire length	1.75	in.	
Luminaire width	2.00	in.	
Number of units (modular products)	-		

**Electrical Measurements**

	Integrating sphere output	Goniophotometer output	
Input wattage	3.71	3.70	W
Input current	0.608	0.599	A
Input voltage	12.00	12.00	V
Power factor	0.515	0.515	
Off-state power	0.00	0.00	W

**Photometric Characteristics**

Total initial lumen output	158.8	160.7	lm
Initial luminaire efficacy	42.80	43.43	lm/W
Correlated color temperature / CCT	2742		K
Color rendering index / CRI	82.1		
R <sub>9</sub> value	15.0		
Duv	0.00193		

**Luminous Intensity Distribution**

	Goniophotometer output	
Center beam candlepower (if applicable)	729	cd
Beam angle (if applicable)	21.0	°
Zonal lumens in the 0°-60° zone	98.2	%
Zonal lumens in the 60°-90° zone	1.8	%
Zonal lumens in the 90°-120° zone	N/A	%
Zonal lumens in the 120°-180° zone	N/A	%



### Program Description

Photometric and electrical testing of an “EnduraLED MR16 2700K P” replacement lamp to IES LM-79-08.

### Executive Summary

Sample Tested = **EnduraLED MR16 2700K P**

12NC number = **929000158204**

SKU number = **046677408756**

Module number = **4GU5.3MR16-1**

<b>Luminous Efficacy*</b> <b>(Lumens/Watt)</b>	<b>Luminous Flux*</b> <b>(Lumens)</b>	<b>Input Power*</b> <b>(Watts)</b>	<b>Power Factor</b>
<b>42.80</b>	<b>158.8</b>	<b>3.71</b>	<b>0.515</b>

<b>CCT (K)*</b>	<b>CRI*</b>	<b>Stabilization Time</b> <b>(Light &amp; Power)</b>
<b>2742</b>	<b>82.1</b>	<b>35 minutes</b>

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



## TABLE OF CONTENTS

Sample.....	5
Test Overview.....	6
Test Results.....	7
Spectral Flux.....	8
Chromaticity Diagram.....	9
Flux Distribution.....	10
Illuminance Plots.....	11
Candela Plots.....	12
Candela Tabulation.....	13
Photometric Testing Information.....	14
Equipment List:.....	15

January 12, 2010

**Sample**

The following sample was submitted for evaluation:

EnduraLED MR16 2700K P



**EnduraLED MR16 2700K P**

## Test Overview

The LED sample was evaluated in accordance with IES LM-79-08.

A *Goniophotometer* and an *Integrating Sphere* were used to measure all photometric characteristics of the sample. A full description of these and the associated equipment is provided at the end of this report.

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

The sample was evaluated for the following photometric properties:

- Luminous Flux
- Correlated Color Temperature (CCT)
- Color Rendering Index (CRI)
- Chromaticity Coordinates
- Luminous Efficacy
- Beam Distribution Properties

The sample was evaluated for the following electrical properties:

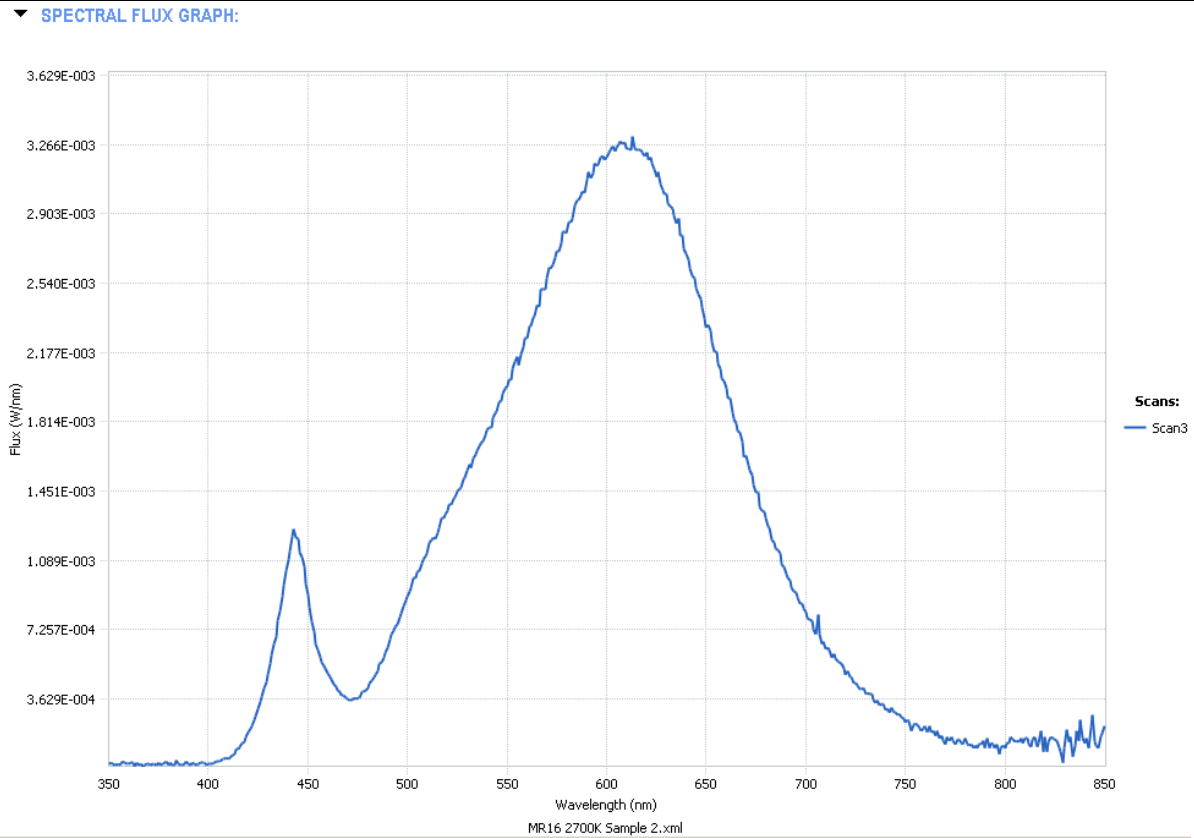
- Input Power (including Voltage, Current, Frequency and Power Factor)
- Total Harmonic Distortion of the input voltage (THD)

January 12, 2010

<b>Test Results –</b>		
The following results were measured after stabilization of the sample in the <b>Integrating Sphere</b> (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).		
<b>Key Photometric Results</b>	<b>Sample Reference</b>	
	<b>EnduraLED MR16 2700K P</b>	
	<b>Integrating Sphere</b>	<b>Goniophotometer</b>
Luminous Efficacy (Lumens/Watt)	<b>42.80</b>	<b>43.43</b>
Total Luminous Flux (Lumens)	<b>158.8</b>	<b>160.7</b>
Total Radiant Flux (Watts)	<b>0.52</b>	
Correlated Color Temperature (CCT)	<b>2741.8</b>	
Color Rendering Index (CRI)	<b>82.1</b>	
Chromaticity (Chroma x / Chroma y)	<b>0.4596 / 0.4157</b>	
Chromaticity (Chroma u / Chroma v)	<b>0.2601 / 0.3528</b>	
Chromaticity (Chroma u' / Chroma v')	<b>0.2601 / 0.5293</b>	
D <sub>uv</sub> Value	<b>0.00193</b>	
Stabilization Time (Light and Power)	<b>Approx. 35 minutes</b>	
Total Run Time – Integrating Sphere	<b>40 minutes</b>	
Total Run Time – Goniophotometer	<b>72 minutes</b>	
Spacing Criteria	<b>0.38 (0° – 180°) / 0.40 (90° – 270°)</b>	
<b>Electrical Input Results:</b>	<b>Sample Reference</b>	
	<b>EnduraLED MR16 2700K P</b>	
	<b>Integrating Sphere</b>	<b>Goniophotometer</b>
Input Power (Watts)	<b>3.71</b>	<b>3.70</b>
Input Voltage (Volts AC)	<b>12.0</b>	<b>12.0</b>
Input Current (Amps)	<b>0.608</b>	<b>0.599</b>
Input Frequency (Hertz)	<b>60.0</b>	<b>60.0</b>
Power Factor	<b>0.515</b>	<b>0.515</b>
Total Harmonic Distortion (THD-V)	<b>9.89%</b>	
<b>Additional Information</b>	<b>Sample Reference</b>	
	<b>EnduraLED MR16 2700K P</b>	
Ambient Temperature	<b>25.7 °C</b>	
Integrating Sphere Detector	<b>CDS 600 Spectroradiometer</b>	
Absorption Correction used?	<b>Yes</b>	

**Spectral Flux**

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

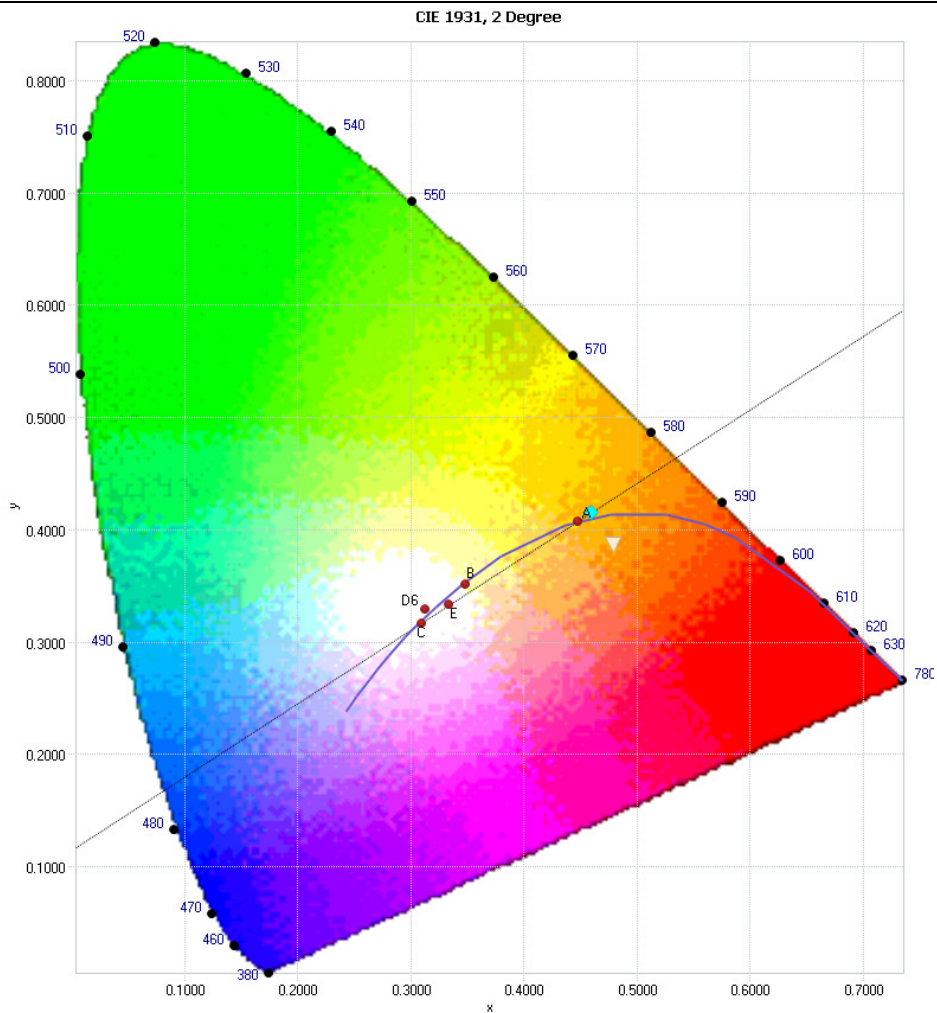


**Spectral response of the Radiant Flux**  
(350nm to 850nm – calibrated range of the Spectroradiometer).



**Chromaticity Diagram**

The following image shows the chromaticity diagram for the sample:



**Tristimulus values (from page 7):**  
 $x / y = 0.4596 / 0.4157$

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

January 12, 2010

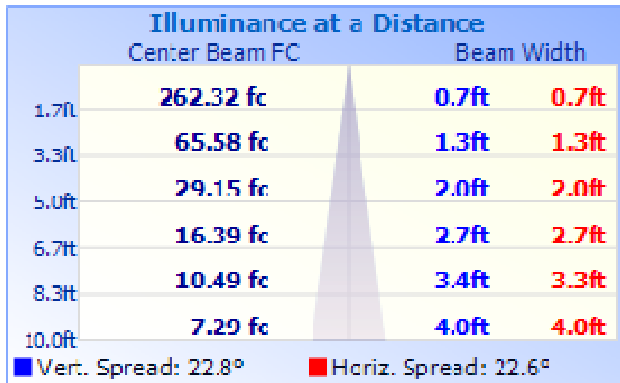
**Test Results – Flux Distribution**

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

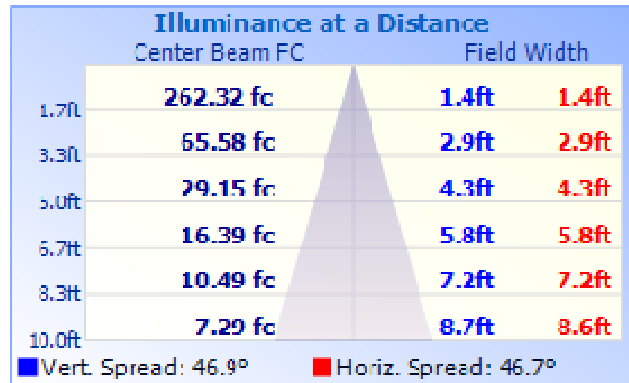
<b>Zone</b>	<b>Lumens</b>	<b>% Total</b>
<b>0 - 10</b>	<b>53.0</b>	<b>33.0%</b>
<b>10 - 20</b>	<b>65.6</b>	<b>40.8%</b>
<b>20 - 30</b>	<b>26.8</b>	<b>16.7%</b>
<b>30 - 40</b>	<b>7.1</b>	<b>4.4%</b>
<b>40 - 50</b>	<b>3.1</b>	<b>1.9%</b>
<b>50 - 60</b>	<b>2.2</b>	<b>1.4%</b>
<b>60 - 70</b>	<b>1.8</b>	<b>1.1%</b>
<b>70 - 80</b>	<b>1.0</b>	<b>0.6%</b>
<b>80 - 90</b>	<b>0.2</b>	<b>0.1%</b>
<b>Total</b>	<b>160.7 Lumens</b>	<b>100%</b>

**Test Results – Illuminance Plots**

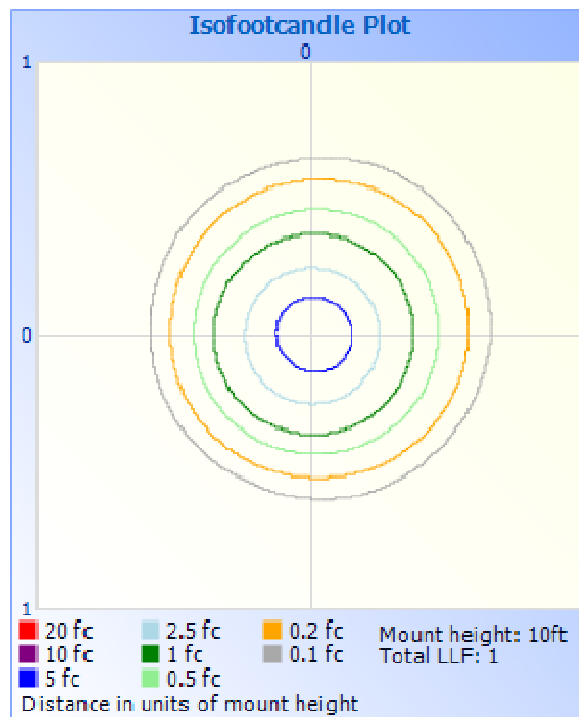
The following images depict the illuminance characteristics of the luminaire.



Beam Angle



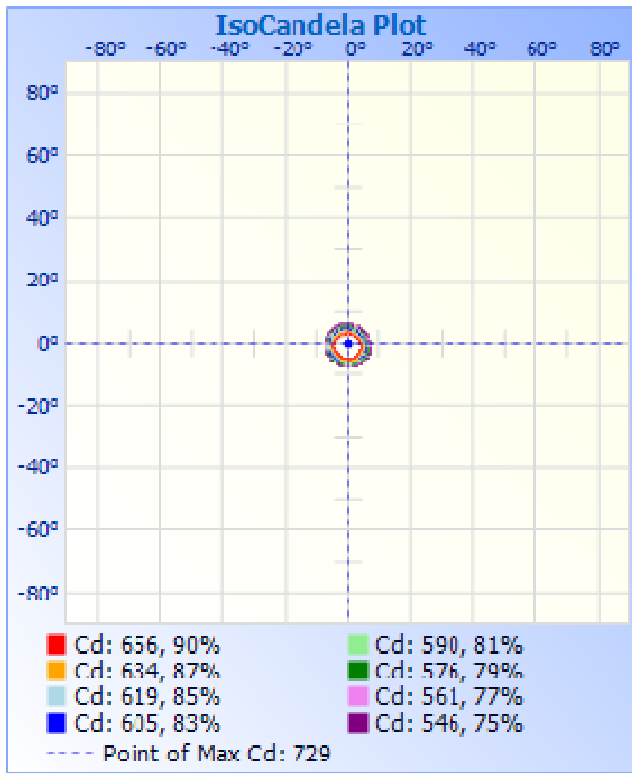
Field Angle



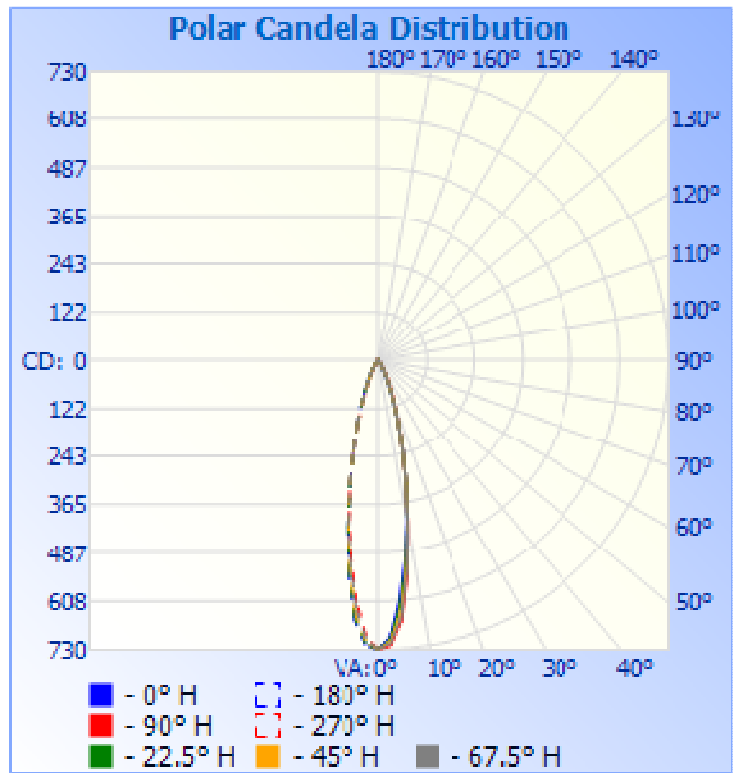
Illuminance Plot (Footcandles)

**Test Results – Candela Plots**

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



Isocandela Plot



Polar Candela Distribution

January 12, 2010

**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	728.66	728.66	728.66	728.66	728.66	728.66	728.66	728.66	728.66	728.66	728.66	728.66	728.66	728.66	728.66	728.66	728.66
2.5	695.51	700.77	706.82	713.27	718.54	721.07	721.38	719.98	717.34	712.94	708.17	701.89	695.92	692.00	690.08	691.54	694.84
5.0	608.77	622.41	639.50	652.46	659.47	662.43	661.87	660.43	658.05	652.94	642.60	626.68	612.35	601.78	598.34	600.17	608.19
7.5	507.71	519.20	531.16	540.94	547.81	550.52	550.23	550.32	549.15	544.05	536.33	523.00	509.94	500.06	494.93	497.82	504.81
10.0	411.60	415.79	418.51	419.93	422.72	425.81	427.47	427.73	428.87	428.28	424.55	417.61	412.15	406.50	403.44	406.66	411.15
12.5	319.12	318.79	316.55	314.17	314.20	316.65	317.84	318.20	319.84	321.54	322.70	320.98	318.93	317.20	316.50	318.36	318.77
15.0	234.90	233.34	231.30	230.04	231.00	234.19	235.83	236.00	236.36	236.94	237.48	236.63	236.51	234.32	234.48	235.60	234.82
17.5	166.82	166.36	166.36	167.05	168.82	172.48	174.27	174.43	174.16	173.17	171.61	170.54	168.73	166.76	166.66	167.06	166.80
20.0	113.47	114.84	117.09	120.10	123.61	127.57	129.52	129.55	128.27	125.09	121.17	118.89	115.42	113.23	112.42	112.54	113.42
22.5	73.15	75.99	80.18	84.55	88.87	93.24	95.67	95.15	92.80	88.18	82.46	78.75	74.63	72.47	71.41	71.44	73.11
25.0	44.78	48.36	52.83	57.94	62.34	66.15	68.76	68.46	65.55	60.33	54.26	49.63	45.85	43.94	43.11	42.68	44.73
27.5	27.09	30.42	33.60	38.24	42.44	45.66	48.10	47.73	44.75	39.97	35.07	30.37	27.44	26.24	25.68	25.17	27.07
30.0	17.15	19.34	20.91	24.44	27.87	30.37	32.38	31.99	29.17	25.61	22.44	18.68	16.77	16.29	15.90	15.63	17.10
32.5	11.64	12.66	13.24	15.48	18.11	19.64	21.22	20.97	18.49	16.29	14.48	12.02	11.05	10.87	10.70	10.65	11.60
35.0	8.43	8.78	9.05	10.27	11.99	12.71	13.64	13.70	11.82	10.75	9.67	8.41	7.96	7.97	7.97	7.93	8.43
37.5	6.48	6.58	6.74	7.44	8.38	8.63	9.08	9.31	8.13	7.63	6.96	6.33	6.15	6.28	6.35	6.29	6.48
40.0	5.20	5.22	5.38	5.80	6.31	6.34	6.53	6.77	6.15	5.87	5.42	5.05	4.97	5.15	5.27	5.19	5.20
42.5	4.21	4.26	4.41	4.76	5.03	4.94	5.03	5.18	4.92	4.80	4.41	4.16	4.08	4.19	4.33	4.22	4.22
45.0	3.49	3.56	3.72	4.04	4.20	4.08	4.12	4.16	4.12	4.07	3.75	3.52	3.44	3.53	3.68	3.59	3.49
47.5	3.02	3.08	3.22	3.56	3.66	3.52	3.52	3.54	3.55	3.56	3.27	3.06	3.00	3.08	3.24	3.14	3.02
50.0	2.68	2.73	2.88	3.20	3.27	3.14	3.10	3.10	3.15	3.19	2.92	2.73	2.68	2.77	2.93	2.81	2.68
52.5	2.45	2.48	2.64	2.94	3.00	2.88	2.82	2.81	2.87	2.92	2.67	2.48	2.45	2.53	2.70	2.56	2.45
55.0	2.24	2.27	2.43	2.74	2.80	2.66	2.60	2.60	2.67	2.72	2.45	2.29	2.26	2.32	2.51	2.35	2.25
57.5	2.06	2.10	2.24	2.59	2.63	2.47	2.43	2.42	2.50	2.55	2.26	2.12	2.09	2.13	2.34	2.16	2.07
60.0	1.89	1.94	2.06	2.43	2.46	2.29	2.26	2.24	2.33	2.41	2.07	1.96	1.92	1.94	2.18	1.97	1.89
62.5	1.72	1.79	1.89	2.27	2.29	2.11	2.10	2.07	2.17	2.26	1.90	1.80	1.75	1.76	2.02	1.79	1.73
65.0	1.55	1.62	1.72	2.09	2.09	1.93	1.92	1.90	1.99	2.07	1.72	1.62	1.56	1.59	1.87	1.61	1.55
67.5	1.38	1.45	1.54	1.87	1.86	1.72	1.72	1.69	1.78	1.87	1.54	1.44	1.38	1.42	1.69	1.44	1.39
70.0	1.21	1.27	1.34	1.62	1.61	1.49	1.47	1.46	1.54	1.63	1.34	1.25	1.21	1.22	1.48	1.24	1.21
72.5	1.03	1.06	1.13	1.37	1.34	1.21	1.18	1.19	1.29	1.37	1.13	1.05	1.02	1.04	1.27	1.06	1.03
75.0	0.84	0.86	0.89	1.09	1.05	0.91	0.89	0.90	1.00	1.10	0.89	0.85	0.84	0.84	1.06	0.86	0.84
77.5	0.65	0.69	0.71	0.87	0.80	0.68	0.65	0.63	0.71	0.82	0.66	0.66	0.65	0.65	0.84	0.66	0.65
80.0	0.46	0.52	0.51	0.60	0.55	0.47	0.44	0.42	0.46	0.51	0.47	0.48	0.47	0.46	0.58	0.46	0.46
82.5	0.29	0.39	0.40	0.44	0.39	0.34	0.20	0.22	0.25	0.31	0.30	0.31	0.32	0.31	0.37	0.29	0.28
85.0	0.11	0.20	0.20	0.24	0.21	0.13	0.04	0.05	0.10	0.14	0.13	0.13	0.15	0.15	0.21	0.15	0.11
87.5	0.02	0.07	0.09	0.12	0.08	0.03	0.01	0.01	0.01	0.03	0.04	0.04	0.05	0.05	0.06	0.04	0.02
90.0	0.01	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02

January 12, 2010

### 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 “ $4\pi$  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, 60 Hertz 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 1<sup>st</sup> 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.....

January 12, 2010

**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)

**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	5-20-2010
Auxiliary Lamp PSU	Labsphere LPS200	LPS200	2-10-2010
Power Analyzer	Voltech PM1000+	PA110	4-27-2010
Regulated Power Supply	California Instruments 1001P	AC100	N/A
Regulated Power Supply	Chroma Instruments 61602	AC300	N/A
Thermometer (Thermocouple)	Fluke 52	TH100	8-04-2010

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 and Voltech PM1000+; which is calibrated by Voltech (NIST traceable certificate).