

ETC LED Test Results

LM79 and InSitu Test

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SECTION 1 - Source Four LED

Lustr+
Studio HD
Tungsten
Daylight



REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: July 30, 2013

REPORT NO. 101158242CRT-010

TEST OF ONE LED PROFILE LIGHT

FIXTURE MODEL NO. S4 LUSTR+
LED MODEL NO. LUXEON REBEL ES

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and LED In-Situ tests.

LABORATORY NOTE: The laboratory that conducted the testing detailed in this report has been Qualified, Verified, and Recognized for LM-79 Testing for ENERGY STAR for SSL by US DOE's CALiPER program.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

Energy Star Version 1.2 (2012): Program Requirements for Luminaires

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number S4 LUSTR+. The sample was received by Intertek on May 6, in undamaged condition, and one sample was tested as received. The sample designation was CRT1304251519-003.

DATES OF TESTS: July 29, 2013

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SUMMARY

Model No.:	S4 LUSTR+
Description:	LED PROFILE LIGHT

Criteria	Result
Maximum In-Situ Source Temperature Point – LXML-PM01 GREEN (°C)	72.4
Maximum In-Situ Source Temperature Point – LXML-PE01 CYAN (°C)	71.2
Maximum In-Situ Source Temperature Point – LXML-PB01 BLUE (°C)	74.5
Maximum In-Situ Source Temperature Point – LXML-PR01 ROYAL BLUE (°C)	73.8
Maximum In-Situ Source Temperature Point – LXM2-PL01 PC AMBER (°C)	74.9
Maximum In-Situ Source Temperature Point – LXM2-PD01 RED LOW VF (°C)	77.0
Maximum In-Situ Source Temperature Point – LXML-PWN1 WHITE (°C)	73.2
Maximum Power Supply Case Temperature	48.9

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Fluke Multimeter	PM2525	M127	10/17/12	10/17/13
Fluke Temp Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

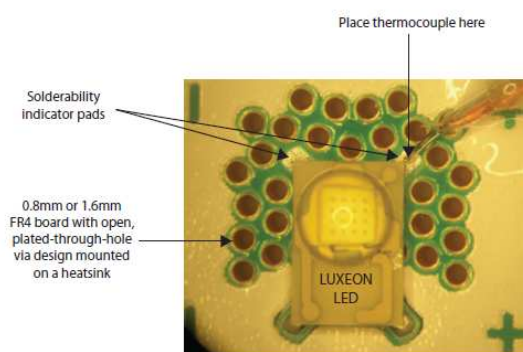
In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Agilent 34970A Data Logger. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TESTS

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED identified as: LUXEON REBEL ES



Electrical Characteristics at 350 mA for LUXEON Rebel color, Thermal Pad Temperature = 25°C

Table 3.

Color	Part Number	Forward Voltage V_f ^[1] (V)			Typical Temperature Coefficient of Forward Voltage ^[2] (mV/°C) $\Delta V_f / \Delta T_f$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R_{\theta_{JC}}$
		Min.	Typ.	Max.		
Green	LXML-PM01	2.55	2.90	3.51	- 2.0 to - 4.0	10
Cyan	LXML-PE01	2.55	2.90	3.51	- 2.0 to - 4.0	10
Blue	LXML-PB01	2.55	2.95	3.51	- 2.0 to - 4.0	10
Royal-Blue	LXML-PR01	2.55	2.95	3.51	- 2.0 to - 4.0	10
Red	LXML-PD01	2.31	2.90	3.51	- 2.0 to - 4.0	12
Red	LXM2-PD01	1.80	2.10	2.80	- 2.0 to - 4.0	8
Deep Red	LXM3-PD01	1.80	2.10	2.80	- 2.0 to - 4.0	8
Red-Orange	LXML-PH01	2.31	2.90	3.51	- 2.0 to - 4.0	12
Red-Orange	LXM2-PH01	1.80	2.10	2.80	- 2.0 to - 4.0	8
PC Amber	LXM2-PL01	2.55	3.05	3.51	- 2.0 to - 4.0	10
Amber	LXML-PL01	2.31	2.90	3.51	- 2.0 to - 4.0	12

Absolute Maximum Ratings

Table 5.

Parameter	Green/Cyan/ Blue/Royal Blue	LUXEON Rebel ES Royal Blue/ES Blue	Red/Deep-Red Red-Orange/Amber	PC Amber
DC Forward Current (mA)	1000	1000	700	700
Peak Pulsed Forward Current (mA)	1000	1200	700	700
Average Forward Current (mA)	1000	1000	700	700
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3A JESD22-A114-B			
LED Junction Temperature ^[1]	150°C	150°C	135°C	130°C



RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXML-PM01 GREEN

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51 V

Measured LED Current = 554 mA

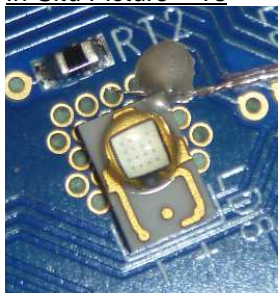
Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 1.945\text{W}$

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 131^\circ\text{C}$

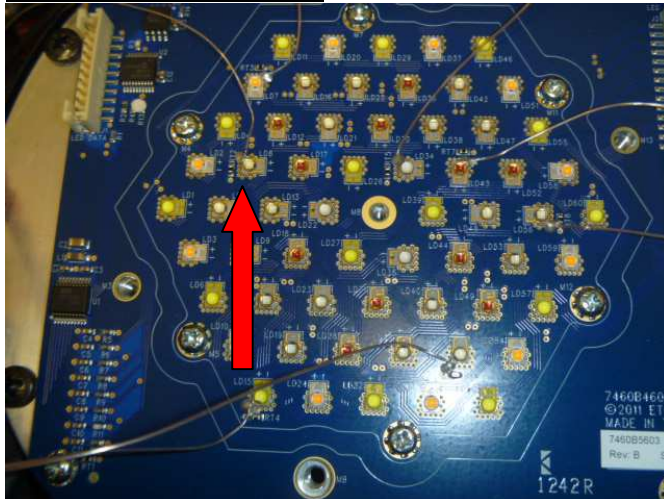
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-003	72.4	Per diagram above	131

In-Situ Picture – T_s



In-Situ Picture – T_s location





RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXML-PE01 CYAN

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51 V

Measured LED Current = 557 mA

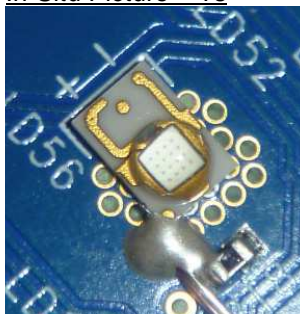
Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 1.955\text{W}$

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 130^\circ\text{C}$

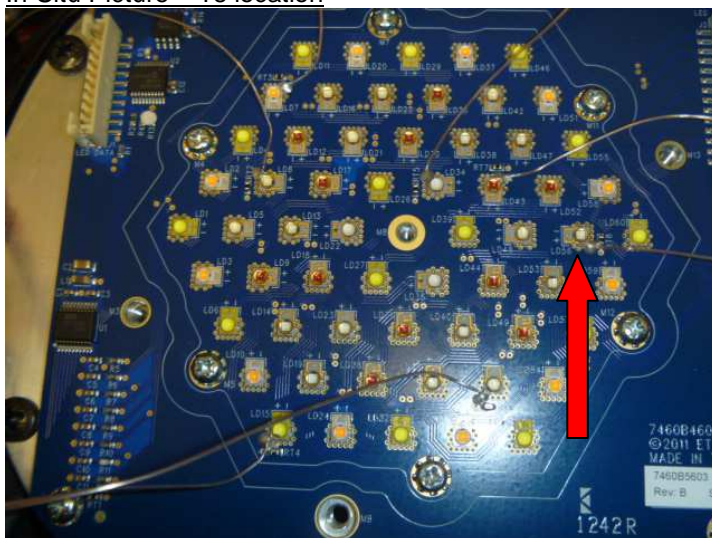
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-003	71.2	Per diagram above	130

In-Situ Picture – T_s



In-Situ Picture – T_s location





RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXML-PB01 BLUE

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51 V

Measured LED Current = 555 mA

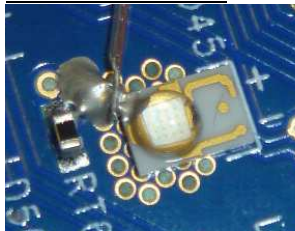
Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 1.948\text{W}$

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 131^\circ\text{C}$

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-003	74.5	Per diagram above	131

In-Situ Picture – T_s



In-Situ Picture – T_s location





RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXML-PR01 ROYAL BLUE

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51 V

Measured LED Current = 553 mA

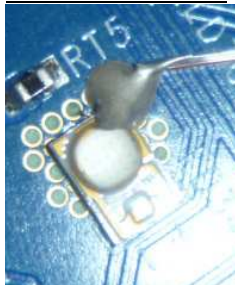
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.941W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 131°C

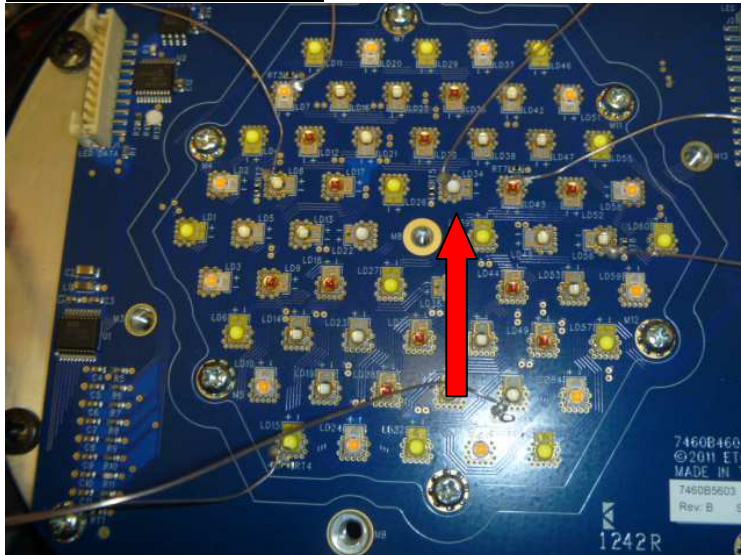
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-003	73.8	Per diagram above	131

In-Situ Picture – T_s



In-Situ Picture – T_s location





RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXM2-PL01 PC AMBER

Maximum Junction Temperature from LED specification (T_j) = 130°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51 V

Measured LED Current = 557 mA

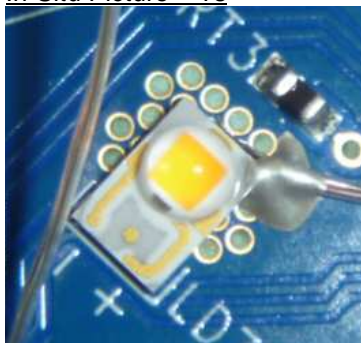
Calculated LED Wattage = $V_f \times$ Measured LED Current = 1.955W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 110^\circ\text{C}$

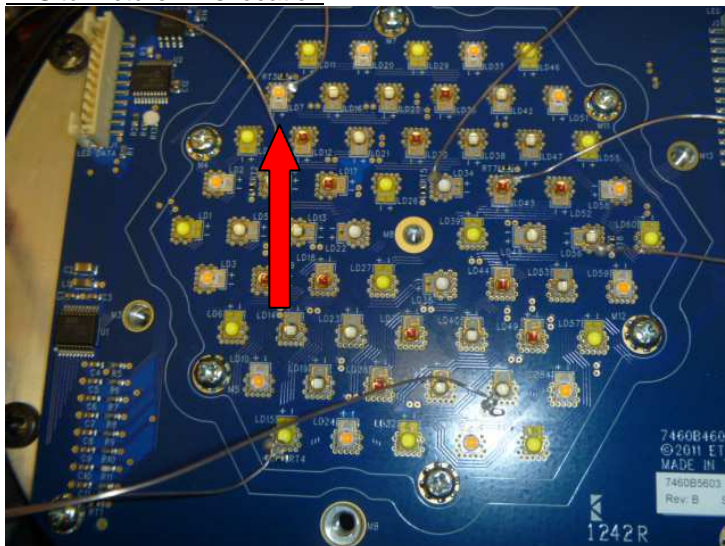
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-003	74.9	Per diagram above	110

In-Situ Picture – T_s



In-Situ Picture – T_s location





RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXM2-PD01 RED LOW VF

Maximum Junction Temperature from LED specification (T_j) = 135°C

Thermal Resistance Formula from LED specification = 8°C/W

Maximum Forward Voltage (V_f) from LED specification = 2.8V

Measured LED Current = 560 mA

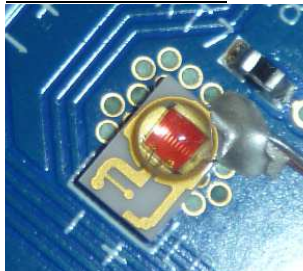
Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 1.568\text{W}$

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 122^\circ\text{C}$

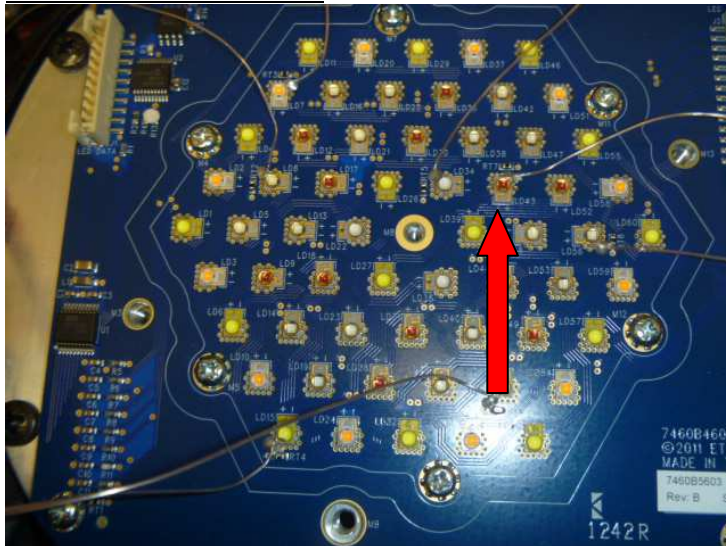
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-003	77.0	Per diagram above	122

In-Situ Picture – T_s



In-Situ Picture – T_s location





RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXML-PWN1 WHITE

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 6°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.5V

Measured LED Current = 548 mA

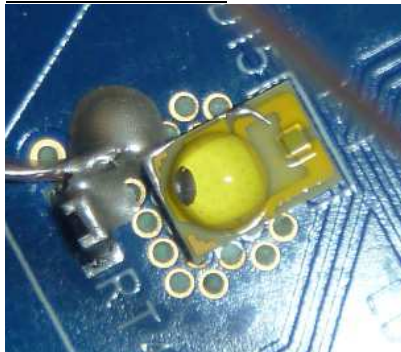
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.918W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 138°C

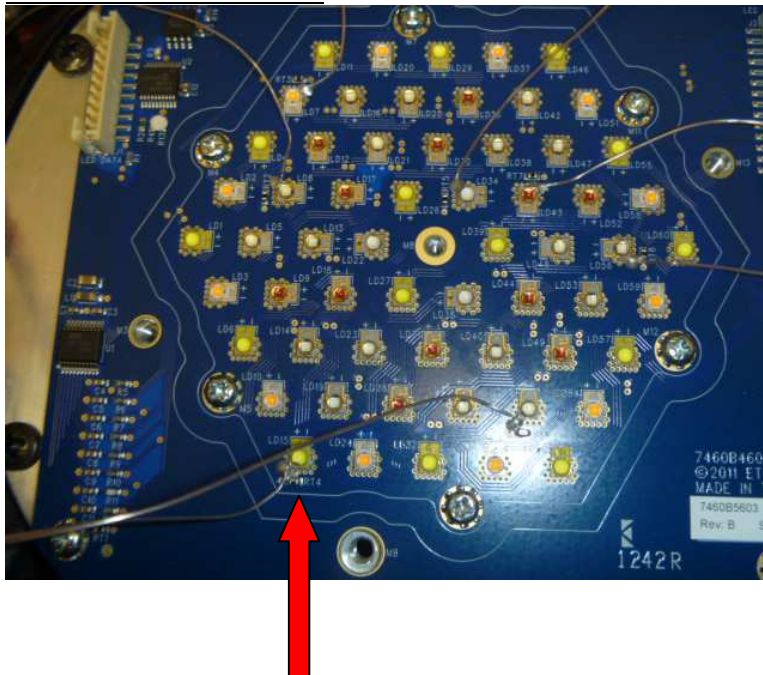
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-003	73.2	Per diagram above	138

In-Situ Picture – T_s



In-Situ Picture – T_s location





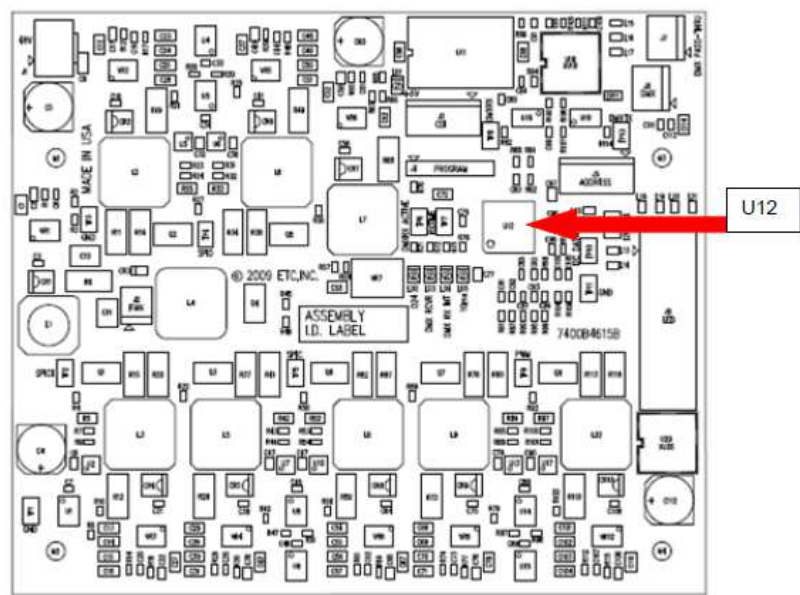
RESULTS OF TESTS (cont'd)

Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation:
Driver identified as: Model No. 7400B5615

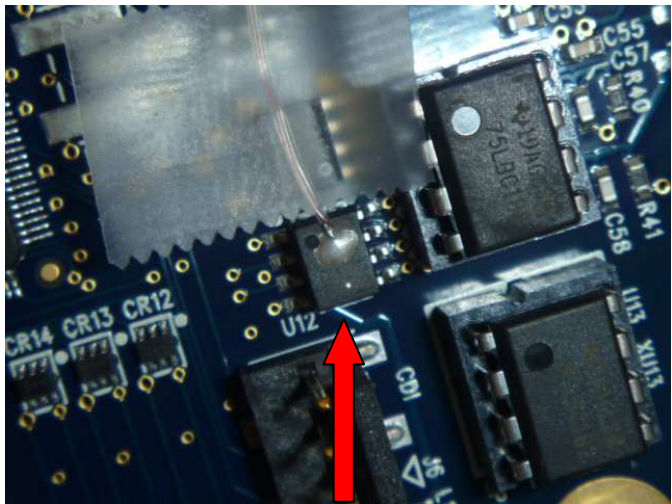
Manufacturer Supplied Documentation:
Driver identified as: 7400B5615, Rev. F

For Selador Classic, measure the temperature at U12.



Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Measured Power Supply Case Temperature (°C)	Location	Maximum Power Supply Case Temperature (°C)
CRT1304251519-003	48.9	U12	100





Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink, appearing to be "K R".

Kenda Branch
Engineer
Lighting Division

Attachment: None

Report Reviewed By:

A handwritten signature in black ink, appearing to be "Joseph Schledorn".

Joseph Schledorn
Project Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: May 23, 2013

REPORT NO. 101158242CRT-002

TEST OF ONE LED PROFILE

FIXTURE MODEL NO. S4 LUSTR+

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

LABORATORY NOTE: The laboratory that conducted the testing detailed in this report has been Qualified, Verified, and Recognized for LM-79 Testing for ENERGY STAR for SSL by US DOE's CALiPER program.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79: 2008 Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products

ANSI ANSLG C38.377: 2012 Specifications of the Chromaticity of Solid State Lighting Products

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number S4 LUSTR+. The sample was received by Intertek on May 6, 2013, in undamaged condition, and one sample was tested as received. The sample designation was CRT1304251519-003.

DATES OF TESTS: May 15, 2013 through May 22, 2013

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SUMMARY

Model No.: S4 LUSTR+
Description: LED PROFILE

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	3724	3704
Total Power (W)	122.7	122.1
Luminaire Efficacy (LPW)	30.35	30.33

Criteria	Result
Power Factor	0.989
Current ATHD (%)	5.53
Correlated Color Temperature (CCT - K)	5543
Color Rendering Index (CRI) – Ra	62.2
Color Rendering Index (CRI) - R9	-74.5
Duv	0.027
Chromaticity Coordinate (x)	0.331
Chromaticity Coordinate (y)	0.293
Chromaticity Coordinate (u')	0.226
Chromaticity Coordinate (v')	0.451

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
LSI High Speed Mirror Goniometer	6440	---	05/20/13	06/20/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Extech Hygro Thermometer	445703	T1359	11/08/12	11/08/13
Fisher Scientific	---	N1132	04/22/13	04/22/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Yokogawa Power Analyzer	WT1600	E462	07/06/12	07/06/13
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temp Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	NA	NA	NA
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Sorensen DC Power Supply	DLM150-20E	N/A	N/A	N/A
FLUKE	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

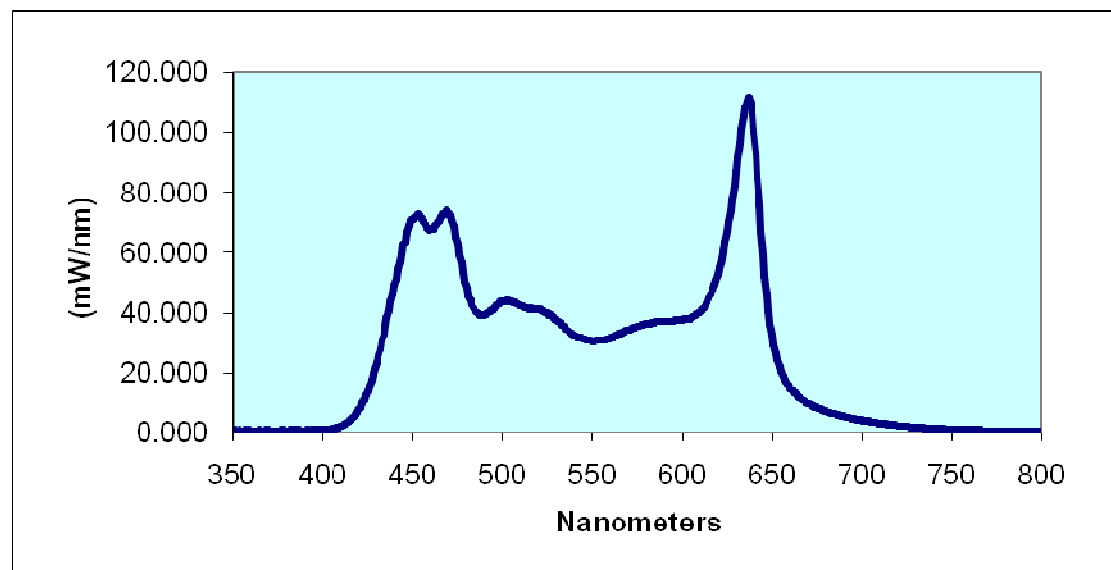
The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

RESULTS OF TESTS

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.799	460	67.806	570	34.004	680	7.042
355	0.525	465	70.360	575	35.244	685	6.055
360	0.620	470	73.215	580	36.125	690	5.252
365	0.652	475	62.632	585	36.767	695	4.537
370	0.651	480	48.124	590	37.031	700	3.972
375	0.616	485	40.432	595	37.040	705	3.439
380	0.550	490	39.240	600	37.556	710	2.985
385	0.576	495	41.090	605	38.280	715	2.600
390	0.620	500	43.612	610	40.255	720	2.285
395	0.711	505	43.486	615	44.732	725	1.947
400	0.806	510	42.431	620	52.909	730	1.688
405	1.145	515	41.319	625	66.875	735	1.474
410	1.949	520	41.035	630	86.688	740	1.294
415	3.848	525	39.917	635	108.281	745	1.093
420	7.620	530	37.586	640	100.082	750	0.999
425	13.850	535	34.522	645	58.941	755	0.870
430	23.396	540	32.367	650	32.404	760	0.738
435	35.641	545	31.080	655	20.270	765	0.000
440	48.897	550	30.438	660	14.716	770	0.581
445	62.526	555	30.738	665	11.716	775	0.521
450	70.845	560	31.539	670	9.721	780	0.445
455	71.081	565	32.777	675	8.162		

Sample No. CRT1304251519-003 Spectral Data Over Visible Wavelengths



RESULTS OF TESTS (cont'd)

Photometric and Electrical Measurements at 25°C – Integrating Sphere Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1304251519-003	UP	120.0	1033	122.7	0.989	5.53	3724	30.35

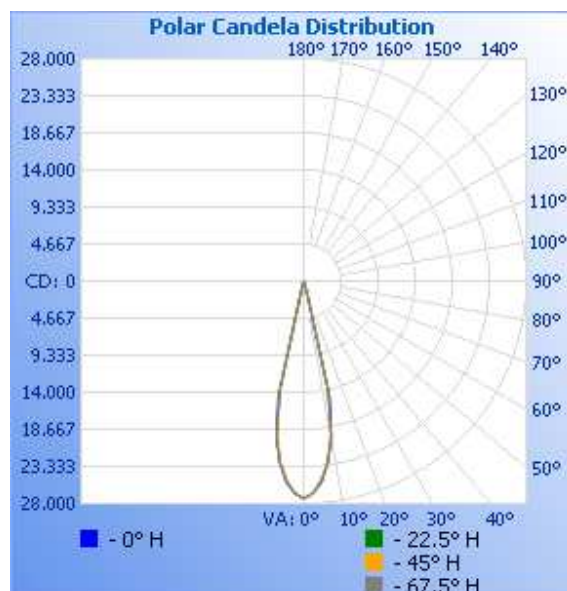
Intertek Sample No.	Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
CRT1304251519-003	5543	62.2	-74.5	0.027	0.331	0.293	0.226	0.451

Photometric and Electrical Measurements – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1304251519-003	UP	120.1	1027	122.1	0.991	3704	30.33

Intensity (Candlepower) Summary at 25°C - Candelas

Angle	0	22.5	45	67.5	90
0	27360	27360	27360	27360	27360
5	25396	25109	25046	25242	25323
10	19936	19796	19406	19995	20003
15	1184	1280	1577	2347	2404
20	56	57	57	57	56
25	21	19	20	20	22
30	5	4	4	3	5
35	0	0	0	0	0
40	0	0	0	0	0
45	0	0	0	0	0
50	0	0	0	0	0
55	0	0	0	0	0
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

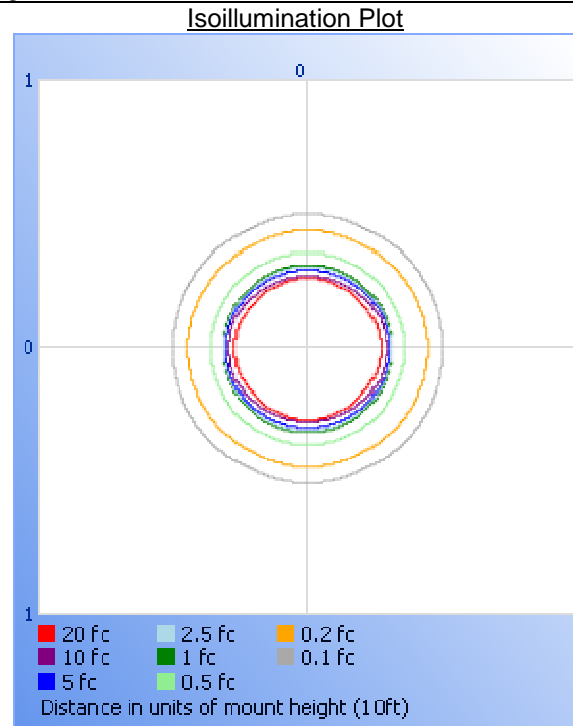
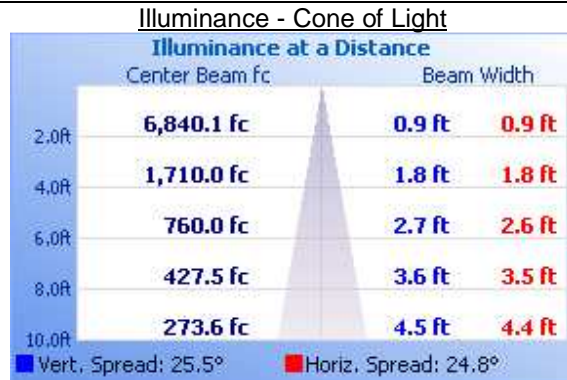




RESULTS OF TESTS (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	3704	100.0
0-40	3704	100.0
0-60	3704	100.0
60-90	0.0	0.0
0-90	3704	100.0
90-180	0.0	0.0
0-180	3704	100.0

Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink, appearing to read 'Kenda Branch'.

Kenda Branch
Engineer
Lighting Division

Report Reviewed By:

A handwritten signature in black ink, appearing to read 'David Ellis'.

David Ellis
Senior Project Engineer
Lighting Division

Attachment: None



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: November 29, 2013

REPORT NO. 101414036CRT-005

TEST OF ONE S4LED STUDIOHD ETL LTENG W/ BARRL (BLK)

MODEL NO. S4LED STUDIOHD
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number S4LED STUDIOHD. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-005.

DATES OF TESTS: November 21, 2013 through November 26, 2013.

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

SUMMARY

Model No.:	S4LED STUDIOHD
Description:	S4LED STUDIOHD ETL LTENG W/ BARRL (BLK)

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	5510	5718
Total Power (W)	109.1	109.3
Luminaire Efficacy (LPW)	50.5	52.31

Criteria	Result
Power Factor	0.985
Current ATHD %	6.35
Correlated Color Temperature (CCT - K)	4018
Color Rendering Index (CRI - Ra)	89.6
Color Rendering Index (CRI - R9)	65.2
DUV	0.014
Chromaticity Coordinate (x)	0.371
Chromaticity Coordinate (y)	0.343
Chromaticity Coordinate (u')	0.233
Chromaticity Coordinate (v')	0.484
Maximum In-Situ Source Temperature Point (°C)	79.6
Maximum In-Situ Driver Case Temperature (°C)	60.6

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Leeds & Northup Standard Resistor	Manganin	Y089	02/07/13	02/07/14
Data Precision Digital Voltmeter	3600	V124	02/07/13	02/07/14
Fluke Multimeter	45	M133	02/07/13	02/07/14
Kikusui DC Power Supply	35-10L	E160	---	---
Sorenson DC Power Supply	DLM150-20E	---	---	---
NIST Spectral Flux Standard Source	RF1024	---	09/18/10	100 hrs of use
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
Cole Palmer Thermometer	03313-85	T1470	05/31/13	05/31/14
LSI High Speed Mirror Goniometer	6440	---	11/21/13	12/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Cole Palmer Thermometer	03313-85	T1470	05/31/13	05/31/14
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Fluke Multimeter	87 V	D590	03/28/13	03/28/14
Fluke Temperature Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

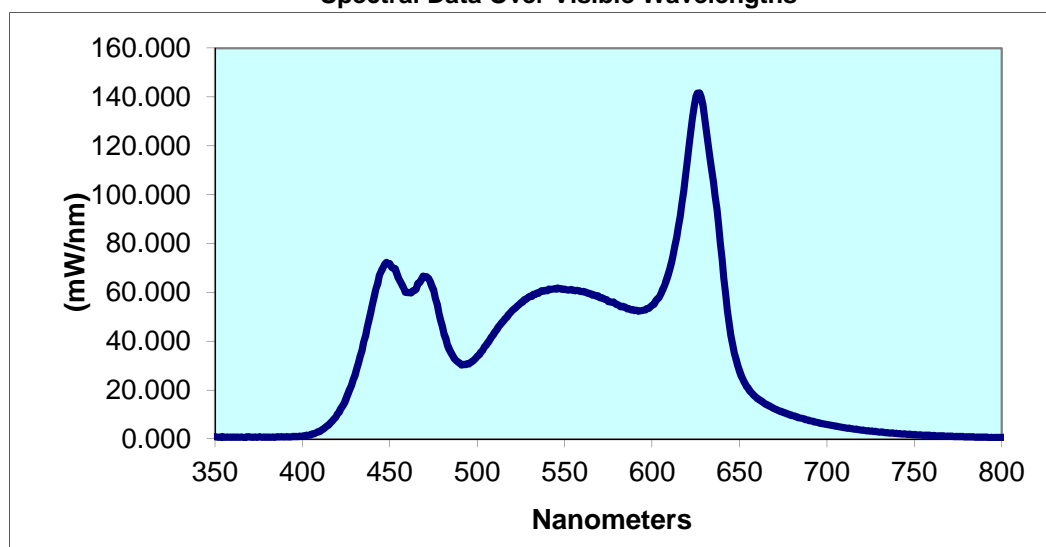
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-005	UP	120.0	922.3	109.1	0.985	6.35	5510	50.5

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
4018	89.6	65.2	0.014	0.371	0.343	0.233	0.484

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.979	440	54.97	530	58.28	620	113.6	710	4.606
355	0.722	445	68.63	535	59.65	625	139.9	715	4.129
360	0.737	450	71.65	540	60.66	630	131.7	720	3.59
365	0.767	455	65.73	545	61.31	635	105.1	725	3.216
370	0.793	460	59.92	550	61.18	640	73.54	730	2.796
375	0.753	465	61.31	555	60.77	645	42.54	735	2.469
380	0.652	470	66.3	560	60.3	650	27.56	740	2.223
385	0.782	475	60.73	565	59.45	655	20.55	745	1.937
390	0.83	480	46.02	570	57.87	660	16.73	750	1.728
395	0.914	485	35.29	575	56.19	665	14.23	755	1.502
400	1.141	490	30.89	580	55.09	670	12.39	760	1.362
405	1.849	495	30.75	585	53.72	675	10.87	765	1.183
410	3.181	500	33.89	590	52.53	680	9.546	770	1.073
415	5.788	505	38.3	595	52.74	685	8.494	775	0.934
420	10.2	510	43.86	600	54.64	690	7.525	780	0.829
425	16.52	515	48.41	605	59.56	695	6.661		
430	26.08	520	52.54	610	69.39	700	5.902		
435	39.74	525	55.9	615	86.78	705	5.231		

Spectral Data Over Visible Wavelengths



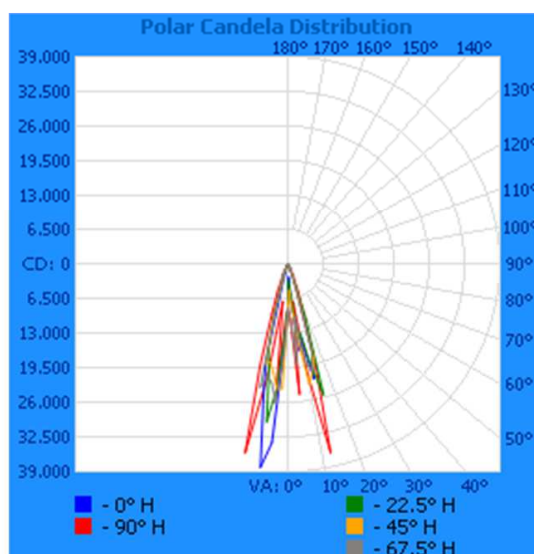
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-005	UP	120.0	922.1	109.3	0.988	5718	52.31

Intensity (Candlepower) Summary at 25°C - Candelas

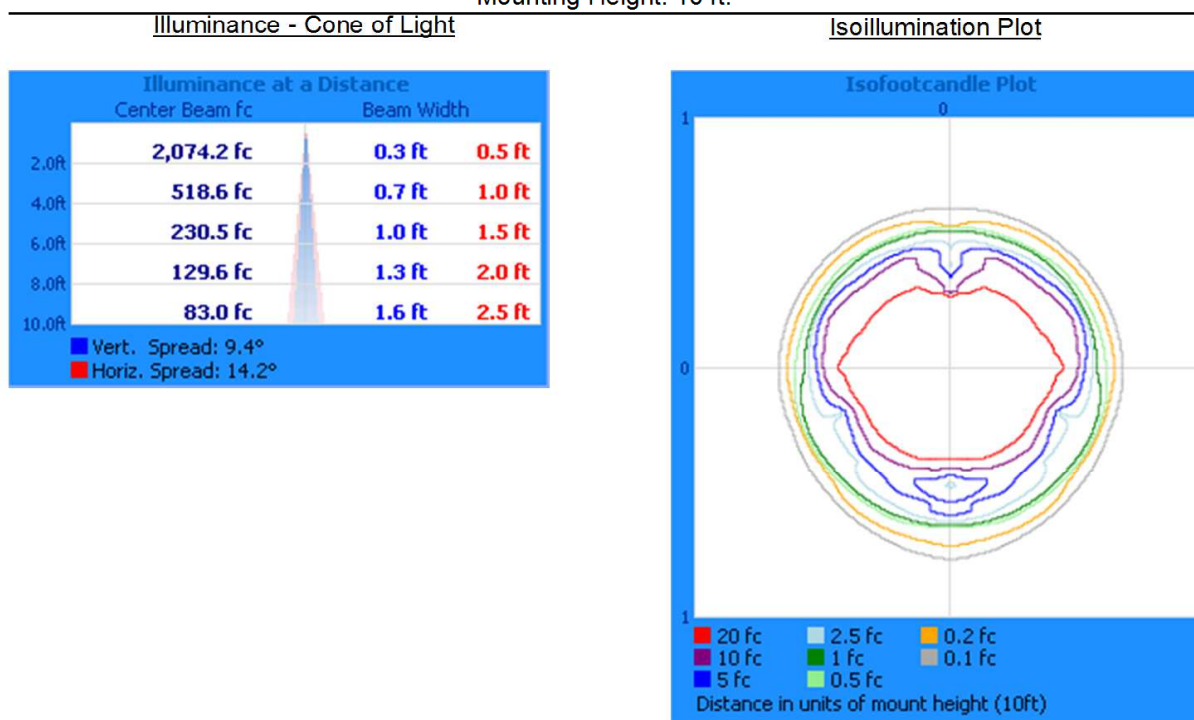
Angle	0	22.5	45	67.5	90
0	8297	8297	8297	8297	8297
5	7799	5750	8357	18889	24545
10	14040	13260	22891	18836	20994
15	17069	25405	18552	17019	19740
20	2130	2930	2944	2885	5593
25	249	768	1012	299	2443
30	939	462	326	330	136
35	42	26	16	10	6
40	13	3	0	0	0
45	0	0	0	0	0
50	0	0	0	0	0
55	0	0	0	0	0
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TEST (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	5692	99.5
0-40	5717	100.0
0-60	5718	100.0
60-90	0.0	0.0
0-90	5718	100.0
90-180	0.0	0.0
0-180	5718	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	1695	29.6
10-20	3445	60.3
20-30	552.3	9.7
30-40	25.6	0.4
40-50	0.2	0.0
50-60	0.0	0.0
60-70	0.0	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as:

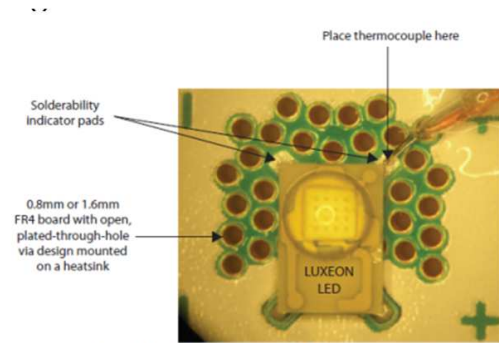


Figure 1. Solderability indicator pad and thermocouple placement.

Forward Voltage V_f ^[1]			Typical Temperature Coefficient of Forward Voltage ^[2] (mV/°C)	Typical Thermal Resistance Junction to Thermal Pad (°C/W)
Min.	Typ.	Max.	$\Delta V_f / \Delta T_j$	$R_{\theta_{JC}}$
2.55	2.90	3.51	- 2.0 to - 4.0	10
LED Junction Temperature ^[3]				150°C

Green LXML-PM01

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51V

Measured LED Current = 583mA

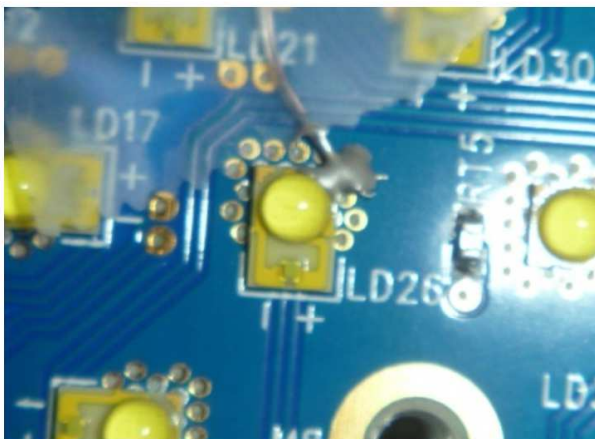
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 2.046W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 129.5°C

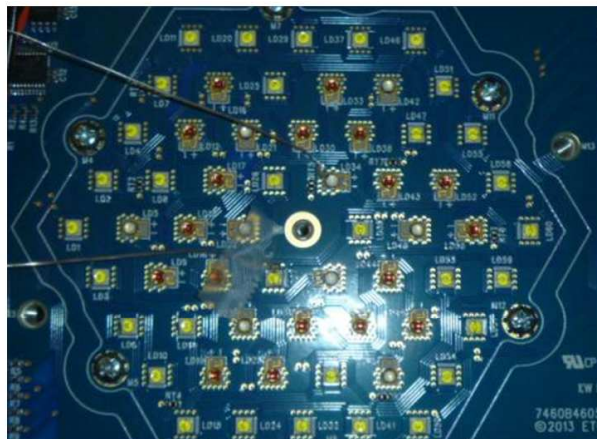
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature (°C)
CRT1311071604-005	79.6	Per diagram	129.5

In-Situ Picture – T_s



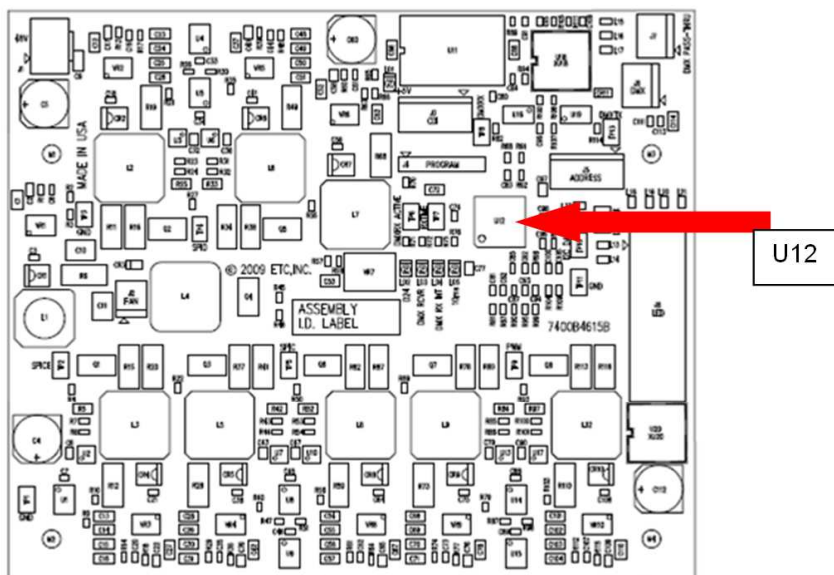
In-Situ Picture – T_s location



RESULTS OF TEST (cont'd)

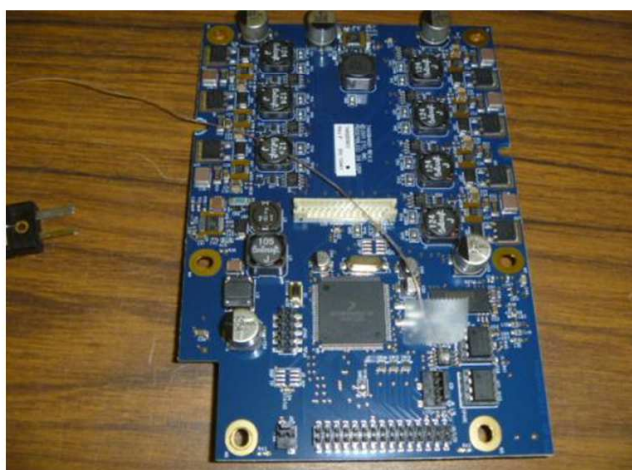
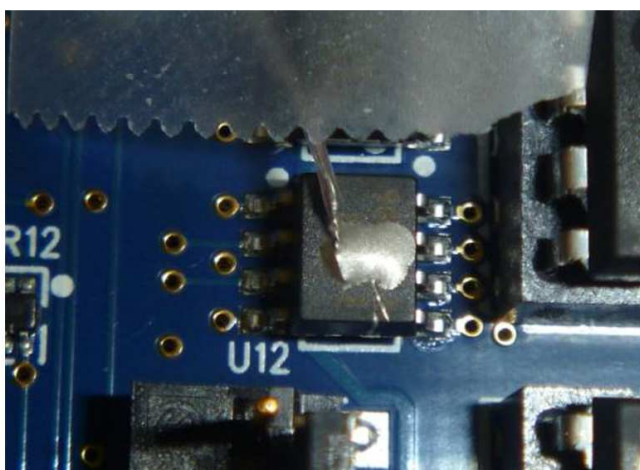
Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-005	60.6	Per diagram	100

Power Supply Picture – Tc location



PICTURE (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

Melanie Brittain

Melanie Brittain
Associate Engineer
Lighting Division

Attachment: None

Report Reviewed By:

Jeffrey Davis

Jeffrey Davis
Engineering Manager
Lighting Division



REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: July 30, 2013

REPORT NO. 101158242CRT-009

TEST OF ONE LED WASH LIGHT

FIXTURE MODEL NO. S4 STUDIO TUNGSTEN
LED MODEL NO. LUXEON REBEL ES

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and LED In-Situ tests.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

Energy Star Version 1.2 (2012): Program Requirements for Luminaires

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number S4 STUDIO TUNGSTEN. The sample was received by Intertek on May 6, in undamaged condition, and one sample was tested as received. The sample designation was CRT1304251519-006.

DATES OF TESTS: July 29, 2013



SUMMARY

Model No.:	S4 STUDIO TUNGSTEN
Description:	LED WASH LIGHT

Criteria	Result
Maximum In-Situ Source Temperature Point (°C)	78.9
Maximum Power Supply Case Temperature (°C)	65.8

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Fluke Multimeter	PM2525	M127	10/17/12	10/17/13
Fluke Temp Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

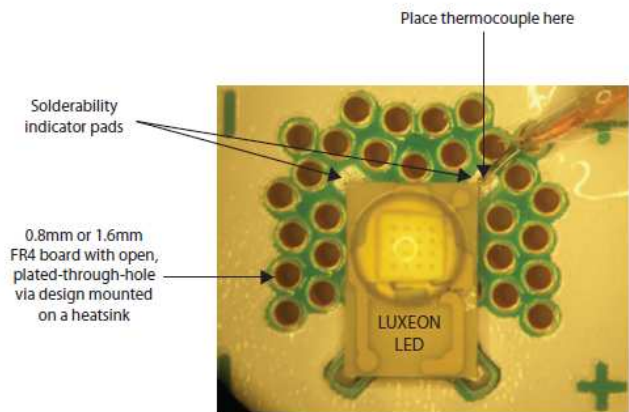
In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Agilent 34970A Data Logger. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TESTS

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED identified as: LUXEON REBEL ES



Color	Forward Voltage V_f ^[1] (V)			Typical Temperature Coefficient of Forward Voltage ^[2] ($mV/^{\circ}C$) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad ($^{\circ}C/W$) $R\theta_{JC}$
	Min.	Typ.	Max.		
Neutral-White	2.5	3.0	3.5	-2.0 to -4.0	6
Cool-White	2.5	3.0	3.5	-2.0 to -4.0	6

Parameter	Cool-White / Neutral-White
DC Forward Current (mA)	1000 mA
Peak Pulsed Forward Current (mA) ^[2]	1200 mA
Average Forward Current (mA)	1000 mA
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3B JESD22-A114-E
LED junction Temperature ^[1]	150°C
Operating Case Temperature at 350 mA	-40°C - 135°C
Storage Temperature	-40°C - 135°C
Soldering Temperature	JEDEC 020c 260°C
Allowable Reflow Cycles	3
Autoclave Conditions	121°C at 2 ATM 100% Relative Humidity for 96 Hours Maximum
Reverse Voltage (Vr)	LUXEON Rebel ES LEDs are not designed to be driven in reverse bias



RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 6°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.5 V

Measured LED Current = 553 mA

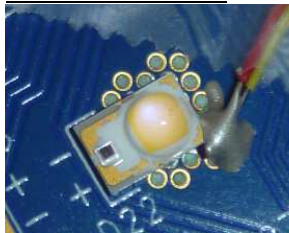
Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 1.9355\text{W}$

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 138^\circ\text{C}$

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-006	78.9	Per diagram above	138

In-Situ Picture – T_s



In-Situ Picture – T_s location





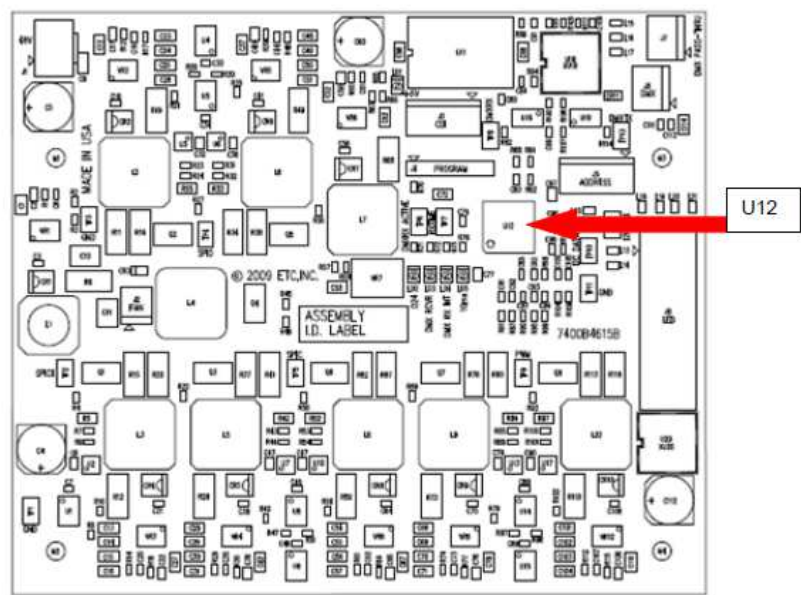
RESULTS OF TESTS (cont'd)

Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation:
Driver identified as: Model No. 7400B5615

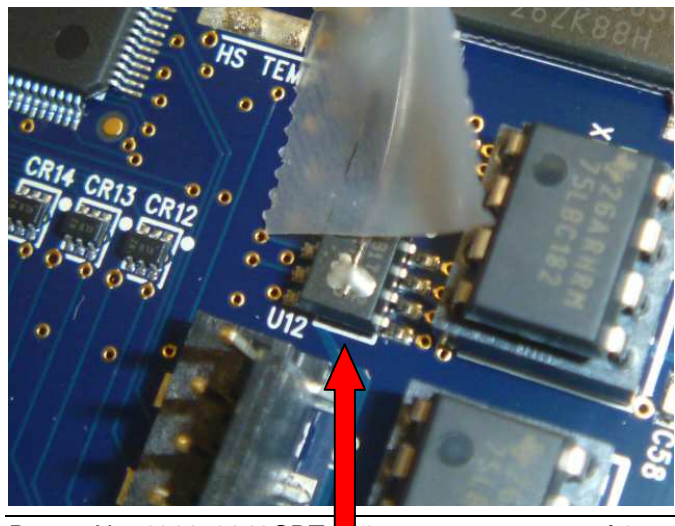
Manufacturer Supplied Documentation:
Driver identified as: 7400B5615, Rev. F

For Selador Classic, measure the temperature at U12.



Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Measured Power Supply Case Temperature (°C)	Location	Maximum Power Supply Case Temperature (°C)
CRT1304251519-006	65.8	U12	100



Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:



Kenda Branch
Engineer
Lighting Division

Attachment: None

Report Reviewed By:



Joseph Schledorn
Project Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: May 23, 2013

REPORT NO. 101158242CRT-004

TEST OF ONE LED PROFILE

FIXTURE MODEL NO. S4 STUDIO TUNGSTEN

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

LABORATORY NOTE: The laboratory that conducted the testing detailed in this report has been Qualified, Verified, and Recognized for LM-79 Testing for ENERGY STAR for SSL by US DOE's CALiPER program.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79: 2008 Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products

ANSI ANSLG C38.377: 2012 Specifications of the Chromaticity of Solid State Lighting Products

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number S4 STUDIO TUNGSTEN. The sample was received by Intertek on May 6, 2013, in undamaged condition, and one sample was tested as received. The sample designation was CRT1304251519-006.

DATES OF TESTS: May 15, 2013 through May 22, 2013

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SUMMARY

Model No.:	S4 STUDIO TUNGSTEN
Description:	LED PROFILE

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	5479	5487
Total Power (W)	151.9	151.3
Luminaire Efficacy (LPW)	36.08	36.27

Criteria	Result
Power Factor	0.992
Current ATHD (%)	5.36
Correlated Color Temperature (CCT - K)	3050
Color Rendering Index (CRI) - Ra	83.2
Color Rendering Index (CRI) - R9	16.0
Duv	0.001
Chromaticity Coordinate (x)	0.435
Chromaticity Coordinate (y)	0.406
Chromaticity Coordinate (u')	0.248
Chromaticity Coordinate (v')	0.522

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
LSI High Speed Mirror Goniometer	6440	---	05/20/13	06/20/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Extech Hygro Thermometer	445703	T1359	11/08/12	11/08/13
Fisher Scientific	---	N1132	04/22/13	04/22/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Yokogawa Power Analyzer	WT1600	E462	07/06/12	07/06/13
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temp Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	NA	NA	NA
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Sorensen DC Power Supply	DLM150-20E	N/A	N/A	N/A
FLUKE	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

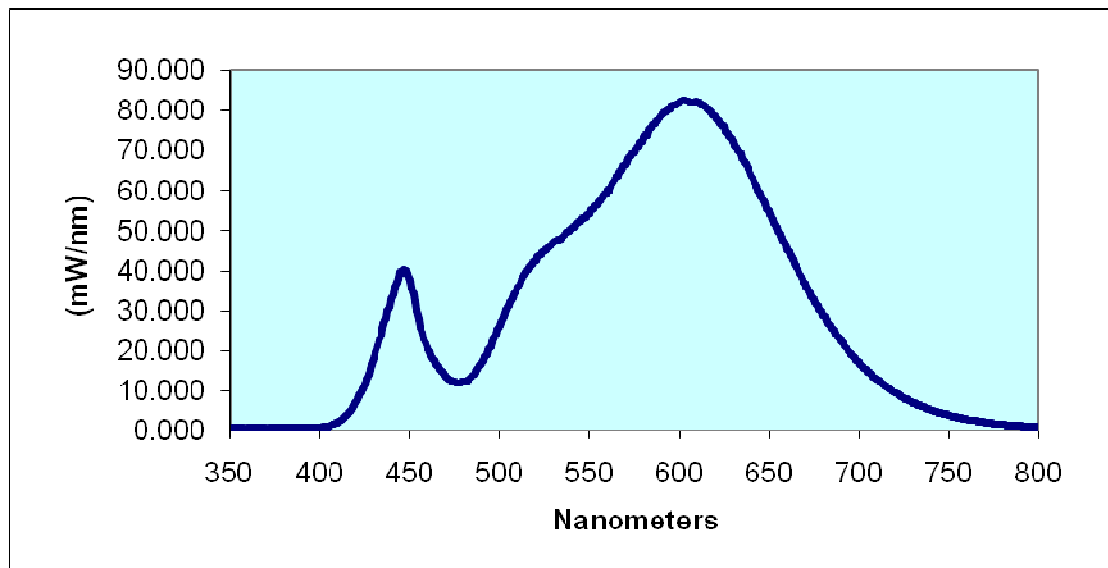
The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

RESULTS OF TESTS

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.620	460	20.569	570	66.386	680	28.804
355	0.522	465	16.591	575	69.591	685	25.451
360	0.585	470	13.692	580	73.058	690	22.379
365	0.518	475	12.052	585	76.303	695	19.445
370	0.579	480	12.151	590	78.370	700	16.995
375	0.602	485	13.738	595	80.349	705	14.705
380	0.516	490	16.620	600	82.045	710	12.742
385	0.583	495	20.953	605	82.221	715	10.993
390	0.500	500	26.187	610	81.797	720	9.484
395	0.612	505	31.059	615	80.555	725	8.182
400	0.758	510	35.752	620	78.520	730	6.954
405	1.106	515	39.518	625	75.846	735	5.992
410	1.965	520	42.378	630	72.102	740	5.116
415	3.797	525	44.999	635	67.905	745	4.434
420	6.960	530	47.009	640	63.765	750	3.758
425	11.540	535	48.433	645	59.247	755	3.224
430	18.120	540	50.117	650	54.678	760	2.807
435	25.516	545	52.224	655	49.848	765	0.000
440	32.652	550	54.311	660	45.295	770	2.030
445	39.500	555	56.996	665	40.976	775	1.727
450	37.328	560	59.992	670	36.720	780	1.487
455	27.756	565	63.072	675	32.664		

Sample No. CRT1304251519-006
Spectral Data Over Visible Wavelengths



RESULTS OF TESTS (cont'd)

Photometric and Electrical Measurements at 25°C – Integrating Sphere Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1304251519-006	UP	120.0	1274	151.9	0.992	5.36	5479	36.08

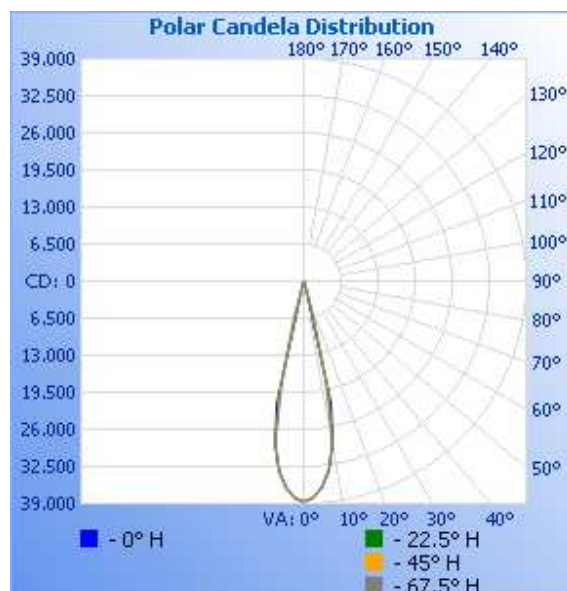
Intertek Sample No.	Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
CRT1304251519-006	3050	83.2	16.0	0.001	0.435	0.406	0.248	0.522

Photometric and Electrical Measurements – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1304251519-006	UP	120.0	1269	151.3	0.993	5487	36.27

Intensity (Candlepower) Summary at 25°C - Candelas

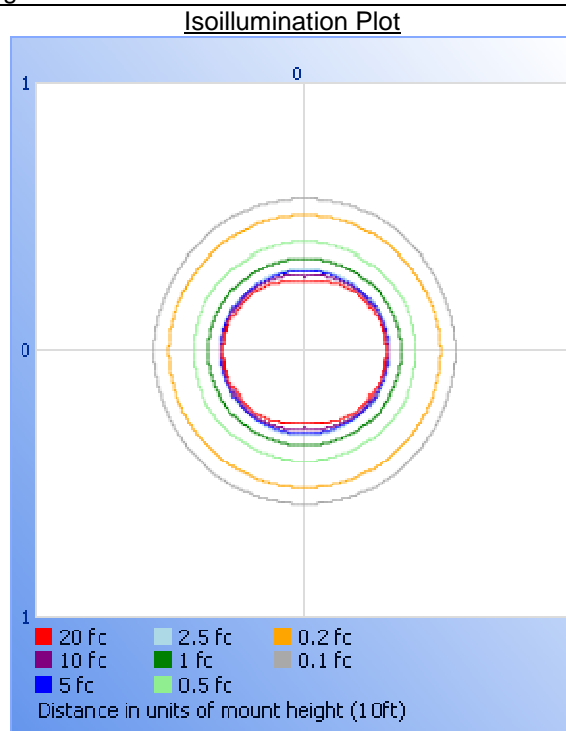
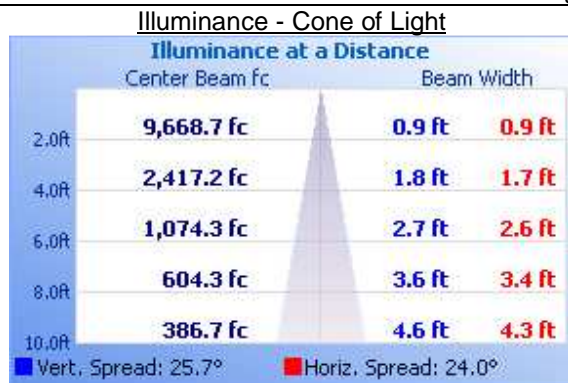
Angle	0	22.5	45	67.5	90
0	38675	38675	38675	38675	38675
5	36308	36269	36252	36256	36109
10	28996	28960	28889	28952	28917
15	1633	2956	5528	6888	7621
20	102	100	102	101	103
25	40	40	41	39	41
30	14	14	13	12	12
35	2	1	0	0	0
40	0	0	0	0	0
45	0	0	0	0	0
50	0	0	0	0	0
55	0	0	0	0	0
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TESTS (cont'd)

Illumination Plots

Mounting Height: 10 ft.

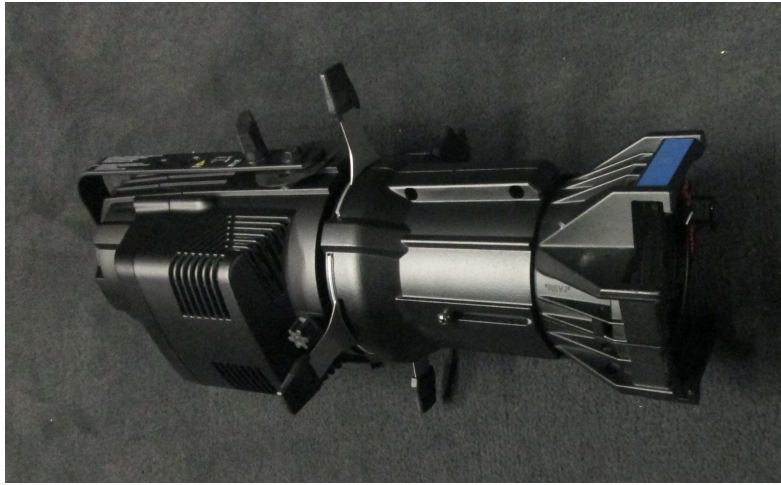


Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	5485	100.0
0-40	5487	100.0
0-60	5487	100.0
60-90	0.0	0.0
0-90	5487	100.0
90-180	0.0	0.0
0-180	5487	100.0



Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink, appearing to read "Kenda Branch".

Kenda Branch
Engineer
Lighting Division

Attachment: None

Report Reviewed By:

A handwritten signature in black ink, appearing to read "David Ellis".

David Ellis
Senior Project Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: November 29, 2013

REPORT NO. 101414036CRT-004

TEST OF ONE S4LED DAYLIGHT ETL LTENG W/ BARRL (BLK)

MODEL NO. S4LED DAYLIGHT
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number S4LED DAYLIGHT. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-004.

DATES OF TESTS: November 21, 2013 through November 25, 2013.

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SUMMARY

Model No.:	S4LED DAYLIGHT
Description:	S4LED DAYLIGHT ETL LTENG W/ BARRL (BLK)

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	7363	7522
Total Power (W)	145.4	145.6
Luminaire Efficacy (LPW)	50.64	51.66

Criteria	Result
Power Factor	0.991
Current ATHD %	5.18
Correlated Color Temperature (CCT - K)	5417
Color Rendering Index (CRI - Ra)	69.5
Color Rendering Index (CRI - R9)	-13.5
DUV	0.008
Chromaticity Coordinate (x)	0.335
Chromaticity Coordinate (y)	0.359
Chromaticity Coordinate (u')	0.202
Chromaticity Coordinate (v')	0.487
Maximum In-Situ Source Temperature Point (°C)	81.5
Maximum In-Situ Driver Case Temperature (°C)	52.8

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Leeds & Northup Standard Resistor	Manganin	Y089	02/07/13	02/07/14
Data Precision Digital Voltmeter	3600	V124	02/07/13	02/07/14
Fluke Multimeter	45	M133	02/07/13	02/07/14
Kikusui DC Power Supply	35-10L	E160	---	---
Sorenson DC Power Supply	DLM150-20E	---	---	---
NIST Spectral Flux Standard Source	RF1024	---	09/18/10	100 hrs of use
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
Cole Palmer Thermometer	03313-85	T1470	05/31/13	05/31/14
LSI High Speed Mirror Goniometer	6440	---	11/21/13	12/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Cole Palmer Thermometer	03313-85	T1470	05/31/13	05/31/14
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Extech Hygro-Thermometer	445703	T1355	11/26/12	11/26/13
Fluke Multimeter	87 V	D590	03/28/13	03/28/14
Fluke Temperature Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

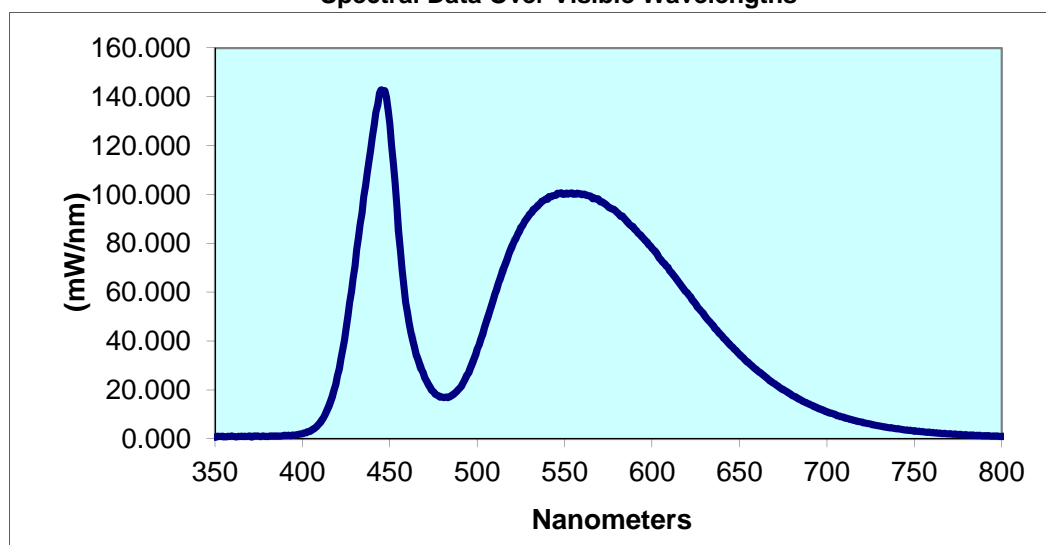
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-004	UP	120.0	1222	145.4	0.991	5.18	7363	50.64

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
5417	69.5	-13.5	0.008	0.335	0.359	0.202	0.487

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.675	440	123.5	530	92.01	620	59.76	710	8.702
355	0.846	445	142.9	535	95.66	625	55.01	715	7.664
360	1.062	450	128.6	540	97.99	630	50.52	720	6.794
365	1.014	455	85.48	545	99.71	635	46.18	725	6.011
370	1.048	460	51.5	550	100.2	640	42.13	730	5.237
375	1.054	465	34.49	555	100.2	645	38.16	735	4.658
380	0.914	470	24.95	560	100.1	650	34.46	740	4.096
385	1.131	475	19.1	565	99.29	655	31.17	745	3.623
390	1.322	480	17	570	97.32	660	28.1	750	3.21
395	1.5	485	17.58	575	94.88	665	25.2	755	2.851
400	2.116	490	20.91	580	92.72	670	22.56	760	2.514
405	3.456	495	27.08	585	89.58	675	20.04	765	2.24
410	6.516	500	36.8	590	85.76	680	17.85	770	1.971
415	13.22	505	47.42	595	82.11	685	15.87	775	1.737
420	25.87	510	59.22	600	77.98	690	14.14	780	1.542
425	45.06	515	69.73	605	73.25	695	12.51		
430	70.84	520	79.04	610	68.77	700	11.06		
435	99.01	525	86.66	615	64.38	705	9.803		

Spectral Data Over Visible Wavelengths



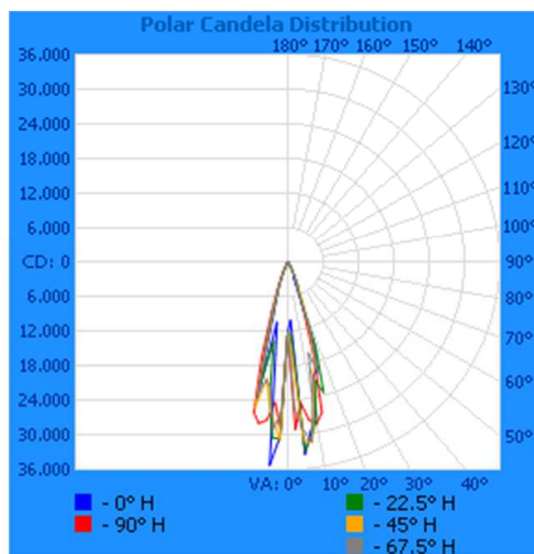
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-004	UP	120.0	1223	145.6	0.992	7522	51.66

Intensity (Candlepower) Summary at 25°C - Candelas

Angle	0	22.5	45	67.5	90
0	12182	12182	12182	12182	12182
5	33484	32846	31122	29099	24506
10	26950	27931	25253	24231	28425
15	19212	23416	18431	20092	17228
20	2760	4930	6954	4860	5452
25	2697	2052	1993	1739	2177
30	1382	951	496	556	121
35	361	172	113	65	20
40	45	32	15	7	2
45	18	6	0	0	0
50	0	0	0	0	0
55	0	0	0	0	0
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

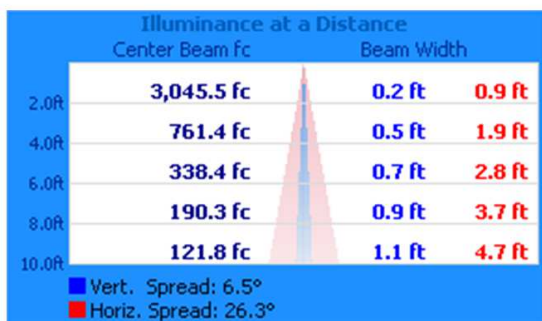


RESULTS OF TEST (cont'd)

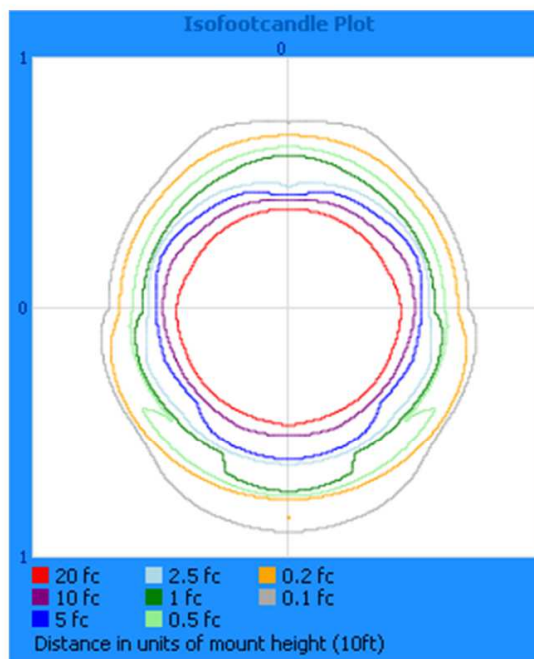
Illumination Plots

Mounting Height: 10 ft.

Illuminance - Cone of Light



Isoillumination Plot



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	7461	99.2
0-40	7520	100.0
0-60	7522	100.0
60-90	0.0	0.0
0-90	7522	100.0
90-180	0.0	0.0
0-180	7522	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	2482	33.0
10-20	4097	54.5
20-30	882.5	11.7
30-40	59.5	0.8
40-50	2.0	0.0
50-60	0.0	0.0
60-70	0.0	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as: Luxeon Rebel

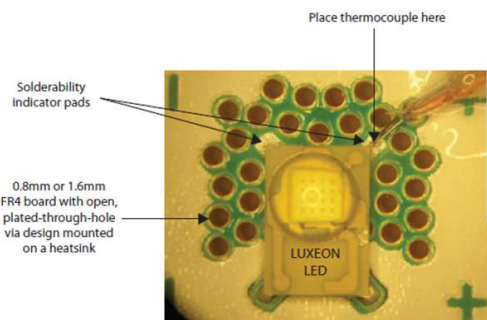


Figure 1. Solderability indicator pad and thermocouple placement.

Nominal ANSI CCT	Forward Voltage V_f ⁽¹⁾ (V)		Typical Temperature Coefficient of Forward Voltage ⁽²⁾ (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R_{\theta jc}$
	Min.	Max.		
2700K	2.5	3.5	-1.8 to -2.4	6
3000K	2.5	3.5	-1.8 to -2.4	6
4000K	2.5	3.5	-1.8 to -2.4	6
5000K	2.5	3.5	-1.8 to -2.4	6

LED Junction Temperature ⁽³⁾ 150°C

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 6°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.5V

Measured LED Current = 592mA

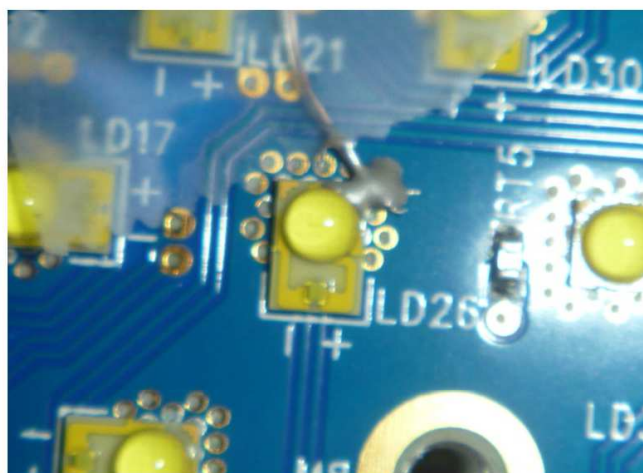
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 2.072W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 137.6°C

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature (°C)
CRT1311071604-004	81.5	Per diagram	137.6

In-Situ Picture – T_s



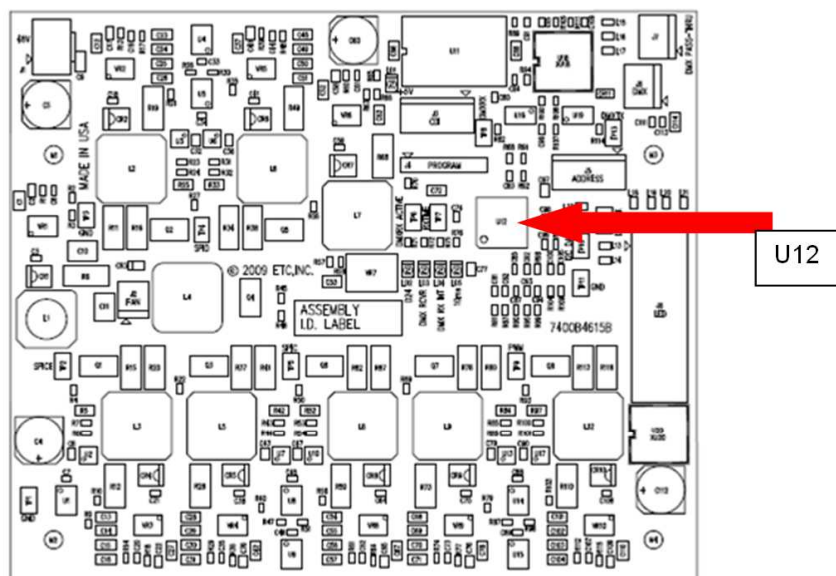
In-Situ Picture – T_s locator



RESULTS OF TEST (cont'd)

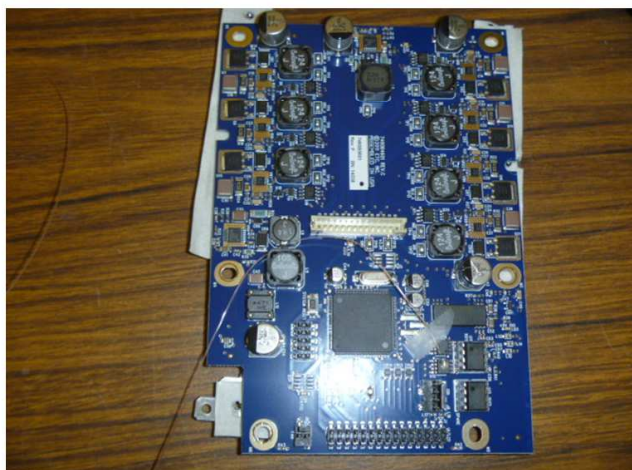
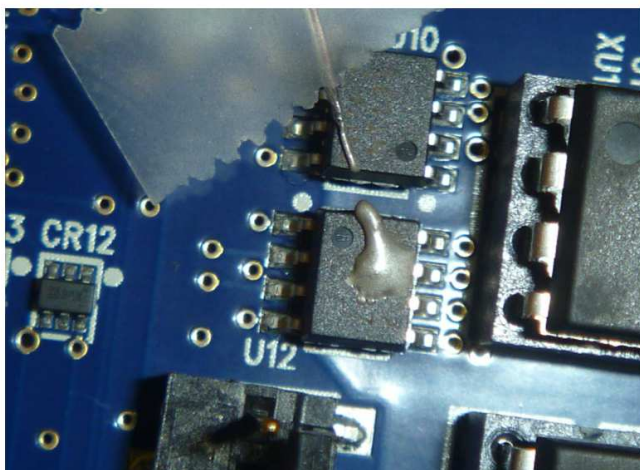
Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-004	52.8	Per diagram	100

Power Supply Picture – Tc location



PICTURE (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

Melanie Brittain

Melanie Brittain
Associate Engineer
Lighting Division

Attachment: None

Report Reviewed By:

Jeffrey Davis

Jeffrey Davis
Engineering Manager
Lighting Division

SECTION 2 - Desire D22

Lustr+
Studio HD
Tungsten
Daylight



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101158242

Date: October 7 , 2013

REPORT NO. 101158242CRT-013

TEST OF ONE STAGE LIGHT

MODEL NO. D22 LUSTR+
DRIVER MODEL NO. 7410B4605
LED MODEL NO. LUXEON REBEL ES

RENDERED TO

ELECTRONIC THEATRE CONTROLS INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Version 1.2 (2012): Program Requirements for Luminaires (Light Fixtures)

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D22 LUSTR+. The sample was received by Intertek on September 6, 2013, in undamaged condition and one sample was tested as received. The sample designation was 1309060840-002.

DATES OF TESTS: September 30, 2013 through October 3, 2013

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SUMMARY

Model No.:	D22 LUSTR+
Description:	STAGE LIGHT

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	3671	3482
Total Power (W)	51.70	50.77
Luminaire Efficacy (LPW)	71.01	68.58

Criteria	Result
Power Factor	0.982
Current ATHD %	6.05
Correlated Color Temperature (CCT - K)	5375
Color Rendering Index (CRI - Ra)	68.7
Color Rendering Index (CRI - R9)	-11.5
DUV	0.007
Chromaticity Coordinate (x)	0.336
Chromaticity Coordinate (y)	0.358
Chromaticity Coordinate (u')	0.203
Chromaticity Coordinate (v')	0.486
Maximum In-Situ Source Temperature Point (°C)	67.5

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Leeds & Northup Standard Resistor	Manganin	Y089	02/07/13	02/07/14
Data Precision Digital Voltmeter	3600	V124	02/07/13	02/07/14
Fluke Multimeter	45	M133	02/07/13	02/07/14
Kikusui DC Power Supply	35-10L	E160	---	---
Sorenson DC Power Supply	DLM150-20E	---	---	---
NIST Spectral Flux Standard Source	RF1024	---	09/18/10	100 hrs of use
LABSPHERE 3M	W/ CDS 1100	N307	VBU	VBU
Fluke Temp Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	VBU	VBU
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
LSI High Speed Mirror Goniometer	6440	---	09/20/13	10/20/13
Elgar Power Supply	CW1251	---	VBU	VBU
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Extech Hygro Thermometer	445703	T1359	11/08/12	11/08/13
Fisher Scientific	---	N1132	04/22/13	04/22/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Fluke Multimeter	PM2525	M127	10/17/12	10/17/13
Fluke Temp Meter	53 II	D588	03/15/13	03/15/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

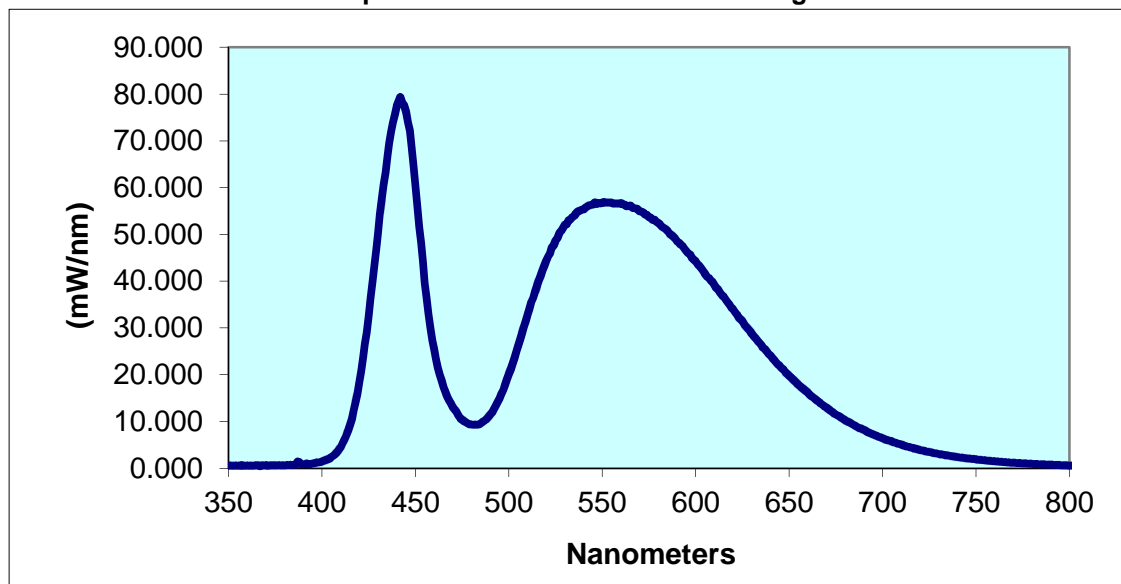
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
1309060840-002	UP	120.0	438.5	51.70	0.982	6.05	3671	71.01

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
5375	68.7	-11.5	0.007	0.336	0.358	0.203	0.486

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.52	440	77.42	530	52.06	620	33.99	710	5.03
355	0.54	445	76.23	535	53.95	625	31.45	715	4.42
360	0.60	450	60.57	540	55.37	630	28.82	720	3.91
365	0.58	455	39.67	545	56.36	635	26.32	725	3.46
370	0.65	460	25.38	550	56.79	640	24.04	730	3.04
375	0.60	465	17.38	555	56.75	645	21.88	735	2.69
380	0.57	470	13.06	560	56.71	650	19.79	740	2.37
385	0.70	475	10.40	565	56.17	655	17.86	745	2.12
390	0.78	480	9.35	570	54.91	660	16.12	750	1.90
395	1.03	485	9.65	575	53.67	665	14.45	755	1.66
400	1.45	490	11.41	580	52.49	670	12.98	760	1.49
405	2.38	495	14.92	585	50.70	675	11.51	765	1.30
410	4.51	500	20.12	590	48.47	680	10.26	770	1.17
415	9.30	505	26.16	595	46.45	685	9.161	775	1.03
420	18.48	510	32.88	600	44.27	690	8.179	780	0.92
425	32.44	515	39.01	605	41.62	695	7.243		
430	50.09	520	44.41	610	39.12	700	6.429		
435	66.79	525	48.66	615	36.63	705	5.698		

Spectral Data Over Visible Wavelengths



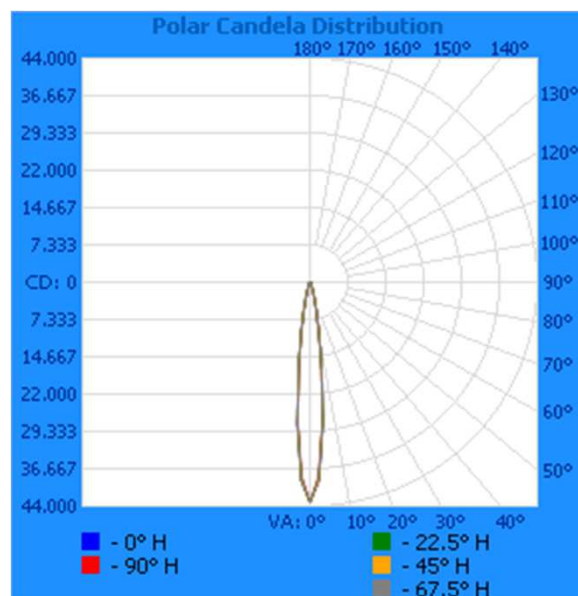
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
1309060840-002	Select One	120.0	429.9	50.77	0.984	3482	68.58

Intensity (Candlepower) Summary at 25°C - Candelas

Angle	0	22.5	45	67.5	90
0	43220	43220	43220	43220	43220
5	28176	27875	27829	27720	27476
10	9919	9864	9876	9719	9738
15	3146	3191	3179	3092	3095
20	1188	1206	1207	1192	1176
25	492	497	495	490	489
30	253	254	249	249	248
35	158	158	154	155	152
40	110	106	109	107	101
45	77	76	78	78	73
50	50	52	54	52	51
55	30	30	33	33	30
60	15	16	16	17	15
65	4	3	4	6	5
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

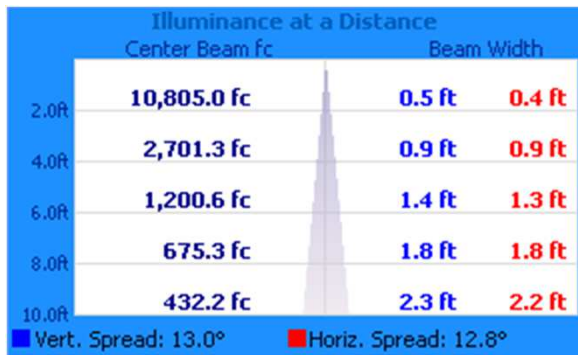


RESULTS OF TEST (cont'd)

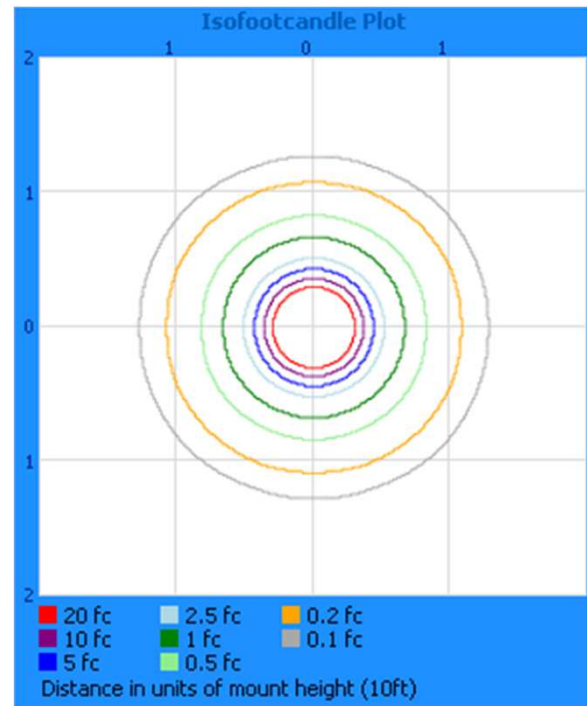
Illumination Plots

Mounting Height: 10 ft.

Illuminance - Cone of Light



Isoillumination Plot



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	3287	94.4
0-40	3388	97.3
0-60	3477	99.8
60-90	5.6	0.2
0-90	3482	100.0
90-180	0.0	0.0
0-180	3482	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	2022	58.1
10-20	1010	29.0
20-30	255.2	7.3
30-40	101.3	2.9
40-50	59.4	1.7
50-60	28.8	0.8
60-70	5.6	0.2
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

Electrical Characteristics at 700 mA for LUXEON Rebel ES
Thermal Pad Temperature = 25°C

LED identified as: Luxeon Rebel ES

Absolute Maximum Ratings

Table 6.

Parameter	Cool-White / Neutral-White
DC Forward Current (mA)	1000 mA
Peak Pulsed Forward Current (mA) ⁽¹⁾	1200 mA
Average Forward Current (mA)	1000 mA
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3B JEDEC22-A114-E
LED Junction Temperature ⁽¹⁾	150°C
Operating Case Temperature at 350 mA	-40°C - 135°C
Storage Temperature	-40°C - 135°C
Soldering Temperature	JEDC C-030k 260°C
Allowable Reflow Cycles	3
Autoclave Conditions	121°C at 2 ATM 100% Relative Humidity for 96 Hours Maximum
Reverse Voltage (Vr)	LUXEON Rebel ES LEDs are not designed to be driven in reverse bias

Table 4.

Color	Forward Voltage V_f ⁽¹⁾ (V)			Typical Temperature Coefficient of Forward Voltage ⁽²⁾ (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R_{\theta_{jc}}$
	Min.	Typ.	Max.		
Neutral White	2.5	3.0	3.5	2.0 to -4.0	6
Cool White	2.5	3.0	3.5	2.0 to -4.0	6

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 6°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.45V

Measured LED Current = 587mA

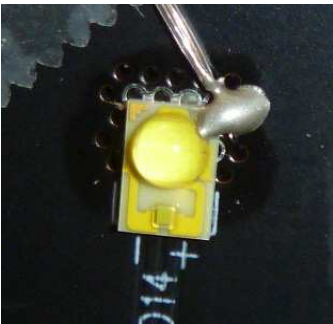
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 2.025W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 137.8°C

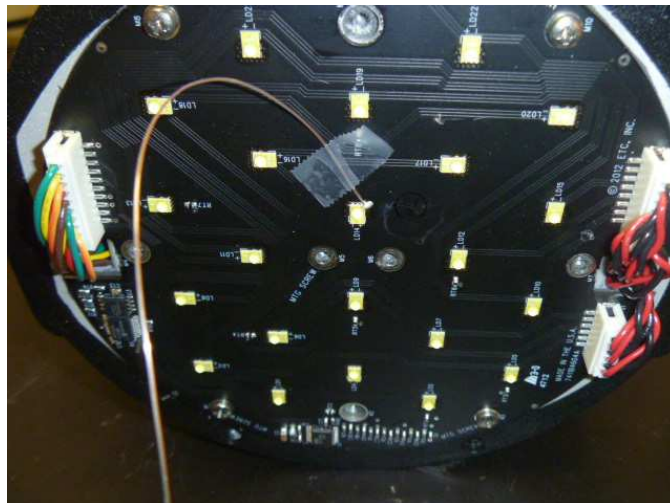
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature (°C)
1309060840-002	67.5	Per diagram	137.8

In-Situ Picture – T_s



In-Situ Picture – T_s location



PICTURE (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:



Jacki Swiernik
Staff Engineer
Lighting Division

Attachment: None

Report Reviewed By:



David Ellis
Senior Project Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: November 29, 2013

REPORT NO. 101414036CRT-001

TEST OF ONE D22 STUDIO HD PORTABLE LED ETL FIX (BLK)

MODEL NO. D22 STUDIO HD
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D22 STUDIO HD. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-001.

DATES OF TESTS: November 19, 2013 through November 25, 2013.

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SUMMARY

Model No.:	D22 STUDIO HD
Description:	D22 STUDIO HD PORTABLE LED ETL FIX (BLK)

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	1822	1761
Total Power (W)	47.53	47.79
Luminaire Efficacy (LPW)	38.33	36.85

Criteria	Result
Power Factor	0.978
Current ATHD %	5.93
Correlated Color Temperature (CCT - K)	4468
Color Rendering Index (CRI - Ra)	85.8
Color Rendering Index (CRI - R9)	78.5
DUV	0.003
Chromaticity Coordinate (x)	0.361
Chromaticity Coordinate (y)	0.359
Chromaticity Coordinate (u')	0.219
Chromaticity Coordinate (v')	0.490
Maximum In-Situ Source Temperature Point (°C)	73.3
Maximum In-Situ Driver Case Temperature (°C)	73.5

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Leeds & Northup Standard Resistor	Manganin	Y089	02/07/13	02/07/14
Data Precision Digital Voltmeter	3600	V124	02/07/13	02/07/14
Fluke Multimeter	45	M133	02/07/13	02/07/14
Kikusui DC Power Supply	35-10L	E160	---	---
Sorenson DC Power Supply	DLM150-20E	---	---	---
NIST Spectral Flux Standard Source	RF1024	---	09/18/10	100 hrs of use
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
Cole Palmer Thermometer	03313-85	T1470	05/31/13	05/31/14
LSI High Speed Mirror Goniometer	6440	---	10/21/13	11/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Cole-Palmer Hygro Thermometer	03313-85	T1469	05/31/13	05/31/14
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Extech Hygro-Thermometer	445703	T1355	11/26/12	11/26/13
Fluke Multimeter	87 V	D590	03/28/13	03/28/14
Fluke Temperature Meter	53 II	D588	03/15/13	03/15/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

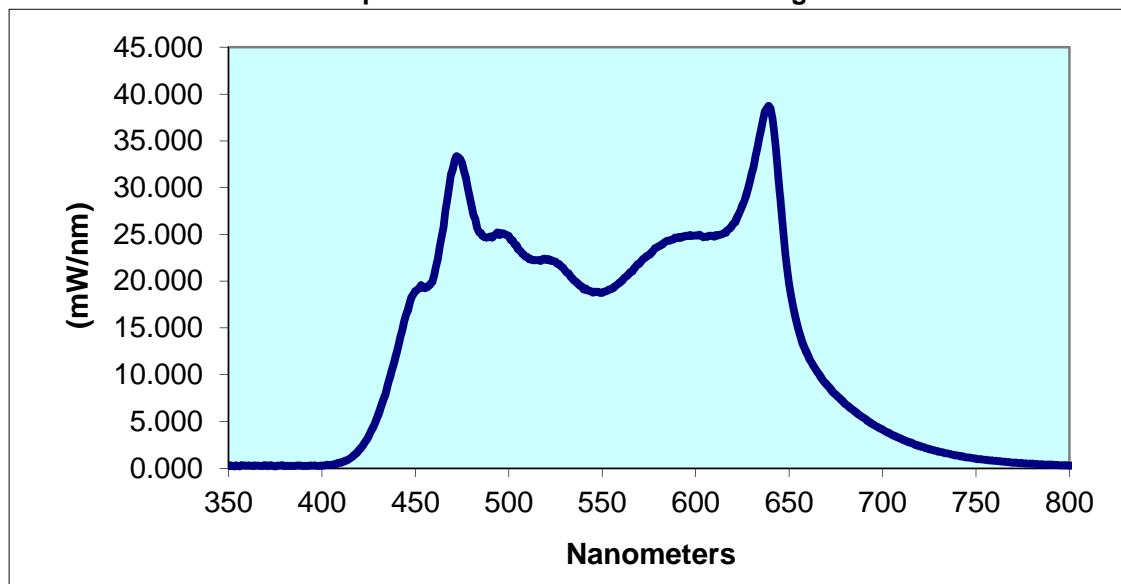
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-001	UP	120.0	404.7	47.53	0.978	5.93	1822	38.33

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
4468	85.8	78.5	0.003	0.361	0.359	0.219	0.490

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.216	440	12.38	530	21.18	620	26.15	710	3.13
355	0.216	445	16.41	535	20.03	625	28.13	715	2.728
360	0.25	450	18.94	540	19.11	630	31.51	720	2.368
365	0.269	455	19.25	545	18.78	635	36.31	725	2.053
370	0.309	460	20.64	550	18.78	640	38.44	730	1.782
375	0.209	465	25.76	555	19.2	645	29.37	735	1.551
380	0.226	470	32	560	19.97	650	19.66	740	1.356
385	0.239	475	32.61	565	20.98	655	14.83	745	1.167
390	0.231	480	28.17	570	21.88	660	12.05	750	1.024
395	0.266	485	25.14	575	22.78	665	10.31	755	0.887
400	0.277	490	24.76	580	23.7	670	8.991	760	0.792
405	0.358	495	24.94	585	24.33	675	7.853	765	0.687
410	0.59	500	24.83	590	24.61	680	6.876	770	0.587
415	1.045	505	23.44	595	24.87	685	6.086	775	0.531
420	1.966	510	22.57	600	24.85	690	5.349	780	0.455
425	3.421	515	22.22	605	24.73	695	4.676		
430	5.605	520	22.28	610	24.78	700	4.129		
435	8.811	525	22.09	615	25.13	705	3.57		

Spectral Data Over Visible Wavelengths



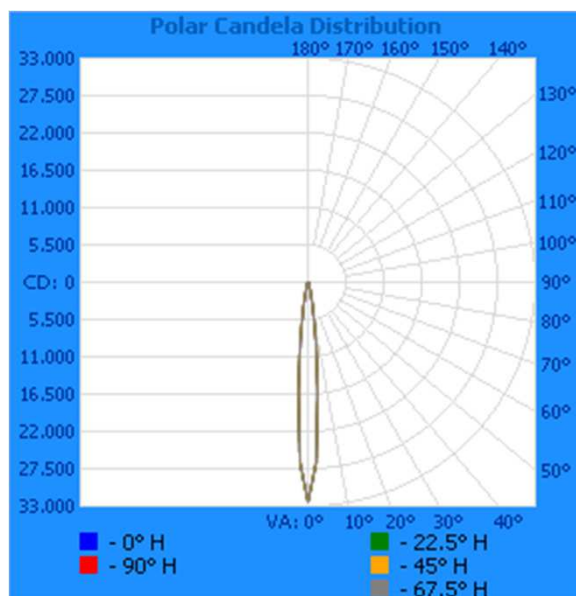
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-001	UP	120.0	405.7	47.79	0.982	1761	36.85

Intensity (Candlepower) Summary at 25°C - Candelas

Angle	0	22.5	45	67.5	90
0	32341	32341	32341	32341	32341
5	16099	16192	16153	16105	16324
10	4346	4433	4527	4466	4418
15	1217	1233	1266	1246	1230
20	490	487	486	491	492
25	208	203	198	203	205
30	106	102	99	102	105
35	65	66	62	63	60
40	40	43	43	47	37
45	31	32	28	29	29
50	22	20	20	19	20
55	10	10	10	11	12
60	1	1	3	4	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

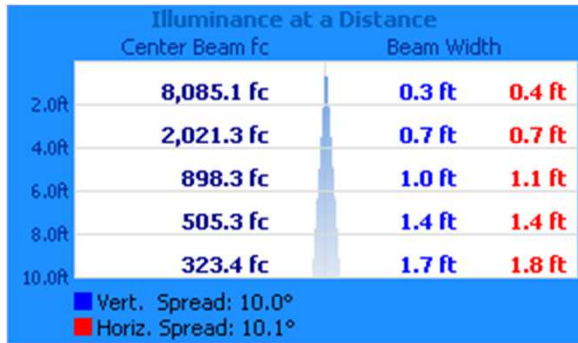


RESULTS OF TEST (cont'd)

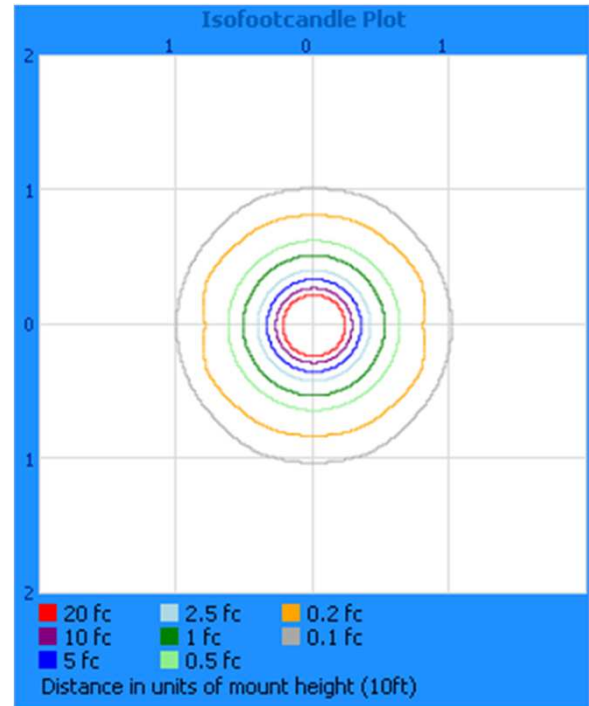
Illumination Plots

Mounting Height: 10 ft.

Illuminance - Cone of Light



Isoillumination Plot



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	1686	95.8
0-40	1727	98.1
0-60	1760	100.0
60-90	0.4	0.0
0-90	1761	100.0
90-180	0.0	0.0
0-180	1761	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	1161	66.0
10-20	421.0	23.9
20-30	104.3	5.9
30-40	40.7	2.3
40-50	23.4	1.3
50-60	9.7	0.6
60-70	0.4	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as:

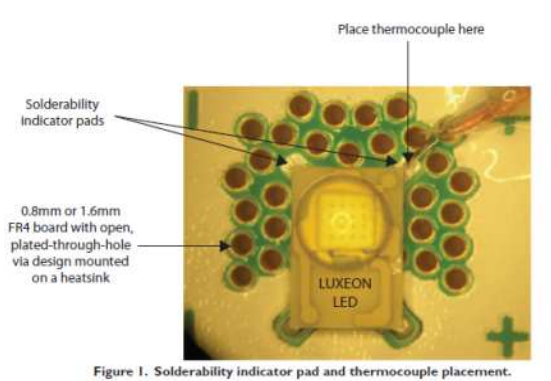


Figure 1. Solderability indicator pad and thermocouple placement.

Forward Voltage V_f ^[1]			Typical Temperature Coefficient of Forward Voltage ^[2] $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad $R\theta_{jc}$ ($^{\circ}\text{C}/\text{W}$)
Min.	Typ.	Max.		
2.55	2.90	3.51	- 2.0 to - 4.0	10
LED Junction Temperature ^[3]				150 $^{\circ}\text{C}$

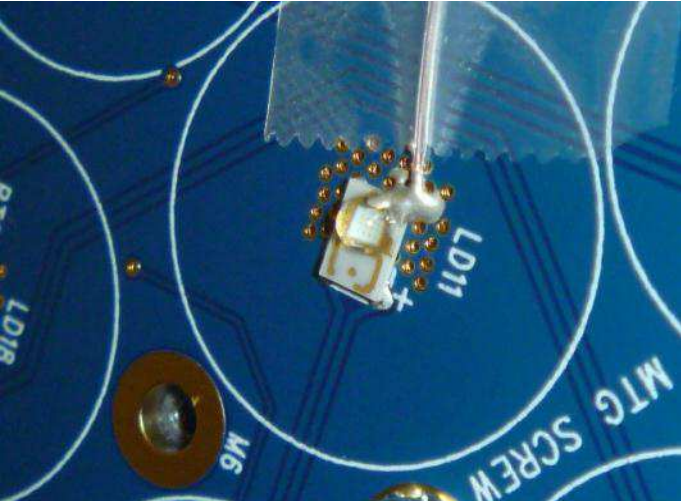
Green LXML-PM01

Maximum Junction Temperature from LED specification (T_j) = 150 $^{\circ}\text{C}$
Thermal Resistance Formula from LED specification = 10 $^{\circ}\text{C}/\text{W}$
Maximum Forward Voltage (V_f) from LED specification = 3.3V
Measured LED Current = 589mA
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.944W
Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 130.6 $^{\circ}\text{C}$

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature ($^{\circ}\text{C}$)	Location	Maximum Rated Source Temperature ($^{\circ}\text{C}$)
CRT1311071604-001	73.3	Per diagram	130.6

In-Situ Picture – T_s



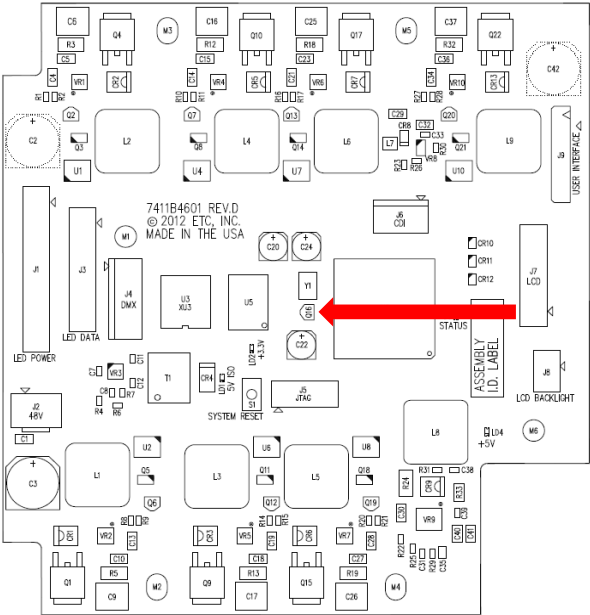
In-Situ Picture – T_s location



RESULTS OF TEST (cont'd)

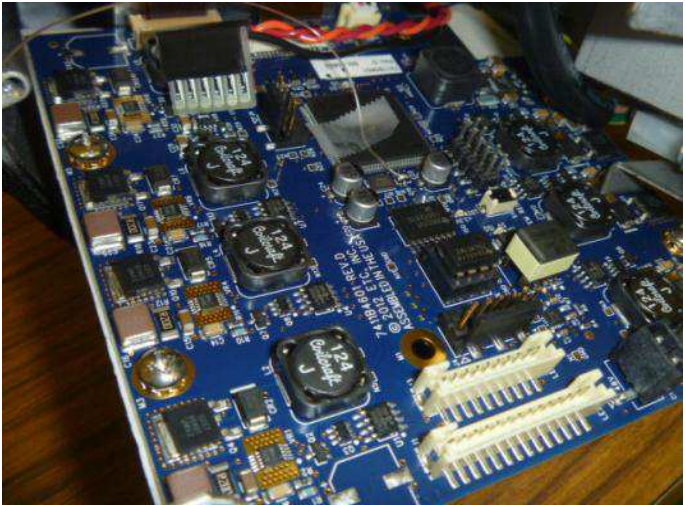
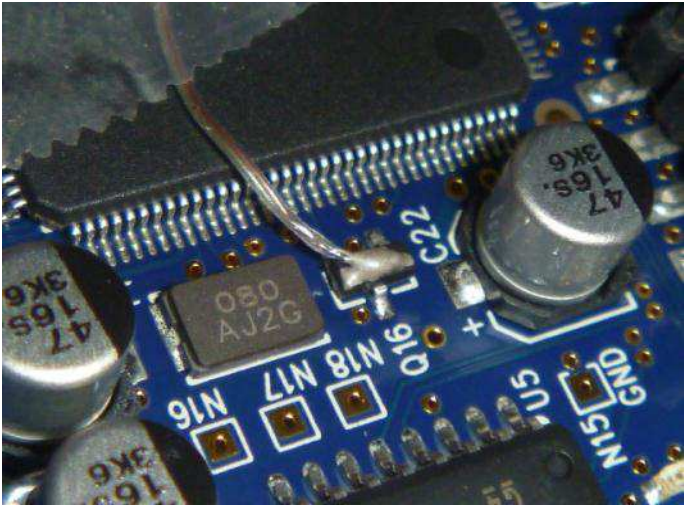
Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-001	73.5	Per diagram	100

Power Supply Picture – Tc location



PICTURE (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:



Melanie Brittain
Associate Engineer
Lighting Division

Attachment: None

Report Reviewed By:



Jeffrey Davis
Engineering Manager
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101158242

Date: October 7, 2013

REPORT NO. 101158242CRT-014

TEST OF ONE STAGE LUMINAIRE

MODEL NO. D22 TUNGSTEN
DRIVER MODEL NO. 7410B4605
LED MODEL NO. LUXEON REBEL ES

RENDERED TO

ELECTRONIC THEATRE CONTROLS INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Version 1.2 (2012): Program Requirements for Luminaires (Light Fixtures)

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D22 TUNGSTEN. The sample was received by Intertek on September 6, 2013, in undamaged condition and one sample was tested as received. The sample designation was 1309060840-001.

DATES OF TESTS: September 30, 2013 through October 4, 2013

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

SUMMARY

Model No.:	D22 TUNGSTEN
Description:	STAGE LUMINAIRE

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	2572	2427
Total Power (W)	52.34	51.17
Luminaire Efficacy (LPW)	49.14	47.43

Criteria	Result
Power Factor	0.969
Current ATHD %	7.83
Correlated Color Temperature (CCT - K)	3131
Color Rendering Index (CRI - Ra)	86.2
Color Rendering Index (CRI - R9)	26.3
DUV	0.000
Chromaticity Coordinate (x)	0.428
Chromaticity Coordinate (y)	0.401
Chromaticity Coordinate (u')	0.246
Chromaticity Coordinate (v')	0.519
Maximum In-Situ Source Temperature Point (°C)	63.5

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Leeds & Northup Standard Resistor	Manganin	Y089	02/07/13	02/07/14
Data Precision Digital Voltmeter	3600	V124	02/07/13	02/07/14
Fluke Multimeter	45	M133	02/07/13	02/07/14
Kikusui DC Power Supply	35-10L	E160	---	---
Sorenson DC Power Supply	DLM150-20E	---	---	---
NIST Spectral Flux Standard Source	RF1024	---	09/18/10	100 hrs of use
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temp Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
LSI High Speed Mirror Goniometer	6440	---	09/20/13	10/20/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Extech Hygro Thermometer	445703	T1359	11/08/12	11/08/13
Fisher Scientific	---	N1132	04/22/13	04/22/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Fluke Multimeter	PM2525	M127	10/17/12	10/17/13
Fluke Temp Meter	53 II	D588	03/15/13	03/15/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

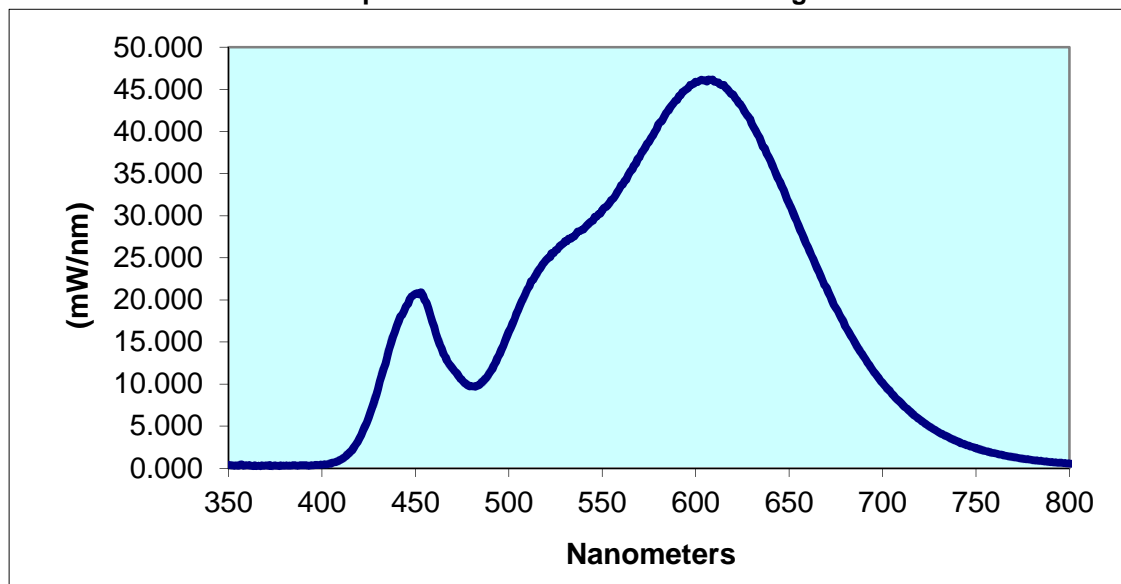
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
1309060840-001	UP	120.0	449.9	52.34	0.969	7.83	2572	49.14

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
3131	86.2	26.3	0.000	0.428	0.401	0.246	0.519

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.40	440	16.89	530	26.95	620	44.38	710	7.71
355	0.28	445	19.22	535	27.55	625	42.87	715	6.68
360	0.33	450	20.72	540	28.40	630	40.95	720	5.78
365	0.27	455	19.95	545	29.43	635	38.72	725	4.97
370	0.34	460	16.80	550	30.62	640	36.51	730	4.28
375	0.34	465	13.55	555	31.88	645	34.03	735	3.70
380	0.28	470	11.81	560	33.60	650	31.45	740	3.18
385	0.34	475	10.47	565	35.28	655	28.83	745	2.75
390	0.32	480	9.77	570	36.98	660	26.24	750	2.38
395	0.35	485	10.11	575	38.76	665	23.71	755	2.04
400	0.41	490	11.43	580	40.80	670	21.41	760	1.79
405	0.59	495	13.52	585	42.40	675	19.05	765	1.52
410	1.02	500	16.24	590	43.73	680	16.86	770	1.32
415	1.91	505	18.77	595	45.01	685	14.98	775	1.14
420	3.54	510	21.32	600	45.91	690	13.23	780	0.98
425	6.00	515	23.18	605	46.05	695	11.55		
430	9.36	520	24.75	610	45.91	700	10.15		
435	13.39	525	25.89	615	45.52	705	8.85		

Spectral Data Over Visible Wavelengths



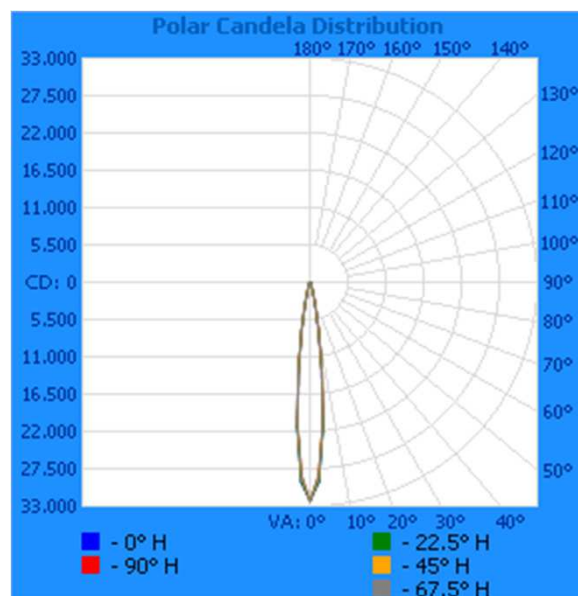
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
1309060840-001	UP	120.0	439.1	51.17	0.971	2427	47.43

Intensity (Candlepower) Summary at 25°C - Candelas

Angle	0	22.5	45	67.5	90
0	32212	32212	32212	32212	32212
5	21318	21443	20998	21008	21183
10	6750	6917	6972	7121	7254
15	1845	1874	1902	1920	1945
20	693	686	690	707	713
25	291	287	287	300	306
30	139	138	139	146	144
35	83	83	83	86	86
40	60	58	58	62	56
45	44	42	43	44	40
50	30	31	32	32	30
55	21	18	19	20	18
60	10	11	10	12	9
65	2	0	3	2	2
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

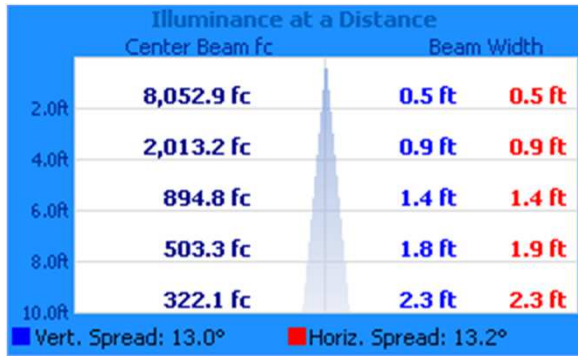


RESULTS OF TEST (cont'd)

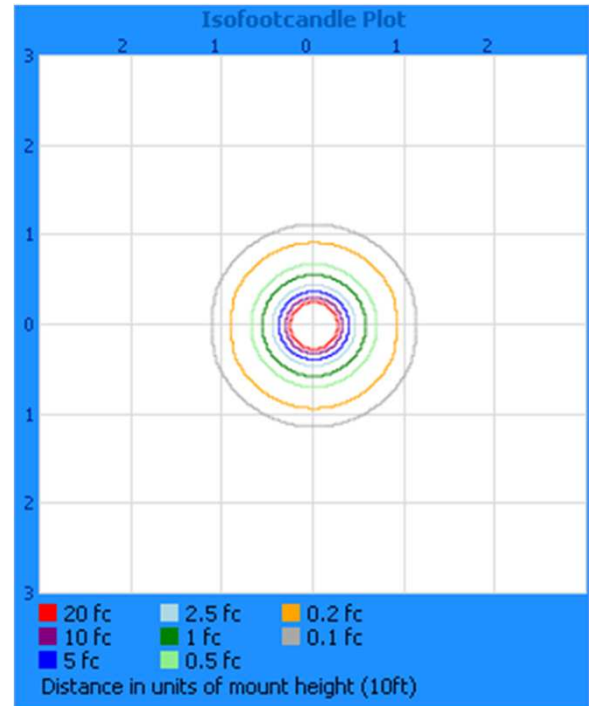
Illumination Plots

Mounting Height: 10 ft.

Illuminance - Cone of Light



Isoillumination Plot

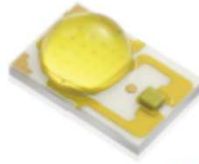


Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	2317	95.5
0-40	2372	97.8
0-60	2424	99.9
60-90	3.1	0.1
0-90	2427	100.0
90-180	0.0	0.0
0-180	2427	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	1520	62.6
10-20	647.4	26.7
20-30	149.6	6.2
30-40	55.6	2.3
40-50	33.8	1.4
50-60	17.7	0.7
60-70	3.1	0.1
70-80	0.0	0.0
80-90	0.0	0.0



RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

Electrical Characteristics at 700 mA for LUXEON Rebel ES
Thermal Pad Temperature = 25°C

LED identified as: Luxeon Rebel ES

Table 4.

Color	Forward Voltage V_f (V)			Typical Temperature Coefficient of Forward Voltage (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R_{\theta_{jc}}$
	Min.	Typ.	Max.		
Neutral-White	2.5	3.0	3.5	-2.0 to -4.0	6
Cool-White	2.5	3.0	3.5	-2.0 to -4.0	6

Absolute Maximum Ratings

Table 6.

Parameter	Cool-White / Neutral-White
DC Forward Current (mA)	1000 mA
Peak Pulsed Forward Current (mA) (P)	1200 mA
Average Forward Current (mA)	1000 mA
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3B (ESD22-A114-E)
LED Junction Temperature (Tj)	150°C
Operating Case Temperature at 350 mA	-40°C - 135°C
Storage Temperature	-40°C - 135°C
Soldering Temperature	(JEDEC 020C) 260°C
Allowable Reflow Cycles	3
Autoclave Conditions	121°C at 2 ATM
Reverse Voltage (Vr)	100% Relative Humidity for 96 Hours Maximum LUXEON Rebel ES LEDs are not designed to be driven in reverse bias

Maximum Junction Temperature from LED specification (Tj) = 150°C

Thermal Resistance Formula from LED specification = 6°C/W

Maximum Forward Voltage (Vf) from LED specification = 3.5V

Measured LED Current = 590mA

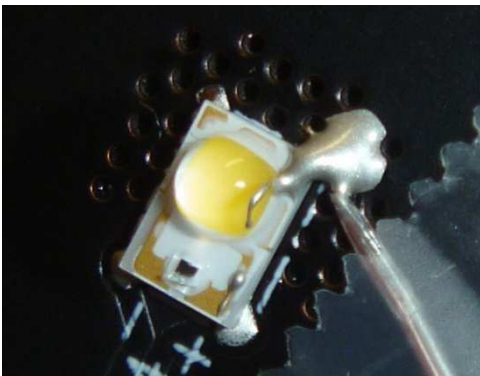
Calculated LED Wattage = Vf x Measured LED Current = 2.065W

Maximum Source Temperature (Ts) = Tj - (LED Wattage x Thermal Resistance) = 137.6°C

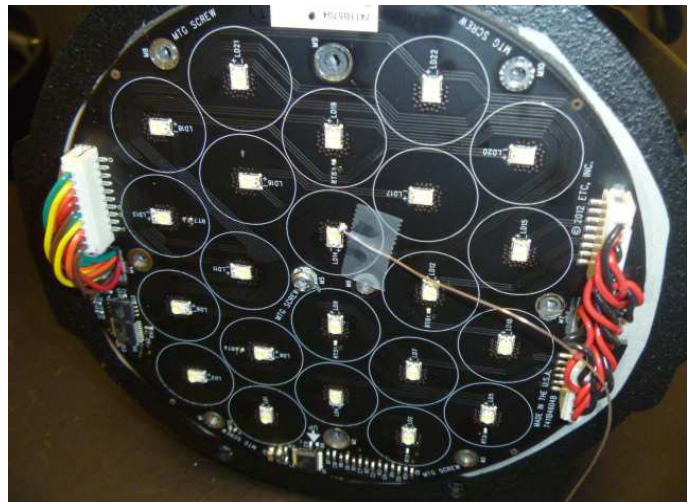
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature (°C)
1309060840-001	63.5	Per diagram	137.6

In-Situ Picture – Ts



In-Situ Picture – Ts location



PICTURE (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:



Jacki Swiernik
Staff Engineer
Lighting Division

Attachment: None

Report Reviewed By:



David Ellis
Senior Project Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: November 29, 2013

REPORT NO. 101414036CRT-002

TEST OF ONE D22 DAYLIGHT PORTABLE LED ETL FIX (BLK)

MODEL NO. D22 DAYLIGHT
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D22 DAYLIGHT. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-002.

DATES OF TESTS: November 20, 2013 through November 25, 2013.

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

SUMMARY

Model No.:	D22 DAYLIGHT
Description:	D22 DAYLIGHT PORTABLE LED ETL FIX (BLK)

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	3540	3510
Total Power (W)	53.32	53.44
Luminaire Efficacy (LPW)	66.39	65.68

Criteria	Result
Power Factor	0.982
Current ATHD %	6.12
Correlated Color Temperature (CCT - K)	5556
Color Rendering Index (CRI - Ra)	72.6
Color Rendering Index (CRI - R9)	-6.2
DUV	0.007
Chromaticity Coordinate (x)	0.331
Chromaticity Coordinate (y)	0.354
Chromaticity Coordinate (u')	0.201
Chromaticity Coordinate (v')	0.484
Maximum In-Situ Source Temperature Point (°C)	73.0
Maximum In-Situ Driver Case Temperature (°C)	71.6

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Leeds & Northup Standard Resistor	Manganin	Y089	02/07/13	02/07/14
Data Precision Digital Voltmeter	3600	V124	02/07/13	02/07/14
Fluke Multimeter	45	M133	02/07/13	02/07/14
Kikusui DC Power Supply	35-10L	E160	---	---
Sorenson DC Power Supply	DLM150-20E	---	---	---
NIST Spectral Flux Standard Source	RF1024	---	09/18/10	100 hrs of use
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
Cole Palmer Thermometer	03313-85	T1469	05/31/13	05/31/14
LSI High Speed Mirror Goniometer	6440	---	10/21/13	11/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Cole-Palmer Hygro Thermometer	03313-85	T1469	05/31/13	05/31/14
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Extech Hygro-Thermometer	445703	T1355	11/26/12	11/26/13
Fluke Multimeter	87 V	D590	03/28/13	03/28/14
Fluke Temperature Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

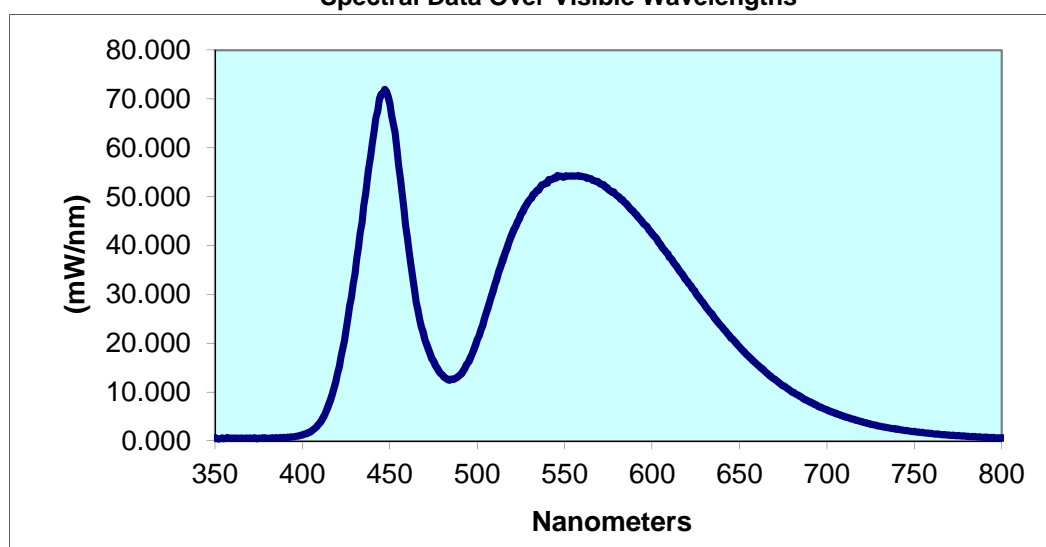
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-002	UP	120.0	452.1	53.32	0.982	6.12	3540	66.39

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
5556	72.6	-6.2	0.007	0.331	0.354	0.201	0.484

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.67	440	60.93	530	49.43	620	32.71	710	5.004
355	0.452	445	70.99	535	51.35	625	30.24	715	4.45
360	0.535	450	69.02	540	52.78	630	27.89	720	3.912
365	0.596	455	56.48	545	53.81	635	25.5	725	3.448
370	0.618	460	41.44	550	54.11	640	23.33	730	3.039
375	0.56	465	28.36	555	54.23	645	21.14	735	2.704
380	0.546	470	20.81	560	54.12	650	19.2	740	2.397
385	0.691	475	16.25	565	53.66	655	17.39	745	2.12
390	0.688	480	13.49	570	52.69	660	15.66	750	1.885
395	0.876	485	12.63	575	51.42	665	14.06	755	1.688
400	1.238	490	13.54	580	50.2	670	12.67	760	1.49
405	1.994	495	16.2	585	48.62	675	11.3	765	1.334
410	3.756	500	20.76	590	46.57	680	10.06	770	1.181
415	7.455	505	26.04	595	44.52	685	9.026	775	1.034
420	13.76	510	32.07	600	42.42	690	8.02	780	0.927
425	22.76	515	37.46	605	40.07	695	7.118		
430	34.21	520	42.42	610	37.59	700	6.379		
435	48.11	525	46.52	615	35.21	705	5.632		

Spectral Data Over Visible Wavelengths



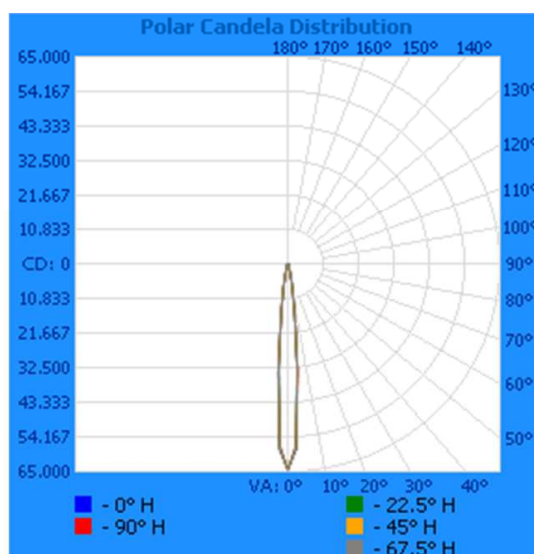
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-002	UP	120.0	451.9	53.44	0.985	3510	65.68

Intensity (Candlepower) Summary at 25°C - Candelas

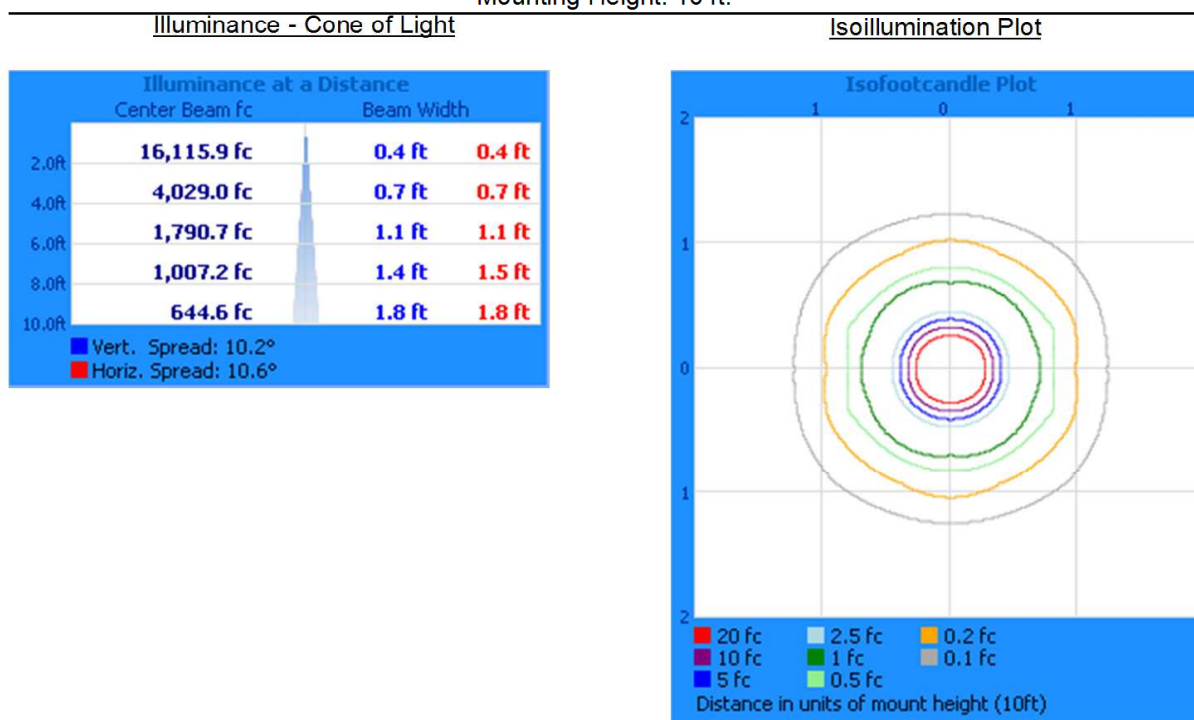
Angle	0	22.5	45	67.5	90
0	64464	64464	64464	64464	64464
5	32815	32518	33183	33655	34204
10	8318	8246	8339	8383	8367
15	2206	2324	2533	2438	2253
20	899	904	952	932	882
25	306	313	325	312	315
30	200	210	207	187	202
35	177	198	193	179	185
40	93	88	87	128	80
45	65	56	58	64	52
50	43	45	48	44	44
55	30	28	32	30	28
60	15	14	13	17	14
65	4	5	4	6	4
70	0	0	0	1	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TEST (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	3321	94.6
0-40	3428	97.7
0-60	3504	99.8
60-90	5.7	0.2
0-90	3510	100.0
90-180	0.0	0.0
0-180	3510	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	2339	66.6
10-20	801.7	22.8
20-30	180.4	5.1
30-40	106.8	3.0
40-50	49.5	1.4
50-60	26.5	0.8
60-70	5.6	0.2
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as: Luxeon Rebel A

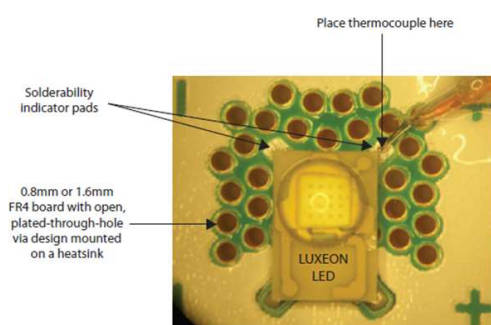


Figure 1. Solderability indicator pad and thermocouple placement.

Forward Voltage V_f ⁽¹⁾		Typical Temperature Coefficient of Forward Voltage ⁽²⁾		Typical Thermal Resistance Junction to Thermal Pad $R_{\theta JC}$ ⁽³⁾
Nominal ANSI CCT	Forward Voltage V_f ⁽¹⁾ (V)	Typical Temperature Coefficient of Forward Voltage ⁽²⁾ (mV/°C)		
2700K	Min. 2.5	Max. 3.5	-1.8 to -2.4	6
3000K	2.5	3.5	-1.8 to -2.4	6
4000K	2.5	3.5	-1.8 to -2.4	6
5000K	2.5	3.5	-1.8 to -2.4	6

LED Junction Temperature ⁽¹⁾	150°C
-----------------------------------------	-------

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 6°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.5V

Measured LED Current = 585mA

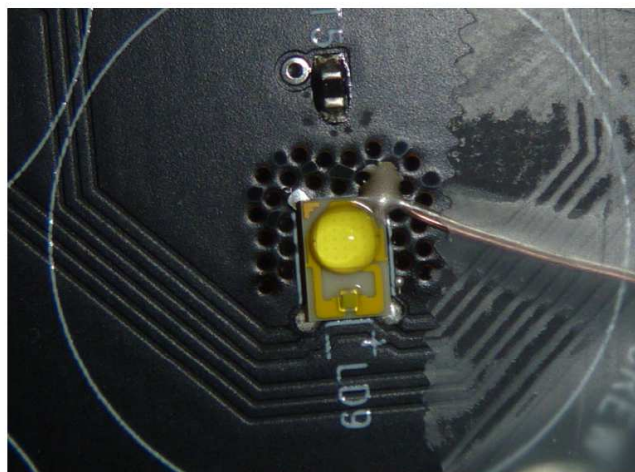
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 2.047W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 137.7°C

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature (°C)
CRT1311071604-002	73.0	Per diagram	137.7

In-Situ Picture – T_s



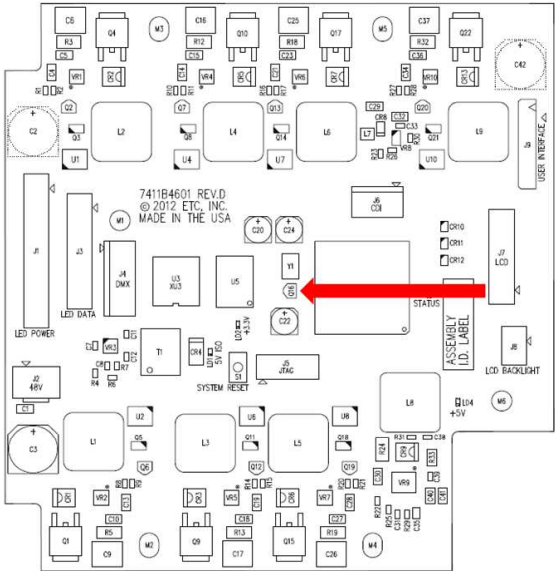
In-Situ Picture – T_s locator



RESULTS OF TEST (cont'd)

Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-001	71.6	Per diagram	100

Power Supply Picture – Tc location



PICTURE (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:



Melanie Brittain
Associate Engineer
Lighting Division

Attachment: None

Report Reviewed By:



Jeffrey Davis
Engineering Manager
Lighting Division

SECTION 3 - Desire D40

Lustr+

Vivid

Studio HD

Tungsten

Daylight



REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: June 10, 2013

REPORT NO. 101158242CRT-008

TEST OF ONE LED WASH LIGHT

FIXTURE MODEL NO. D40 LUSTR+
LED MODEL NO. LUXEON REBEL ES

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and LED In-Situ tests.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

Energy Star Version 1.2 (2012): Program Requirements for Luminaires
Energy Star Manufacturer's Guide Version 2.0 (2009): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one sample of model number D40 LUSTR+. The sample was received by Intertek on May 6, in undamaged condition, and one sample was tested as received. The sample designation was CRT1304251519-007.

DATES OF TESTS: June 7, 2013



SUMMARY

Model No.:	D40 LUSTR+
Description:	LED WASH LIGHT

Criteria	Result
Maximum In-Situ Source Temperature Point (°C)	74.7
Maximum Power Supply Case Temperature (°C)	48.3

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Fluke Multimeter	PM2525	M127	10/17/12	10/17/13
Fluke Temp Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

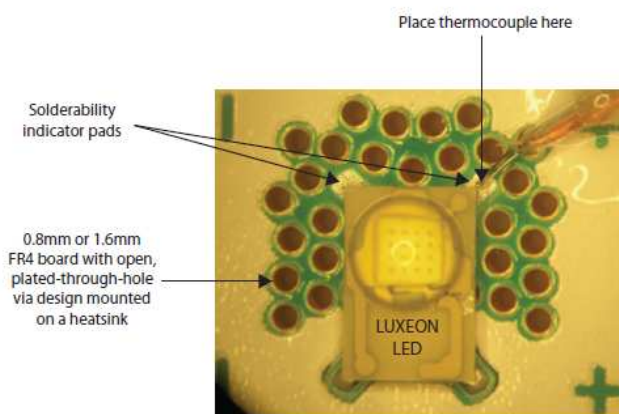
In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Agilent 34970A Data Logger. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TESTS

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED identified as: LUXEON REBEL ES



Color	Forward Voltage V_f ^[1] (V)			Typical Temperature Coefficient of Forward Voltage ^[2] (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R\theta_{JC}$
	Min.	Typ.	Max.		
Neutral-White	2.5	3.0	3.5	-2.0 to -4.0	6
Cool-White	2.5	3.0	3.5	-2.0 to -4.0	6

Parameter	Cool-White / Neutral-White
DC Forward Current (mA)	1000 mA
Peak Pulsed Forward Current (mA) ^[2]	1200 mA
Average Forward Current (mA)	1000 mA
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3B JESD22-A114-E
LED Junction Temperature ^[1]	150°C
Operating Case Temperature at 350 mA	-40°C - 135°C
Storage Temperature	-40°C - 135°C
Soldering Temperature	JEDEC 020c 260°C
Allowable Reflow Cycles	3
Autoclave Conditions	121°C at 2 ATM 100% Relative Humidity for 96 Hours Maximum
Reverse Voltage (Vr)	LUXEON Rebel ES LEDs are not designed to be driven in reverse bias

RESULTS OF TESTS (cont'd)

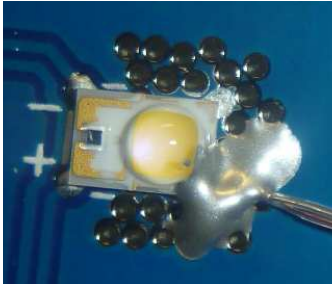
In-Situ Maximum Measured LED Source Temperature - LXML-PM01 GREEN

Maximum Junction Temperature from LED specification (Tj) = 150°C
 Thermal Resistance Formula from LED specification = 6°C/W
 Maximum Forward Voltage (Vf) from LED specification = 3.5 V
 Measured LED Current = 565 mA
 Calculated LED Wattage = Vf x Measured LED Current = 2.254W
 Maximum Source Temperature (Ts) = Tj – (LED Wattage x Thermal Resistance) = 127°C

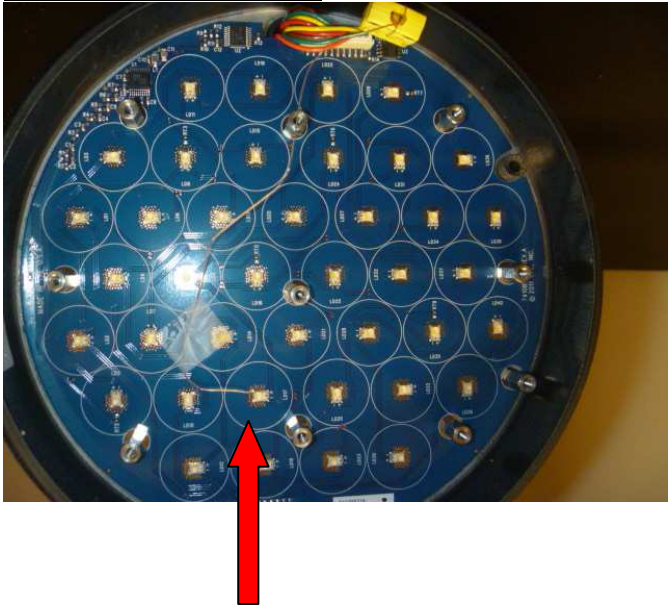
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-007	74.7	Per diagram above	127

In-Situ Picture – Ts



In-Situ Picture – Ts location





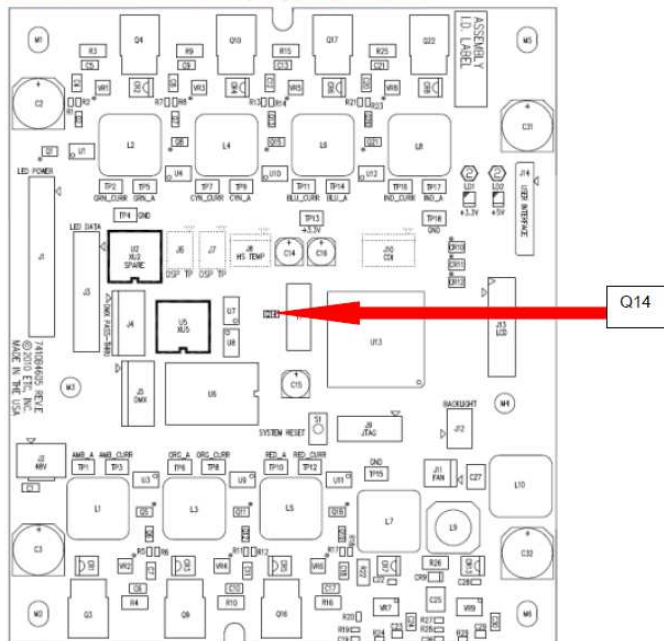
RESULTS OF TESTS (cont'd)

Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation:

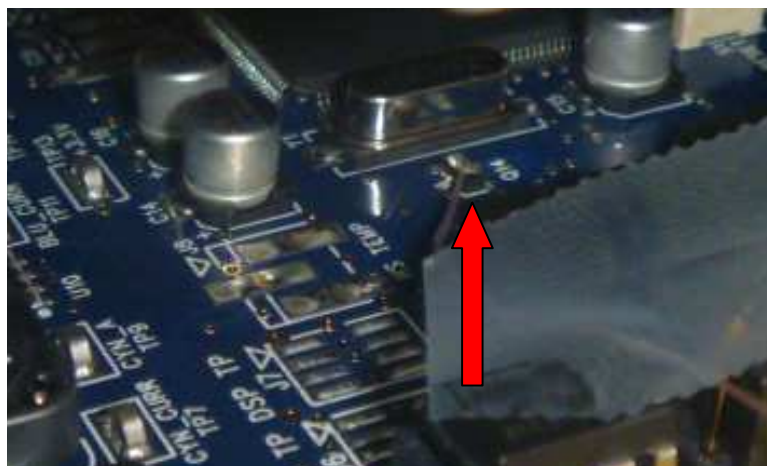
Driver identified as: Model No. 7410B4605

For the Desire control card, measure the temperature at Q14.



Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Measured Power Supply Case Temperature (°C)	Location	Maximum Power Supply Case Temperature (°C)
CRT1304251519-007	48.3	Q14	100





Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink, appearing to be "K R".

Kenda Branch
Engineer
Lighting Division

Attachment: None

Report Reviewed By:

A handwritten signature in black ink, appearing to be "Jacki Swiernik".

Jacki Swiernik
Staff Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: May 23, 2013

REPORT NO. 101158242CRT-005

TEST OF ONE LED WASH LIGHT

FIXTURE MODEL NO. D40 LUSTR+

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

LABORATORY NOTE: The laboratory that conducted the testing detailed in this report has been Qualified, Verified, and Recognized for LM-79 Testing for ENERGY STAR for SSL by US DOE's CALiPER program.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79: 2008 Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products

ANSI ANSLG C38.377: 2012 Specifications of the Chromaticity of Solid State Lighting Products

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D40 LUSTR+. The sample was received by Intertek on May 6, 2013, in undamaged condition, and one sample was tested as received. The sample designation was CRT1304251519-007.

DATES OF TESTS: May 15, 2013 through May 22, 2013

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

SUMMARY

Model No.:	D40 LUSTR+
Description:	LED WASH LIGHT

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	3303	3324
Total Power (W)	94.24	93.79
Luminaire Efficacy (LPW)	35.05	35.44

Criteria	Result
Power Factor	0.996
Current ATHD (%)	3.16
Correlated Color Temperature (CCT - K)	6139
Color Rendering Index (CRI) - Ra	64.5
Color Rendering Index (CRI) - R9	-60.9
Duv	0.029
Chromaticity Coordinate (x)	0.324
Chromaticity Coordinate (y)	0.284
Chromaticity Coordinate (u')	0.225
Chromaticity Coordinate (v')	0.443

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
LSI High Speed Mirror Goniometer	6440	---	05/20/13	06/20/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Extech Hygro Thermometer	445703	T1359	11/08/12	11/08/13
Fisher Scientific	---	N1132	04/22/13	04/22/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Yokogawa Power Analyzer	WT1600	E462	07/06/12	07/06/13
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temp Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	NA	NA	NA
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Sorensen DC Power Supply	DLM150-20E	N/A	N/A	N/A
FLUKE	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

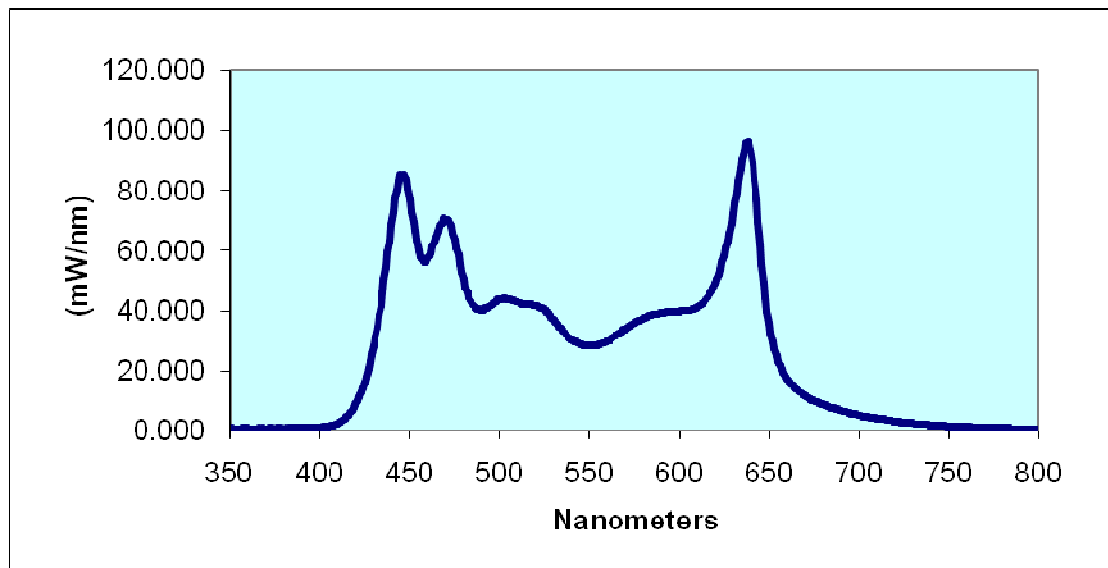
The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

RESULTS OF TESTS

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.770	460	57.199	570	33.728	680	8.589
355	0.587	465	64.405	575	35.622	685	7.525
360	0.676	470	70.295	580	37.315	690	6.574
365	0.634	475	63.499	585	38.571	695	5.739
370	0.597	480	50.295	590	38.916	700	5.059
375	0.647	485	41.893	595	39.307	705	4.438
380	0.613	490	39.954	600	39.648	710	3.922
385	0.681	495	41.373	605	39.913	715	3.429
390	0.714	500	43.460	610	41.108	720	3.045
395	0.785	505	43.612	615	43.643	725	2.629
400	0.953	510	42.726	620	48.890	730	2.340
405	1.363	515	41.992	625	58.167	735	2.038
410	2.281	520	41.418	630	72.279	740	1.790
415	4.468	525	40.109	635	90.276	745	1.613
420	8.659	530	37.048	640	93.514	750	1.407
425	16.052	535	33.183	645	62.005	755	1.255
430	28.282	540	30.390	650	35.558	760	1.107
435	45.917	545	28.705	655	23.010	765	0.000
440	68.324	550	28.114	660	17.090	770	0.888
445	85.245	555	28.688	665	13.755	775	0.778
450	76.756	560	29.933	670	11.601	780	0.709
455	59.913	565	31.713	675	9.858		

Sample No. CRT1304251519-007
Spectral Data Over Visible Wavelengths



RESULTS OF TESTS (cont'd)

Photometric and Electrical Measurements at 25°C – Integrating Sphere Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1304251519-007	UP	120.0	788	94.24	0.996	3.16	3303	35.05

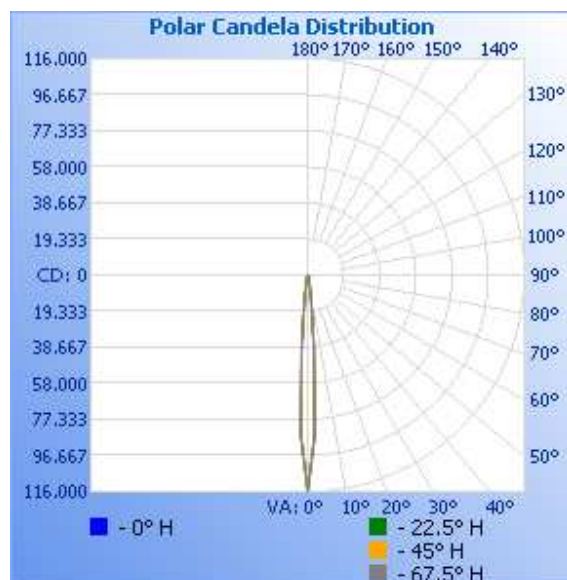
Intertek Sample No.	Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
CRT1304251519-007	6139	64.5	-60.9	0.029	0.324	0.284	0.225	0.443

Photometric and Electrical Measurements – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1304251519-007	UP	120.1	784.0	93.79	0.996	3324	35.44

Intensity (Candlepower) Summary at 25°C - Candelas

Angle	0	22.5	45	67.5	90
0	115486	115486	115486	115486	115486
5	35845	36062	36949	37990	38882
10	5905	6187	6423	6226	5950
15	1033	1133	1198	1080	1030
20	465	477	484	476	455
25	113	117	116	117	112
30	55	53	54	51	49
35	33	33	29	30	31
40	25	20	23	26	18
45	22	16	19	22	22
50	14	19	16	17	18
55	8	9	10	13	11
60	0	0	0	3	2
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

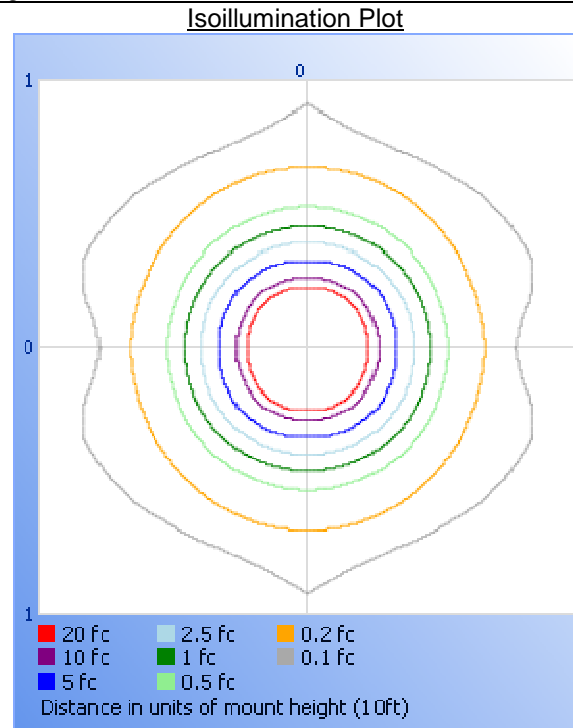
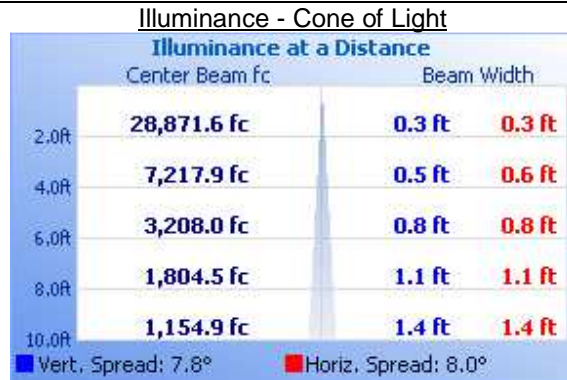




RESULTS OF TESTS (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	3279	98.7
0-40	3300	99.3
0-60	3324	100.0
60-90	0.1	0.0
0-90	3324	100.0
90-180	0.0	0.0
0-180	3324	100.0



Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink, appearing to read "Kenda Branch".

Kenda Branch
Engineer
Lighting Division

Attachment: None

Report Reviewed By:

A handwritten signature in black ink, appearing to read "David Ellis".

David Ellis
Senior Project Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: November 29, 2013

REPORT NO. 101414036CRT-011

TEST OF ONE D40 VIVID LED FIXTURE ETL (BLK)

MODEL NO. D40 VIVID
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D40 VIVID. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-011.

DATES OF TESTS: November 21, 2013 through November 26, 2013.

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SUMMARY

Model No.:	D40 VIVID
Description:	D40 VIVID LED FIXTURE ETL (BLK)

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	2899	3018
Total Power (W)	88.85	88.96
Luminaire Efficacy (LPW)	32.63	33.93

Criteria	Result
Power Factor	0.995
Current ATHD %	3.18
Correlated Color Temperature (CCT - K)	3256
Color Rendering Index (CRI - Ra)	33.3
Color Rendering Index (CRI - R9)	-69.3
DUV	0.058
Chromaticity Coordinate (x)	0.363
Chromaticity Coordinate (y)	0.265
Chromaticity Coordinate (u')	0.267
Chromaticity Coordinate (v')	0.437
Maximum In-Situ Source Temperature Point (°C)	75.9
Maximum In-Situ Driver Case Temperature (°C)	61.5

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Leeds & Northup Standard Resistor	Manganin	Y089	02/07/13	02/07/14
Data Precision Digital Voltmeter	3600	V124	02/07/13	02/07/14
Fluke Multimeter	45	M133	02/07/13	02/07/14
Kikusui DC Power Supply	35-10L	E160	---	---
Sorenson DC Power Supply	DLM150-20E	---	---	---
NIST Spectral Flux Standard Source	RF1024	---	09/18/10	100 hrs of use
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
Cole Palmer Thermometer	03313-85	T1469	05/31/13	05/31/14
LSI High Speed Mirror Goniometer	6440	---	11/21/13	12/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Cole Palmer Thermometer	03313-85	T1470	05/31/13	05/31/14
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Fluke Multimeter	87 V	D590	03/28/13	03/28/14
Fluke Temperature Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

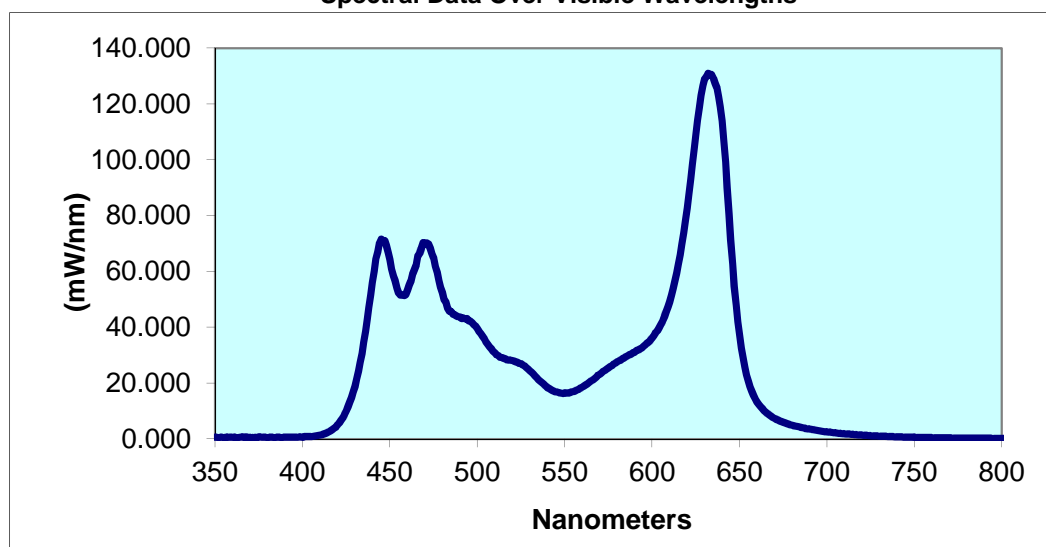
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-011	UP	120.0	743.7	88.85	0.995	3.18	2899	32.63

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
3256	33.3	-69.3	0.058	0.363	0.265	0.267	0.437

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.623	440	55.97	530	24.44	620	82.75	710	1.865
355	0.515	445	71.53	535	21.28	625	109.2	715	1.599
360	0.647	450	64.24	540	18.38	630	128.9	720	1.354
365	0.669	455	52.29	545	16.86	635	129.2	725	1.152
370	0.629	460	53.39	550	16.4	640	113.9	730	0.981
375	0.648	465	62.29	555	16.95	645	71.32	735	0.847
380	0.451	470	69.96	560	18.6	650	36.82	740	0.739
385	0.547	475	64.65	565	20.73	655	20.67	745	0.625
390	0.563	480	52.45	570	23.19	660	13.25	750	0.55
395	0.569	485	45.68	575	25.44	665	9.543	755	0.477
400	0.629	490	43.68	580	27.69	670	7.401	760	0.425
405	0.874	495	42.34	585	29.48	675	5.936	765	0.368
410	1.394	500	39.61	590	31.08	680	4.932	770	0.33
415	2.543	505	34.72	595	33.16	685	4.176	775	0.286
420	5.055	510	30.88	600	36.18	690	3.517	780	0.253
425	9.878	515	28.89	605	41.06	695	2.987		
430	18.79	520	28.11	610	49.15	700	2.539		
435	34.7	525	26.94	615	62.5	705	2.163		

Spectral Data Over Visible Wavelengths



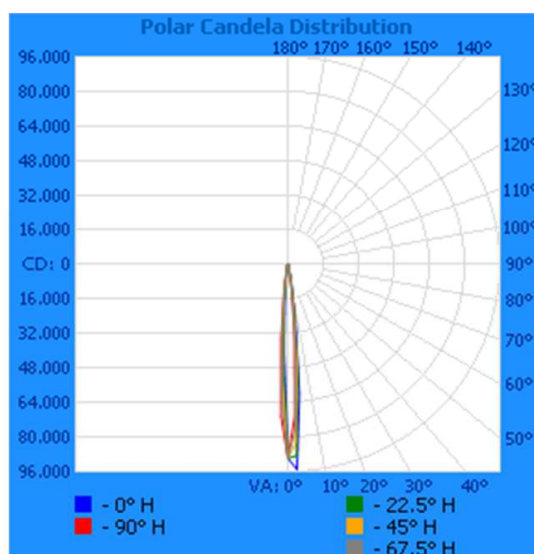
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-011	UP	120.0	743.7	88.96	0.996	3018	33.93

Intensity (Candlepower) Summary at 25°C - Candelas

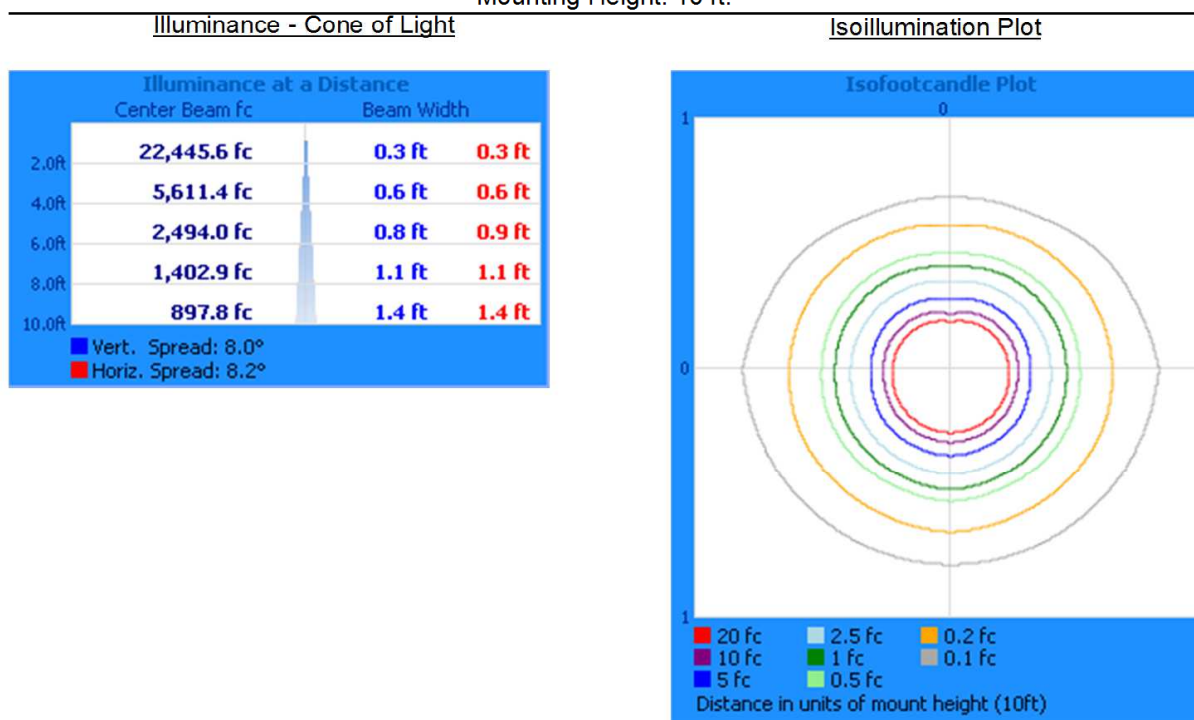
Angle	0	22.5	45	67.5	90
0	89782	89782	89782	89782	89782
5	60262	52845	46814	40033	34061
10	9870	8605	7680	6610	5791
15	1555	1414	1299	1130	1012
20	508	479	471	442	412
25	166	143	133	121	104
30	53	48	47	46	44
35	29	26	25	26	27
40	14	17	18	18	21
45	13	16	15	16	20
50	17	13	13	14	13
55	8	7	6	5	4
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TEST (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	2985	98.9
0-40	3001	99.4
0-60	3018	100.0
60-90	0.0	0.0
0-90	3018	100.0
90-180	0.0	0.0
0-180	3018	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	2483	82.3
10-20	434.3	14.4
20-30	67.1	2.2
30-40	16.0	0.5
40-50	12.2	0.4
50-60	4.8	0.2
60-70	0.0	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as:

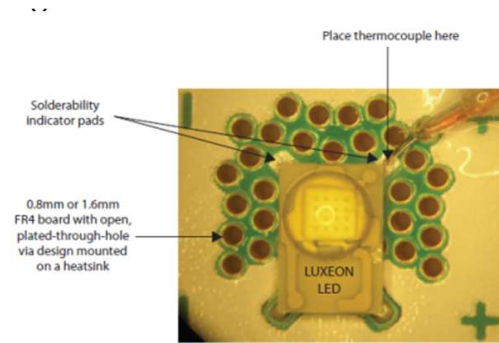


Figure 1. Solderability indicator pad and thermocouple placement.

Figure 1. Solderability indicator pad and thermocouple placement.

Forward Voltage V_f ^[1] (V)			Typical Temperature Coefficient of Forward Voltage ^[2] (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R_{\theta_{jc}}$
Min.	Typ.	Max.		
2.55	2.90	3.51	- 2.0 to - 4.0	10
2.55	2.90	3.51	- 2.0 to - 4.0	10
LED Junction Temperature ^[3]				150°C

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51V

Measured LED Current = 583mA

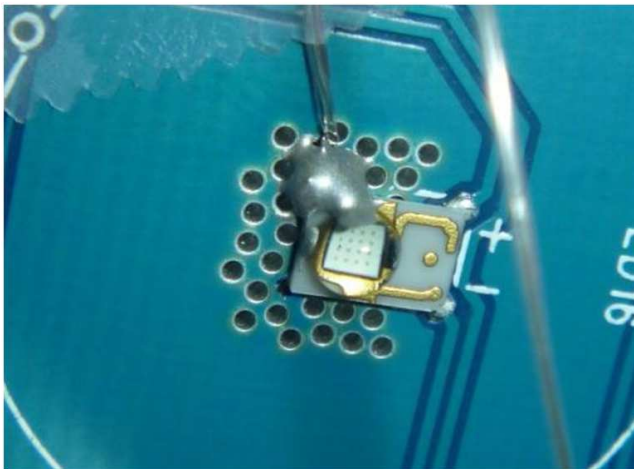
Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 2.046\text{W}$

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 129.5^\circ\text{C}$

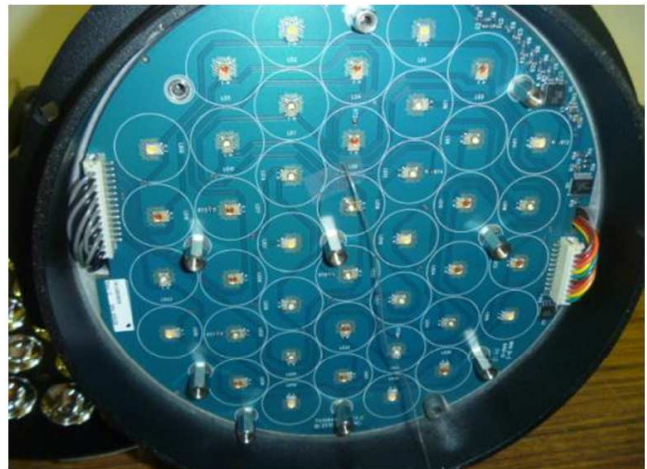
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature (°C)
CRT1311071604-011	75.9	Per diagram	129.5

In-Situ Picture – T_s



In-Situ Picture – T_s locator

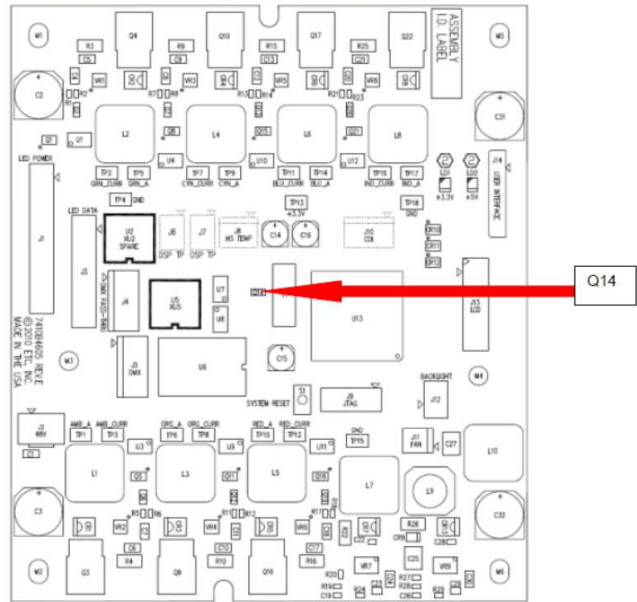


RESULTS OF TEST (cont'd)

Maximum Measured Power Supply Case Temperature

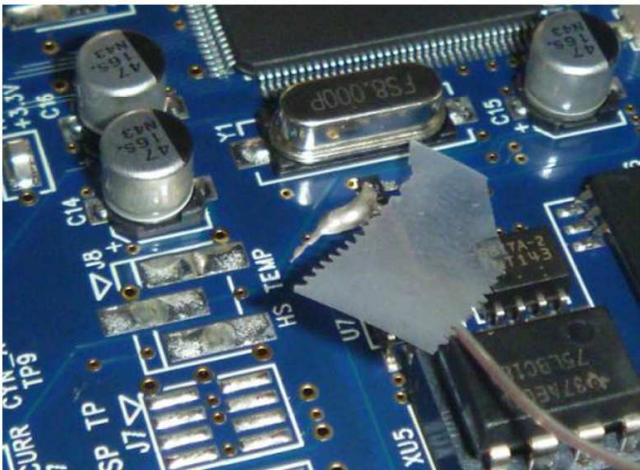
Manufacturer Supplied Documentation

For the Desire control card, measure the temperature at Q14.



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-011	61.5	Per diagram	100

Power Supply Picture – Tc location



PICTURE (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

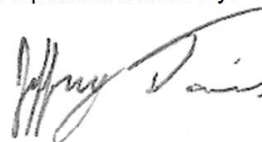
In Charge Of Tests:



Melanie Brittain
Associate Engineer
Lighting Division

Attachment: None

Report Reviewed By:



Jeffrey Davis
Engineering Manager
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101414036

Date: November 29, 2013

REPORT NO. 101414036CRT-006

TEST OF ONE D40 STUDIO LED FIXTURE ETL (BLK)

MODEL NO. D40 STUDIO
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 (2008): Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products

ANSI ANSLG C38.377 (2012): Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D40 STUDIO. The sample was received by Intertek on November 7, 2013, in undamaged condition, and one sample was tested as received. The sample designation was CRT1311071604-006.

DATES OF TESTS: November 21, 2013 through November 26, 2013.

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SUMMARY

Model No.:	D40 STUDIO
Description:	D40 STUDIO LED FIXTURE ETL (BLK)

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	3651	4073
Total Power (W)	91.94	91.84
Luminaire Efficacy (LPW)	39.71	44.35

Criteria	Result
Power Factor	0.995
Current ATHD (%)	2.93
Correlated Color Temperature (CCT - K)	4114
Color Rendering Index (CRI) – Ra	81.80
Color Rendering Index (CRI) - R9	64.70
Duv	0.010
Chromaticity Coordinate (x)	0.370
Chromaticity Coordinate (y)	0.351
Chromaticity Coordinate (u')	0.229
Chromaticity Coordinate (v')	0.488
Maximum In-Situ Source Temperature Point (°C)	74.6
Maximum In-Situ Driver Temperature Point (°C)	73.9



EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
Leeds & Northup Standard Resistor	Manganin	Y089	02/07/13	02/07/14
Data Precision Digital Voltmeter	3600	V124	02/07/13	02/07/14
Kikusui DC Power Supply	35-10L	E160	---	---
NIST Spectral Flux Standard Source	RF1024	---	09/18/10	100 hrs of use
Sorenson DC Power Supply	DLM150-20E	---	---	---
LSI High Speed Mirror Goniometer	6440	---	11/21/13	12/21/13
Elgar Power Supply	CW1251	---	VBU	VBU
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Cole Palmer Thermometer	03313-85	T1470	05/31/13	05/31/14
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
LABSPHERE 3M	W/ CDS 1100	N307	VBU	VBU
Fluke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	VBU	VBU
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
Cole Parmer Thermometer	03313-85	T1469	05/31/13	05/31/14
Fluke Multimeter	87 V	D590	03/28/13	03/28/14
Fluke Temperature Meter	53 II	D588	03/15/13	03/15/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

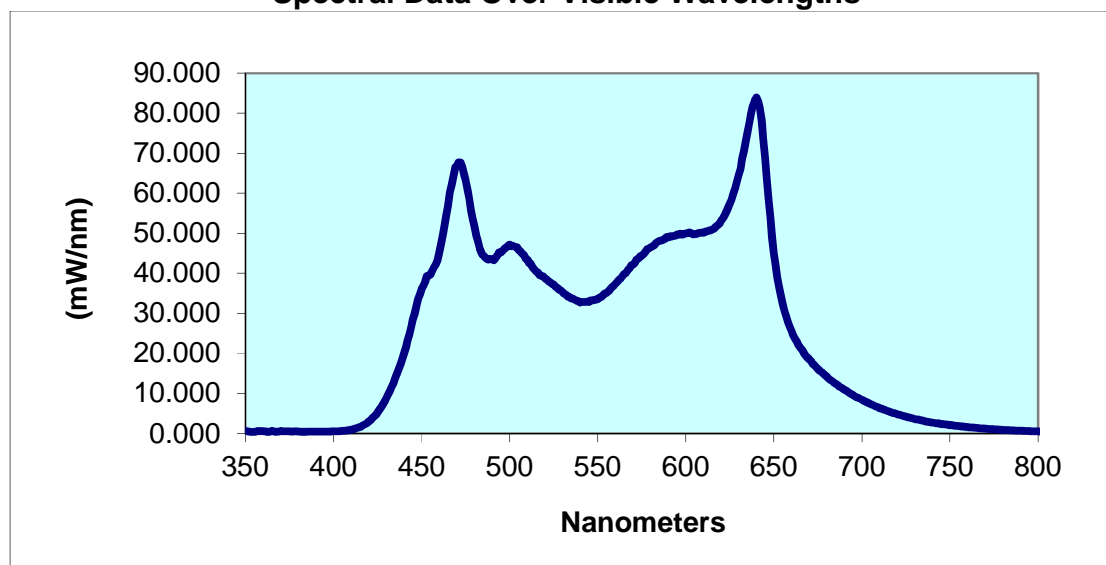
Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMP_{PS} or T_S point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TESTS

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.666	460	45.248	570	42.212	680	14.151
355	0.428	465	56.769	575	44.349	685	12.481
360	0.545	470	66.901	580	46.520	690	10.950
365	0.643	475	63.171	585	48.141	695	9.618
370	0.613	480	51.678	590	48.951	700	8.393
375	0.552	485	44.502	595	49.672	705	7.341
380	0.469	490	43.474	600	50.011	710	6.354
385	0.509	495	45.214	605	49.841	715	5.582
390	0.478	500	47.164	610	50.162	720	4.871
395	0.473	505	45.938	615	50.959	725	4.204
400	0.533	510	43.483	620	53.196	730	3.622
405	0.645	515	40.497	625	57.438	735	3.136
410	0.954	520	38.760	630	64.645	740	2.779
415	1.667	525	37.212	635	75.317	745	2.371
420	3.033	530	35.304	640	83.891	750	2.115
425	5.283	535	33.700	645	68.790	755	1.832
430	8.846	540	32.745	650	45.204	760	1.589
435	13.872	545	32.889	655	32.299	765	0.000
440	20.029	550	33.674	660	25.567	770	1.201
445	28.438	555	35.119	665	21.445	775	1.061
450	36.246	560	37.372	670	18.571	780	0.909
455	39.785	565	39.883	675	16.106		

Sample No. 101414036CRT-006
Spectral Data Over Visible Wavelengths



RESULTS OF TESTS (cont'd)

Photometric and Electrical Measurements at 25°C – Integrating Sphere Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
101414036CRT-006	UP	120.0	769.5	91.94	0.995	2.93	3651	39.71

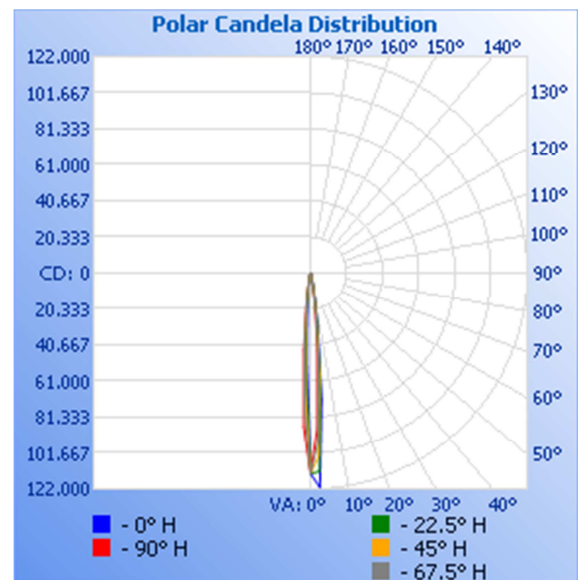
Intertek Sample No.	Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
101414036CRT-006	4114	81.80	64.70	0.010	0.370	0.351	0.229	0.488

Photometric and Electrical Measurements – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
101414036CRT-006	UP	120.1	767.7	91.84	0.997	4073	44.35

Intensity (Candlepower) Summary at 25°C - Candelas

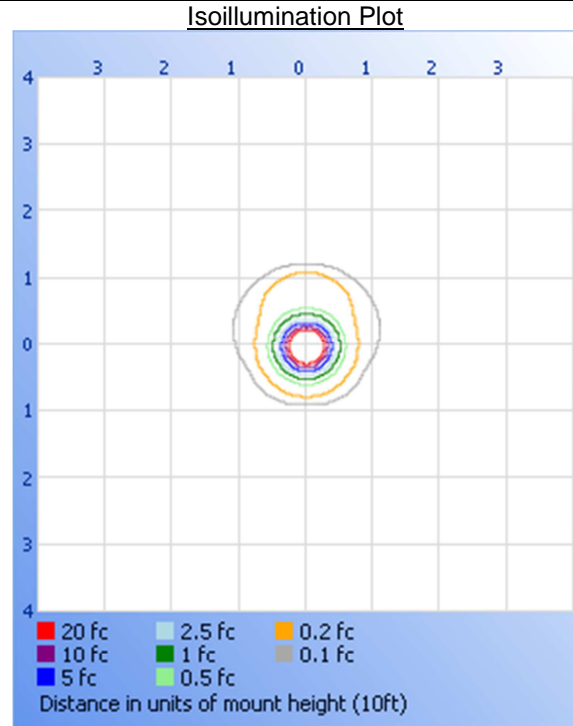
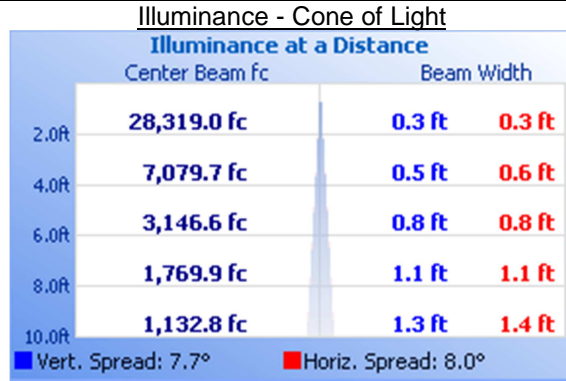
Angle	0	22.5	45	67.5	90
0	113276	113276	113276	113276	113276
5	71332	64192	57167	50201	43462
10	12758	11526	10235	9102	8072
15	2751	2537	2274	2046	1832
20	864	827	779	723	678
25	238	219	202	194	191
30	87	83	82	82	81
35	54	48	49	47	48
40	28	31	33	34	36
45	17	22	23	24	32
50	19	17	21	22	28
55	7	12	14	14	20
60	5	5	6	5	3
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TESTS (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	3995	98.1
0-40	4029	98.9
0-60	4072	100.0
60-90	0.6	0.0
0-90	4073	100.0
90-180	0.0	0.0
0-180	4073	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	3174	77.9
10-20	708.6	17.4
20-30	112.3	2.8
30-40	34.0	0.8
40-50	28.7	0.7
50-60	14.7	0.4
60-70	0.6	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED identified as: Luxeon Rebel A

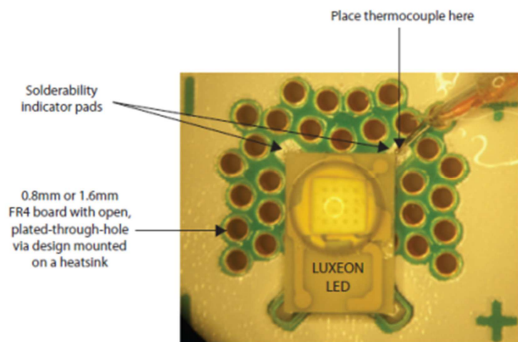


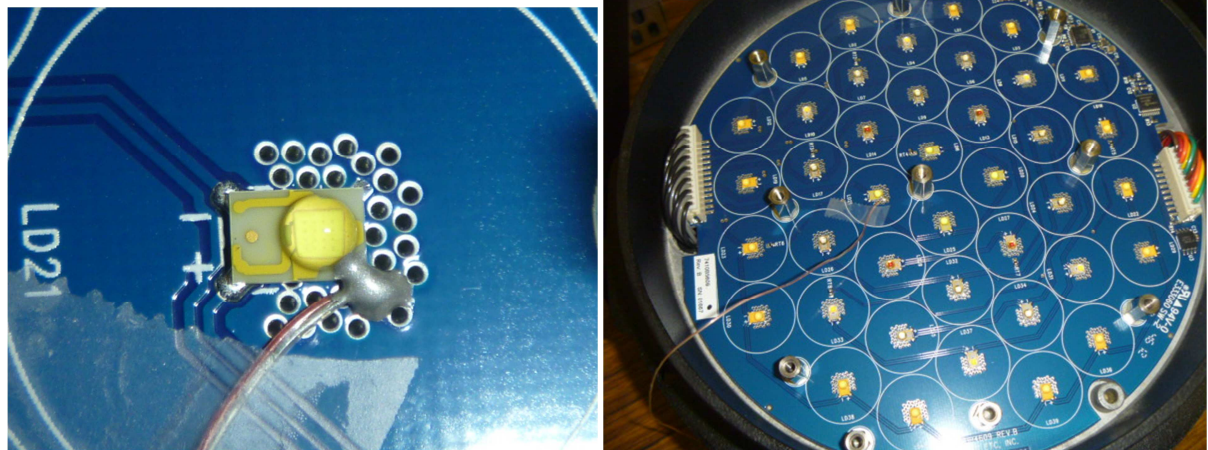
Figure 1. Solderability indicator pad and thermocouple placement.

Nominal ANSI CCT	Forward Voltage V_f ^[1] (V)		Typical Temperature Coefficient of Forward Voltage ^[2] Voltage $\Delta V_f / \Delta T_j$ (mV/°C)	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R\theta_{JC}$
	Min.	Max.		
2700K	2.5	3.5	-1.8 to -2.4	6
3000K	2.5	3.5	-1.8 to -2.4	6
4000K	2.5	3.5	-1.8 to -2.4	6
5000K	2.5	3.5	-1.8 to -2.4	6

LED Junction Temperature ^[3]	150°C
-----------------------------------------	-------

Maximum Junction Temperature from LED specification (Tj) = 150°C
Thermal Resistance Formula from LED specification = 6°C/W
Maximum Forward Voltage (Vf) from LED specification = 3.5V
Measured LED Current = 585mA
Calculated LED Wattage = Vf x Measured LED Current = 2.048W
Maximum Source Temperature (Ts) = Tj – (LED Wattage x Thermal Resistance) = 138°C

Intertek Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
101414036CRT-006	74.6	Per diagram	138

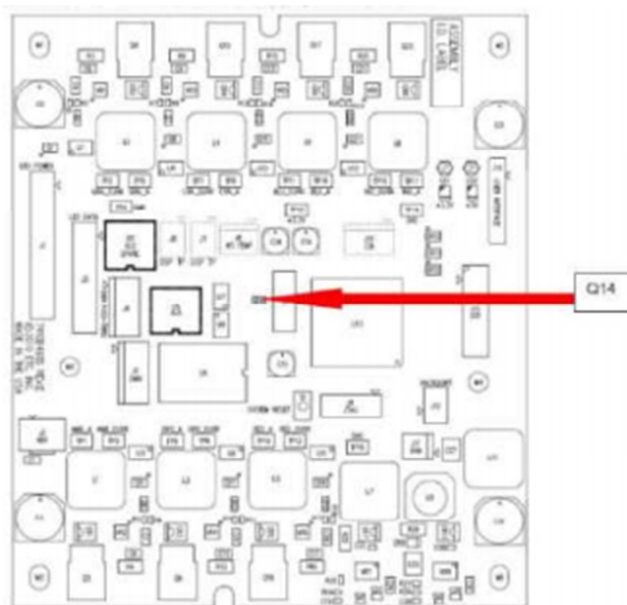


RESULTS OF TESTS (cont'd)

Maximum Measured Power Supply Case Temperature

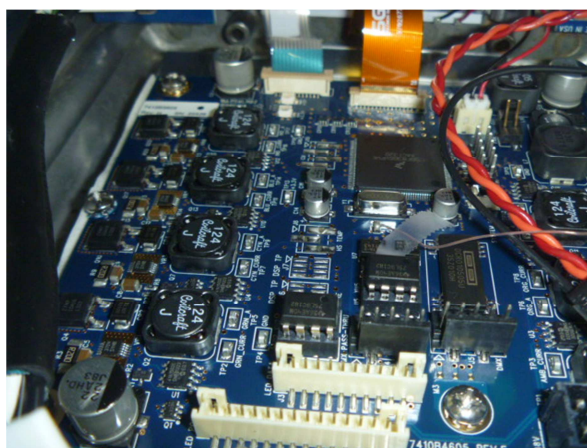
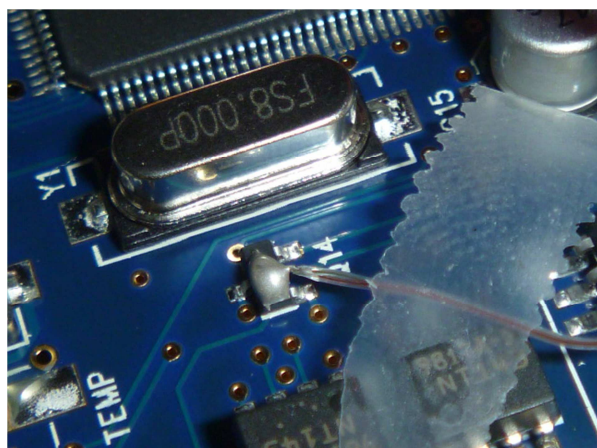
Manufacturer Supplied Documentation:

Driver identified as:



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-006	73.9	Per diagram	100

Power Supply Picture – Tc location





Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink that reads "Melanie Brittain".

Melanie Brittain
Associate Engineer
Lighting Division

Attachment: None

Report Reviewed By:

A handwritten signature in black ink that reads "Jeffrey Davis".

Jeffrey Davis
Engineering Manager
Lighting Division



REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: June 10, 2013

REPORT NO. 101158242CRT-007

TEST OF ONE LED WASH LIGHT

FIXTURE MODEL NO. D40 STUDIO TUNGSTEN
LED MODEL NO. LUXEON REBEL ES

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and LED In-Situ tests.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

Energy Star Version 1.2 (2012): Program Requirements for Luminaires
Energy Star Manufacturer's Guide Version 2.0 (2009): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one sample of model number D40 STUDIO TUNGSTEN. The sample was received by Intertek on May 6, in undamaged condition, and one sample was tested as received. The sample designation was CRT1304251519-005.

DATES OF TESTS: June 7, 2013



SUMMARY

Model No.:	D40 STUDIO TUNGSTEN
Description:	LED WASH LIGHT

Criteria	Result
Maximum In-Situ Source Temperature Point (°C)	76.9
Maximum Power Supply Case Temperature (°C)	51.5

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Fluke Multimeter	PM2525	M127	10/17/12	10/17/13
Fluke Temp Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

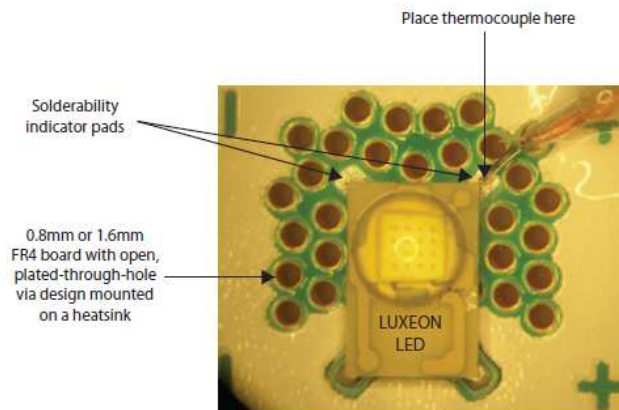
In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Agilent 34970A Data Logger. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TESTS

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED identified as: LUXEON REBEL ES



Color	Forward Voltage V_f ^[1]			Typical Temperature Coefficient of Forward Voltage ^[2] $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad ($^{\circ}\text{C}/\text{W}$) $R\theta_{JC}$
	Min.	Typ.	Max.		
Neutral-White	2.5	3.0	3.5	-2.0 to -4.0	6
Cool-White	2.5	3.0	3.5	-2.0 to -4.0	6

Parameter	Cool-White / Neutral-White
DC Forward Current (mA)	1000 mA
Peak Pulsed Forward Current (mA) ^[2]	1200 mA
Average Forward Current (mA)	1000 mA
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3B JESD22-A114-E
LED Junction Temperature ^[1]	150°C
Operating Case Temperature at 350 mA	-40°C - 135°C
Storage Temperature	-40°C - 135°C
Soldering Temperature	JEDEC 020c 260°C
Allowable Reflow Cycles	3
Autoclave Conditions	121°C at 2 ATM 100% Relative Humidity for 96 Hours Maximum
Reverse Voltage (V_r)	LUXEON Rebel ES LEDs are not designed to be driven in reverse bias



RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXML-PM01 GREEN

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 6°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.5 V

Measured LED Current = 569 mA

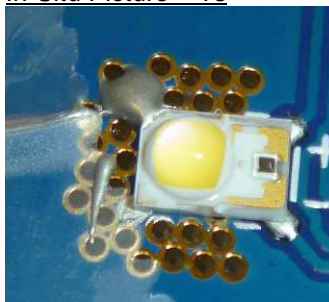
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 2.270W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 127°C

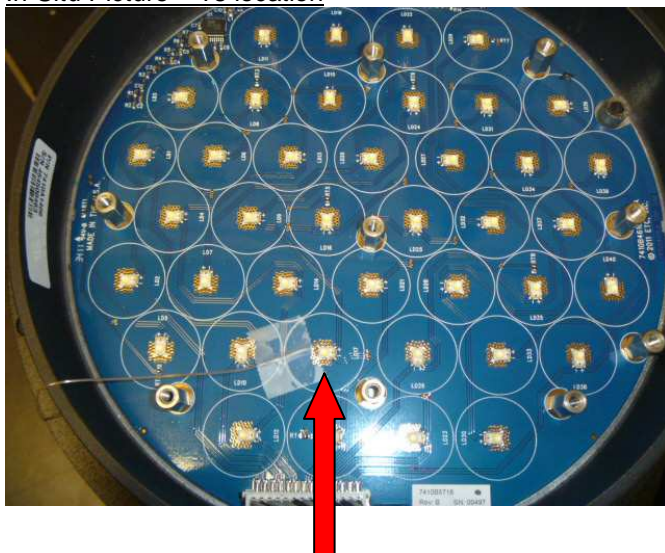
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-005	76.9	Per diagram above	127

In-Situ Picture – T_s



In-Situ Picture – T_s location





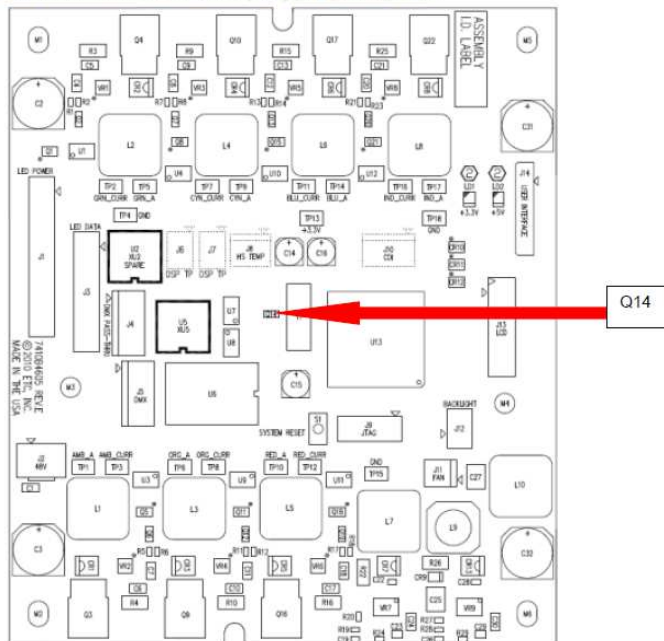
RESULTS OF TESTS (cont'd)

Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation:

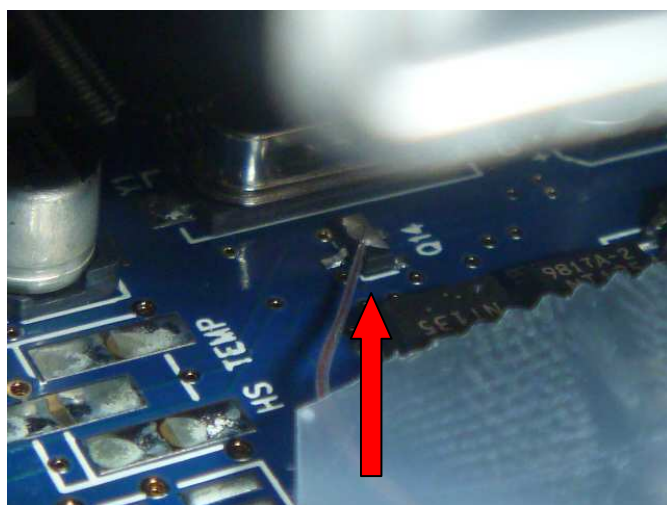
Driver identified as: Model No. 7410B4605

For the Desire control card, measure the temperature at Q14.



Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Measured Power Supply Case Temperature (°C)	Location	Maximum Power Supply Case Temperature (°C)
CRT1304251519-005	51.5	Q14	100





Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink, appearing to be "K R".

Kenda Branch
Engineer
Lighting Division

Attachment: None

Report Reviewed By:

A handwritten signature in black ink, appearing to be "Jacki Swiernik".

Jacki Swiernik
Staff Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: May 23, 2013

REPORT NO. 101158242CRT-003

TEST OF ONE LED WASH LIGHT

FIXTURE MODEL NO. D40 STUDIO TUNGSTEN

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

LABORATORY NOTE: The laboratory that conducted the testing detailed in this report has been Qualified, Verified, and Recognized for LM-79 Testing for ENERGY STAR for SSL by US DOE's CALiPER program.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79: 2008 Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products

ANSI ANSLG C38.377: 2012 Specifications of the Chromaticity of Solid State Lighting Products

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D40 STUDIO TUNGSTEN. The sample was received by Intertek on May 6, 2013, in undamaged condition, and one sample was tested as received. The sample designation was CRT1304251519-005.

DATES OF TESTS: May 15, 2013 through May 22, 2013

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

SUMMARY

Model No.:	D40 STUDIO TUNGSTEN
Description:	LED WASH LIGHT

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	4686	4804
Total Power (W)	100.9	100.5
Luminaire Efficacy (LPW)	46.44	47.79

Criteria	Result
Power Factor	0.994
Current ATHD (%)	2.20
Correlated Color Temperature (CCT - K)	3084
Color Rendering Index (CRI) – Ra	84.7
Color Rendering Index (CRI) - R9	20.6
Duv	0.001
Chromaticity Coordinate (x)	0.434
Chromaticity Coordinate (y)	0.408
Chromaticity Coordinate (u')	0.247
Chromaticity Coordinate (v')	0.522

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
LSI High Speed Mirror Goniometer	6440	---	05/20/13	06/20/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Extech Hygro Thermometer	445703	T1359	11/08/12	11/08/13
Fisher Scientific	---	N1132	04/22/13	04/22/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Yokogawa Power Analyzer	WT1600	E462	07/06/12	07/06/13
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temp Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	NA	NA	NA
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Sorensen DC Power Supply	DLM150-20E	N/A	N/A	N/A
FLUKE	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

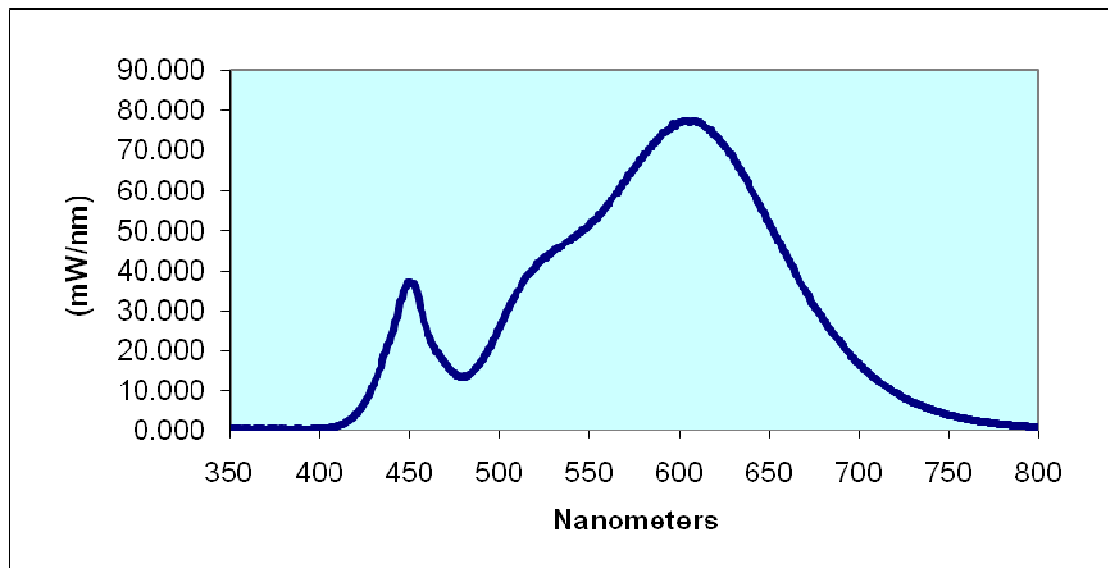
The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

RESULTS OF TESTS

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.613	460	24.656	570	62.168	680	27.746
355	0.540	465	19.763	575	65.265	685	24.639
360	0.575	470	16.752	580	68.504	690	21.708
365	0.537	475	14.300	585	71.499	695	18.967
370	0.473	480	13.597	590	73.537	700	16.724
375	0.552	485	14.674	595	75.372	705	14.544
380	0.484	490	17.153	600	76.998	710	12.674
385	0.476	495	20.848	605	77.249	715	11.038
390	0.436	500	25.822	610	76.932	720	9.491
395	0.465	505	30.501	615	75.764	725	8.208
400	0.552	510	34.836	620	73.899	730	6.997
405	0.708	515	38.210	625	71.450	735	6.094
410	1.168	520	40.794	630	68.095	740	5.240
415	2.213	525	43.184	635	64.178	745	4.561
420	4.027	530	44.886	640	60.295	750	3.898
425	7.035	535	46.139	645	56.188	755	3.354
430	11.514	540	47.539	650	51.960	760	2.913
435	17.344	545	49.374	655	47.432	765	0.000
440	23.766	550	51.262	660	43.176	770	2.194
445	31.978	555	53.728	665	39.061	775	1.871
450	37.046	560	56.355	670	35.250	780	1.619
455	32.782	565	59.122	675	31.294		

Sample No. CRT1304251519-005
Spectral Data Over Visible Wavelengths



RESULTS OF TESTS (cont'd)

Photometric and Electrical Measurements at 25°C – Integrating Sphere Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1304251519-005	UP	120.0	844.6	100.9	0.994	2.20	4686	46.44

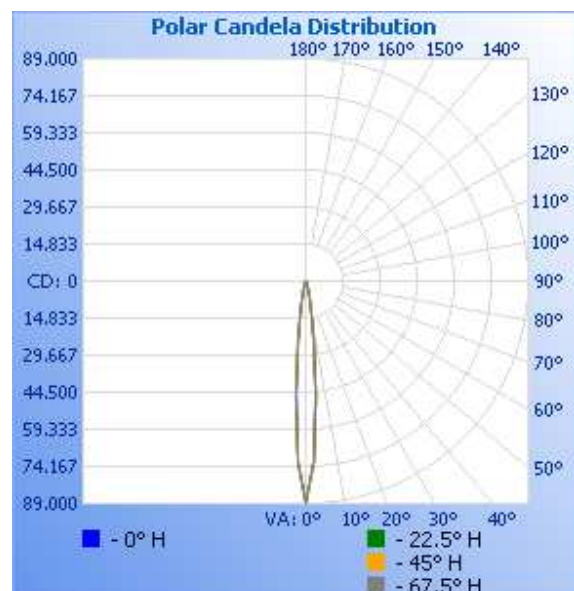
Intertek Sample No.	Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
CRT1304251519-005	3084	84.7	20.6	0.001	0.434	0.408	0.247	0.522

Photometric and Electrical Measurements – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1304251519-005	UP	120.0	841.2	100.5	0.996	4804	47.79

Intensity (Candlepower) Summary at 25°C - Candelas

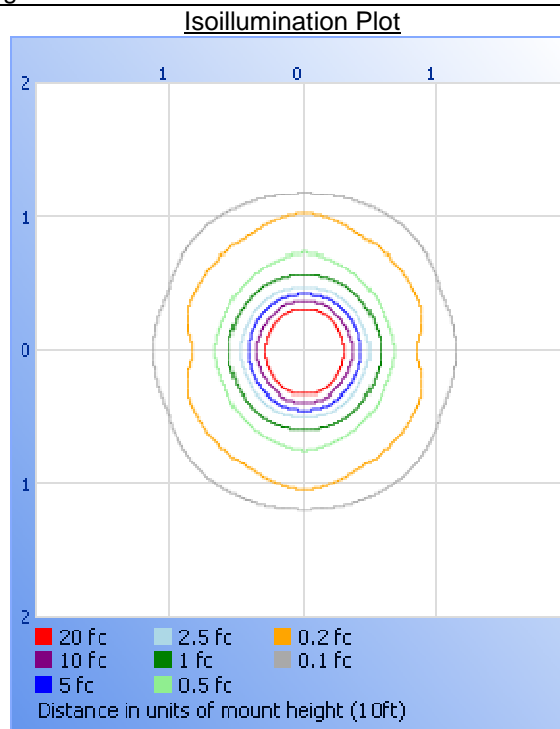
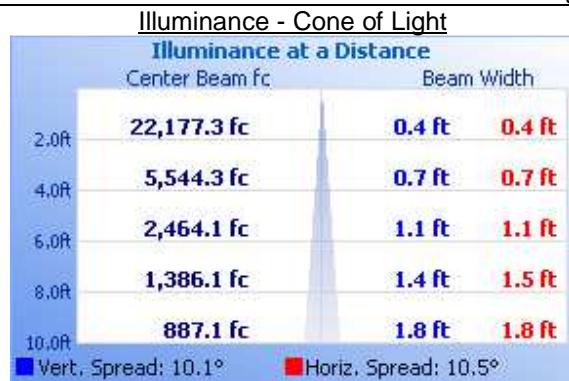
Angle	0	22.5	45	67.5	90
0	88709	88709	88709	88709	88709
5	44590	46050	46747	46158	46566
10	12391	12557	12791	12544	13110
15	4078	4168	3801	3156	3095
20	1421	1452	1231	1127	1161
25	416	426	413	386	405
30	152	160	153	133	133
35	102	95	78	66	76
40	87	67	64	57	43
45	68	51	46	40	35
50	36	39	36	33	30
55	15	16	21	18	13
60	2	5	5	6	4
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TESTS (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	4694	97.7
0-40	4750	98.9
0-60	4803	100.0
60-90	0.7	0.0
0-90	4804	100.0
90-180	0.0	0.0
0-180	4804	100.0



Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink, appearing to read "Kenda Branch".

Kenda Branch
Engineer
Lighting Division

Attachment: None

Report Reviewed By:

A handwritten signature in black ink, appearing to read "David Ellis".

David Ellis
Senior Project Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: December 6, 2013

REPORT NO. 101414036CRT-008

TEST OF ONE D40 DAYLIGHT LED FIXTURE ETL (BLK)

MODEL NO. D40 DAYLIGHT
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D40 DAYLIGHT. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-008.

DATES OF TESTS: November 21, 2013 through November 26, 2013

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SUMMARY

Model No.:	D40 DAYLIGHT
Description:	D40 DAYLIGHT LED FIXTURE ETL (BLK)

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	6008	6601
Total Power (W)	98.55	98.38
Luminaire Efficacy (LPW)	60.96	67.1

Criteria	Result
Power Factor	0.995
Current ATHD %	2.28
Correlated Color Temperature (CCT - K)	5758
Color Rendering Index (CRI - Ra)	72.6
Color Rendering Index (CRI - R9)	-5.2
DUV	0.004
Chromaticity Coordinate (x)	0.326
Chromaticity Coordinate (y)	0.345
Chromaticity Coordinate (u')	0.201
Chromaticity Coordinate (v')	0.479
Maximum In-Situ Source Temperature Point (°C)	73.6
Maximum In-Situ Driver Case Temperature (°C)	71.8

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Leeds & Northup Standard Resistor	Manganin	Y089	02/07/13	02/07/14
Data Precision Digital Voltmeter	3600	V124	02/07/13	02/07/14
Fluke Multimeter	45	M133	02/07/13	02/07/14
Kikusui DC Power Supply	35-10L	E160	---	---
Sorenson DC Power Supply	DLM150-20E	---	---	---
NIST Spectral Flux Standard Source	RF1024	---	09/18/10	100 hrs of use
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temp Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
Cole Parmer Thermometer	03313-85	T1469	05/31/13	05/31/14
LSI High Speed Mirror Goniometer	6440	---	11/21/13	12/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Cole Palmer Thermometer	03313-85	T1470	05/31/13	05/31/14
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Fluke Multimeter	87 V	D590	03/28/13	03/28/14
Fluke Temp Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

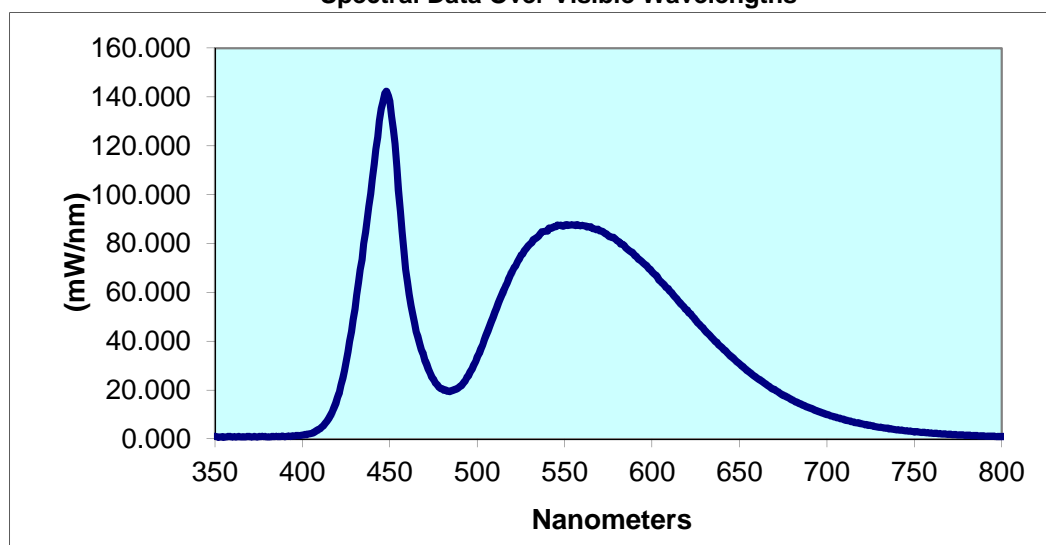
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-008	UP	120.0	825.2	98.55	0.995	2.28	6008	60.96

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
5758	72.6	-5.2	0.004	0.326	0.345	0.201	0.479

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	1.071	440	106.4	530	79.74	620	52.67	710	7.858
355	0.723	445	135.3	535	82.96	625	48.57	715	7.007
360	0.855	450	138	540	85.1	630	44.62	720	6.166
365	0.847	455	101.8	545	86.93	635	40.8	725	5.476
370	0.961	460	64.16	550	87.37	640	37.36	730	4.786
375	0.915	465	43.92	555	87.51	645	33.81	735	4.286
380	0.796	470	32.31	560	87.41	650	30.64	740	3.74
385	1.079	475	24.21	565	86.73	655	27.65	745	3.345
390	0.999	480	20.5	570	85.16	660	24.95	750	2.948
395	1.177	485	19.73	575	83.1	665	22.4	755	2.616
400	1.544	490	21.5	580	81.21	670	20.15	760	2.324
405	2.291	495	25.95	585	78.28	675	17.91	765	2.097
410	4.19	500	33.58	590	75.08	680	16	770	1.839
415	8.382	505	42.31	595	72.03	685	14.27	775	1.638
420	16.9	510	51.93	600	68.44	690	12.72	780	1.474
425	31.53	515	60.7	605	64.34	695	11.25		
430	53.22	520	68.52	610	60.55	700	10.02		
435	79.97	525	75.21	615	56.48	705	8.914		

Spectral Data Over Visible Wavelengths



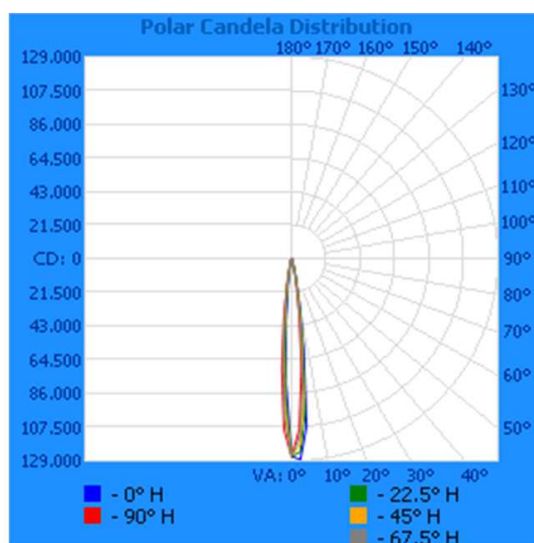
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-008	UP	120.0	822.9	98.38	0.996	6601	67.1

Intensity (Candlepower) Summary at 25°C - Candelas

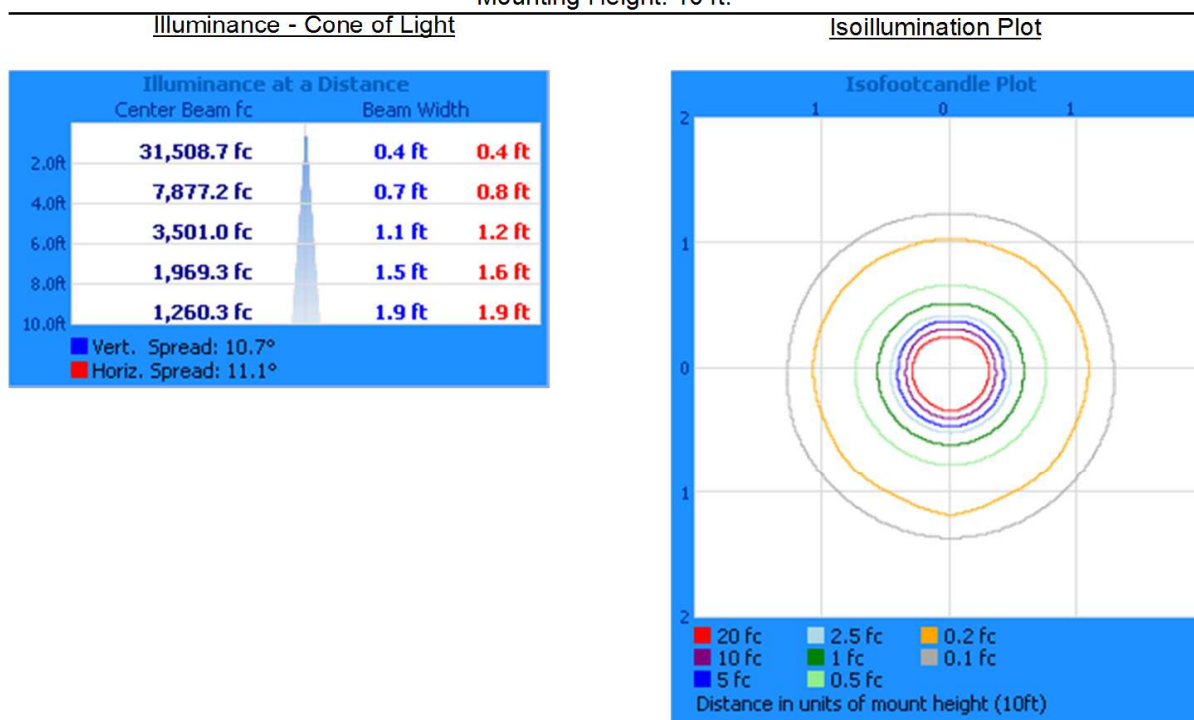
Angle	0	22.5	45	67.5	90
0	126035	126035	126035	126035	126035
5	107210	97890	88563	79279	70077
10	27377	24833	22320	19637	17043
15	6014	5277	4631	3953	3478
20	1586	1481	1348	1194	1053
25	580	526	459	404	344
30	184	175	164	159	149
35	119	111	110	108	104
40	80	88	83	82	88
45	70	74	70	66	72
50	74	63	59	55	51
55	40	38	37	32	29
60	14	16	12	9	7
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TEST (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	6454	97.8
0-40	6520	98.8
0-60	6600	100.0
60-90	1.3	0.0
0-90	6601	100.0
90-180	0.0	0.0
0-180	6601	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	4882	74.0
10-20	1367	20.7
20-30	205.4	3.1
30-40	65.1	1.0
40-50	51.9	0.8
50-60	28.0	0.4
60-70	1.3	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as: Luxeon Rebel A

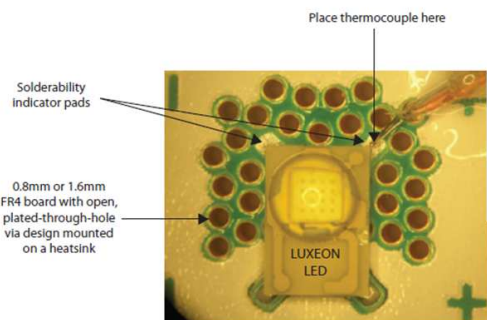


Figure 1. Solderability indicator pad and thermocouple placement.

Nominal ANSI CCT	Forward Voltage V_f ^[1] (V)		Typical Temperature Coefficient of Forward Voltage ^[2] $\Delta V_f / \Delta T_j$ (mV/°C)	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R_{\theta j-c}$
	Min.	Max.		
2700K	2.5	3.5	-1.8 to -2.4	6
3000K	2.5	3.5	-1.8 to -2.4	6
4000K	2.5	3.5	-1.8 to -2.4	6
5000K	2.5	3.5	-1.8 to -2.4	6

LED Junction Temperature ^[3]

150°C

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 6°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.5V

Measured LED Current = 580mA

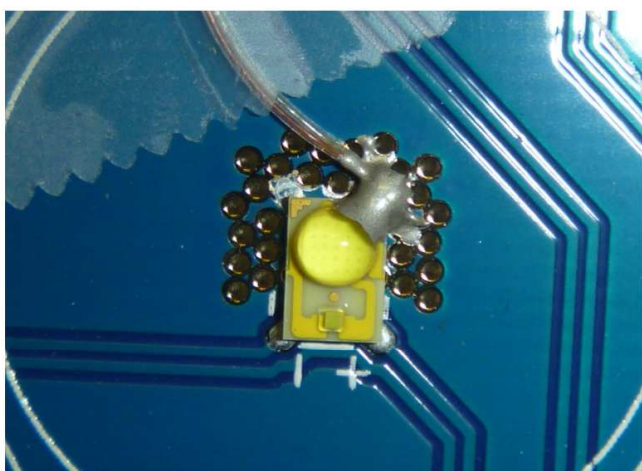
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 2.03W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 137.8°C

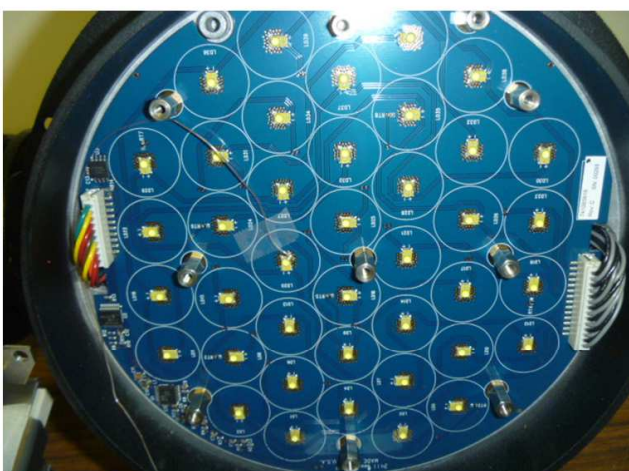
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature (°C)
CRT1311071604-008	73.6	Per diagram	137.8

In-Situ Picture – T_s



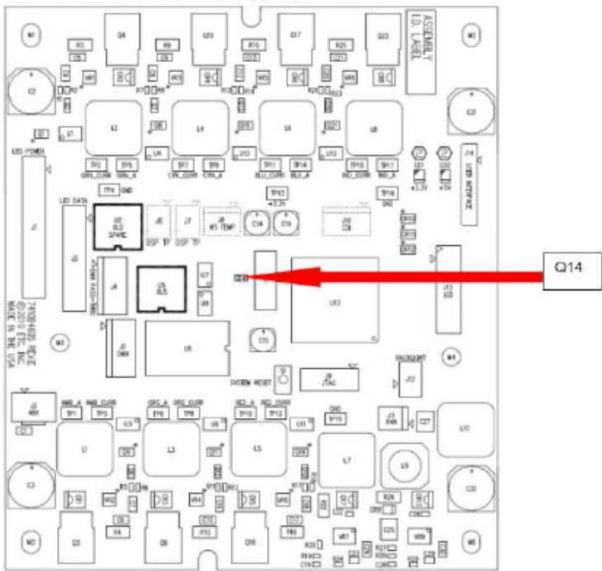
In-Situ Picture – T_s locator



RESULTS OF TEST (cont'd)

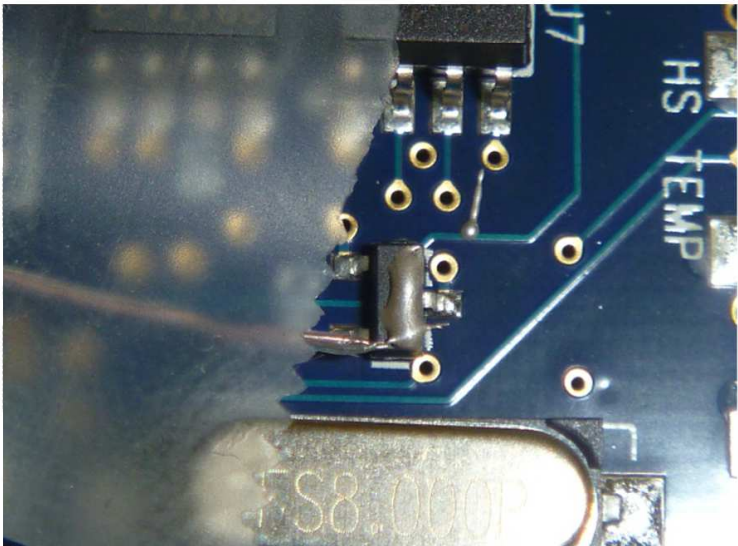
Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-008	47.0	Per diagram	100

Power Supply Picture – Tc location



PICTURE (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

Melanie Brittain

Melanie Brittain
Associate Engineer
Lighting Division

Attachment: None

Report Reviewed By:

Jeffrey Davis

Jeffrey Davis
Engineering Manager
Lighting Division

SECTION 4 - Desire D60

Lustr+

Vivid

Studio HD

Tungsten

Daylight



REPORT

545 E. ALGONQUIN ROAD ARLINGTON HEIGHTS, IL 60005

Project No. G101042629

Date: March 13, 2013

REPORT NO. 101042629CHI-001

IN-SITU TEST OF ONE LED STAGE LIGHT

FIXTURE MODEL NO. DESIRE D60
LED MODEL NO. PHILIPS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

AUTHORIZATION: The testing performed was authorized by signed quote number 500428354.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

Energy Star Version 1.1 (2008): Program Requirements for Solid-State Lighting Luminaires
Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one sample of model number Desire D60
The sample was received by Intertek on January 16, 2013, in undamaged condition, and one sample was tested as received. The sample designation was 01162013123956.

DATE OF TESTS: February 26, 2013 through March 5, 2013

SUMMARY

Model No.:	DESIRE D60
Description:	LED Stage and Theatre Lighting

Criteria	Result	
Maximum In-Situ Source Temperature Point - LEDG REBEL GRN 1812	59.0	Compliant
Maximum In -Situ Source Temperature Point - LEDC REBEL CYAN 1812	59.8	Compliant
Maximum In -Situ Source Temperature Point - LEDB REBEL BLUE 1812	58.4	Compliant
Maximum In -Situ Source Temperature Point - LEDI REBEL INDIGO 1812	65.0	Compliant
Maximum In -Situ Source Temperature Point - LEDA REBEL PC-AMBER 1812	57.5	Compliant
Maximum In -Situ Source Temperature Point - LEDW REBEL 4300K WHT binTO/TN 1812	57.3	Compliant
Maximum In -Situ Source Temperature Point - LEDR REBEL RED LOW Vf 1812	54.6	Compliant
Maximum Power Supply Case Temperature	57.0	Compliant

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
Agilent Data Logger	34970A	146764	2/21/13	2/21/14
Yokogawa Power Meter	WT230	146454	2/21/13	2/21/14
Newport Thermometer/Hygrometer	iTHX-SD	146959	2/21/13	2/21/14
Staco Variac	3PN1510B	146359	VBU	VBU
General, Wireless Weather Station	DBAR880	146558	7/23/12	7/23/13
Fluke IR Thermometer	561 HVACPRO	146578	VBU	VBU



TEST METHODS

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Agilent 34970A Data Logger. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

Estimated Total Operating Time

Model No.	Total Hours
Desire D60	33

RESULTS OF TESTS

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED identified as: Philips Luxeon Rebel

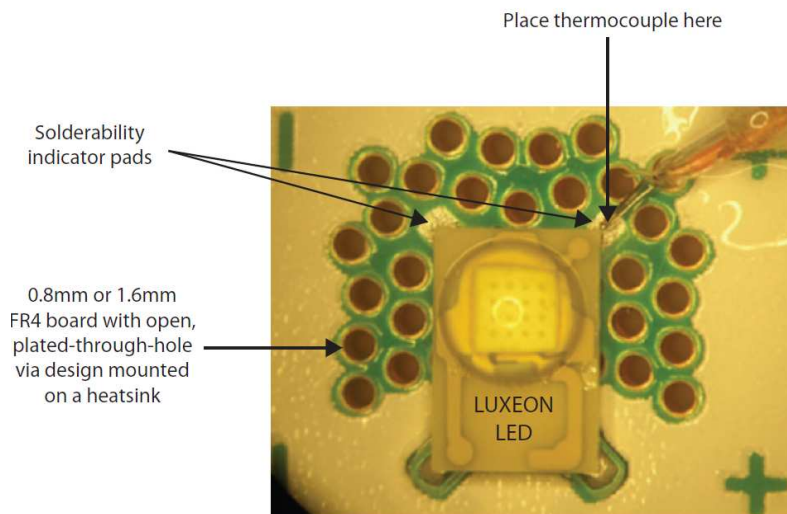


Figure 1. Solderability indicator pad and thermocouple placement.

CR9180-F	LEDG REBEL GRN 1812	PHILIPS LIGHTING	LXML-PM01-0090 (C-BIN 4)
CR9180-F	LEDG REBEL GRN 1812	PHILIPS LIGHTING	LXML-PM01-0090 (C-BIN 5)
CR9180-F	LEDG REBEL GRN 1812	PHILIPS LIGHTING	LXML-PM01-0090 (C-BIN 6)
CR9180-F	LEDG REBEL GRN 1812	PHILIPS LIGHTING	LXML-PM01-0090 (C-BIN 3)
CR9181-F	LEDC REBEL CYAN 1812	PHILIPS LIGHTING	LXML-PE01-0070 (C-BIN 1)
CR9181-F	LEDC REBEL CYAN 1812	PHILIPS LIGHTING	LXML-PE01-0070 (C-BIN 2)
CR9181-F	LEDC REBEL CYAN 1812	PHILIPS LIGHTING	LXML-PE01-0070 (C-BIN 3)
CR9182-F	LEDB REBEL BLUE 1812	PHILIPS LIGHTING	LXML-PB01-0030 (C-BIN 3)
CR9182-F	LEDB REBEL BLUE 1812	PHILIPS LIGHTING	LXML-PB01-0030 (C-BIN 4)
CR9182-F	LEDB REBEL BLUE 1812	PHILIPS LIGHTING	LXML-PB01-0030 (C-BIN 5)
CR9183-F	LEDI REBEL INDIGO 1812	PHILIPS LIGHTING	LXML-PR01-0350 (C-BIN 1)
CR9183-F	LEDI REBEL INDIGO 1812	PHILIPS LIGHTING	LXML-PR01-0350 (C-BIN 2)
CR9183-F	LEDI REBEL INDIGO 1812	PHILIPS LIGHTING	LXML-PR01-0350 (C-BIN 3)
CR9183-F	LEDI REBEL INDIGO 1812	PHILIPS LIGHTING	LXML-PR01-0350 (C-BIN 4)
CR9183-F	LEDI REBEL INDIGO 1812	PHILIPS LIGHTING	LXML-PR01-0425 (C-BIN 1)
CR9183-F	LEDI REBEL INDIGO 1812	PHILIPS LIGHTING	LXML-PR01-0425 (C-BIN 2)
CR9183-F	LEDI REBEL INDIGO 1812	PHILIPS LIGHTING	LXML-PR01-0425 (C-BIN 3)
CR9183-F	LEDI REBEL INDIGO 1812	PHILIPS LIGHTING	LXML-PR01-0425 (C-BIN 4)
CR9184-F	LEDA REBEL PC-AMBER 1812	PHILIPS LIGHTING	LXM2-PL01-0000
CR9197-F	LEDW REBEL 4300K WHT binTO/TN 1812	PHILIPS LIGHTING	LXML-PWN1-0100 (C-BIN TO)
CR9197-F	LEDW REBEL 4300K WHT binTO/TN 1812	PHILIPS LIGHTING	LXML-PWN1-0100 (C-BIN TN)
CR9214-F	LEDR REBEL RED LOW Vf 1812	PHILIPS LIGHTING	LXM2-PD01-0050-2000RL(T/R)(C-BIN4)

RESULTS OF TESTS (cont'd)

Manufacturer Supplied Documentation:

Electrical Characteristics at 350 mA for LUXEON Rebel color, Thermal Pad Temperature = 25°C

Table 3.

Color	Part Number	Forward Voltage V_f ^[1] (V)			Typical Temperature Coefficient of Forward Voltage ^[2] (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R\theta_{JC}$
		Min.	Typ.	Max.		
Green	LXML-PM01	2.55	2.90	3.51	- 2.0 to - 4.0	10
Cyan	LXML-PE01	2.55	2.90	3.51	- 2.0 to - 4.0	10
Blue	LXML-PB01	2.55	2.95	3.51	- 2.0 to - 4.0	10
Royal-Blue	LXML-PR01	2.55	2.95	3.51	- 2.0 to - 4.0	10
Red	LXML-PD01	2.31	2.90	3.51	- 2.0 to - 4.0	12
Red	LXM2-PD01	1.80	2.10	2.80	- 2.0 to - 4.0	8
Deep Red	LXM3-PD01	1.80	2.10	2.80	- 2.0 to - 4.0	8
Red-Orange	LXML-PH01	2.31	2.90	3.51	- 2.0 to - 4.0	12
Red-Orange	LXM2-PH01	1.80	2.10	2.80	- 2.0 to - 4.0	8
PC Amber	LXM2-PL01	2.55	3.05	3.51	- 2.0 to - 4.0	10
Amber	LXML-PL01	2.31	2.90	3.51	- 2.0 to - 4.0	12

Absolute Maximum Ratings

Table 5.

Parameter	Green/Cyan/ Blue/Royal Blue	LUXEON Rebel ES Royal Blue/ES Blue	Red/Deep-Red Red-Orange/Amber	PC Amber
DC Forward Current (mA)	1000	1000	700	700
Peak Pulsed Forward Current (mA)	1000	1200	700	700
Average Forward Current (mA)	1000	1000	700	700
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3A JESD22-A114-B			
LED Junction Temperature ^[1]	150°C	150°C	135°C	130°C

Table 11. Applicable for LXML-PXXI and LXM2-PL01 (PC Amber) emitters.

V _f Bins		
Bin Code	Minimum Forward Voltage (V)	Maximum Forward Voltage (V)
A	2.31	2.55
B	2.55	2.79
C	2.79	3.03
D	3.03	3.27
E	3.27	3.51

Table 12. Applicable for LXML-PR02-XXXX (ES Royal Blue) and LXML-PB02-XXXX (ES Blue) emitters tested at 700 mA.

Bin Code	Minimum Forward Voltage (V)	Maximum Forward Voltage (V)
P	2.50	2.75
R	2.75	3.00
S	3.00	3.25
T	3.25	3.50

Table 13. Applicable for LXM2-PXXI (Red and Red Orange) and LXM3-PD01 (Deep Red) emitters tested at 350 mA.

Bin Code	Minimum Forward Voltage (V)	Maximum Forward Voltage (V)
V	1.80	2.00
W	2.00	2.20
X	2.20	2.40
Y	2.40	2.60
Z	2.60	2.80

RESULTS OF TESTS (cont'd)

LED Identified as Philips Luxeon LEDG Rebel GRN 1812 LXML-PM01-0090

In-Situ Maximum Measured LED Source Temperature

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10 °C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51

Measured LED Current = 458.0 mA

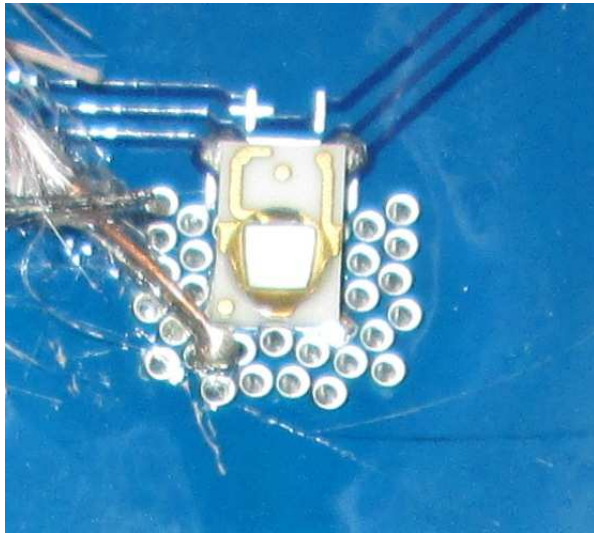
Calculated LED Wattage = $V_f \times$ Measured LED Current = 1.607

Maximum Source Temperature (T_s) = 134 C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013123956	Philips Luxeon LEDG Rebel GRN 1812 LXML-PM01-0090	59.0	Per diagram above	134

In-Situ Picture – T_s point



In-Situ Picture – Array location



RESULTS OF TESTS (cont'd)

LED Identified as Philips Luxeon LEDC REBEL CYAN 1812 LXML-PE01-0070

In-Situ Maximum Measured LED Source Temperature

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10 °C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51

Measured LED Current = 479.0 mA

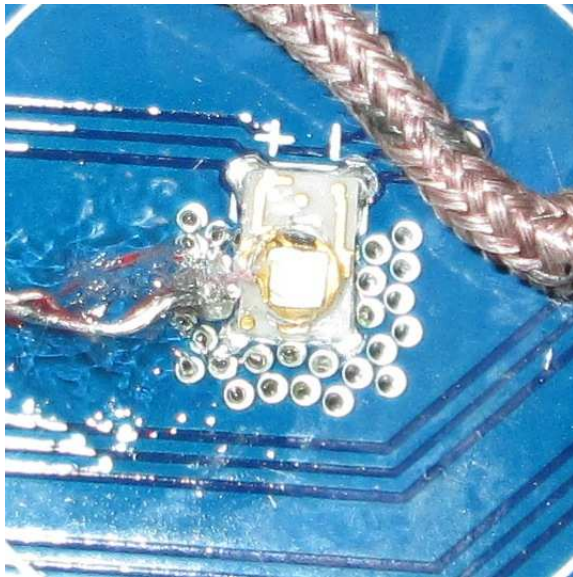
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.680

Maximum Source Temperature (T_s) = 133 C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013123956	Philips Luxeon LEDC REBEL CYAN 1812 LXML-PE01-0070	59.8	Per diagram above	133

In-Situ Picture – T_s point



In-Situ Picture – Array location



Location of measured T_c point.

RESULTS OF TESTS (cont'd)

LED Identified as Philips Luxeon LEDB REBEL BLUE 1812 LXML-PB01-0030

In-Situ Maximum Measured LED Source Temperature

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10 °C/W

Maximum Forward Voltage (V_f) from LED specification = 3.5

Measured LED Current = 480.0 mA

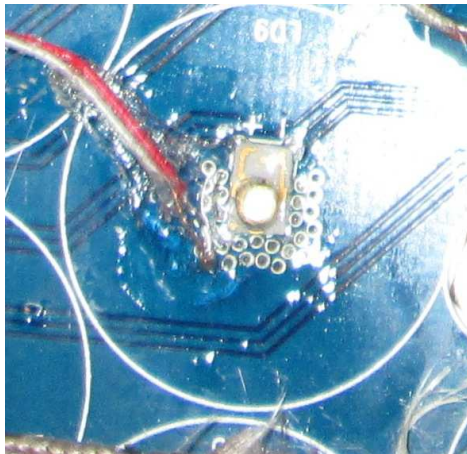
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.685

Maximum Source Temperature (T_s) = 133 C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013123956	Philips Luxeon LEDB REBEL BLUE 1812 LXML-PB01-0030	58.4	Per diagram above	133

In-Situ Picture – T_s point



In-Situ Picture – Array location



Location of measured T_c point.

RESULTS OF TESTS (cont'd)

LED Identified as Philips Luxeon LEDI REBEL INDIGO 1812 LXML-PR01-0350

In-Situ Maximum Measured LED Source Temperature

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10 °C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51

Measured LED Current = 485.0 mA

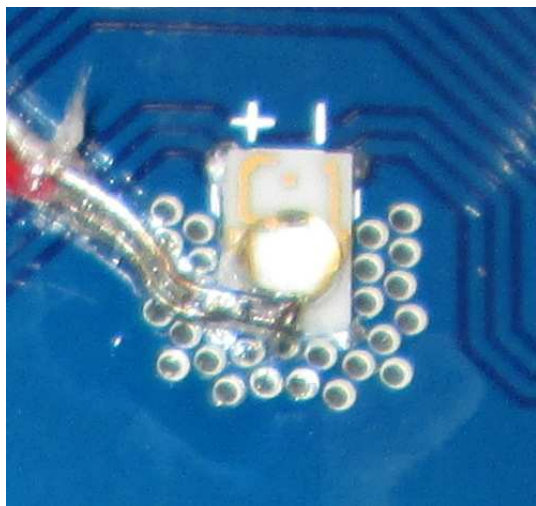
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.703

Maximum Source Temperature (T_s) = 133 C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013123956	Philips Luxeon LEDI REBEL INDIGO 1812 LXML-PR01-0350	65.0	Per diagram above	133

In-Situ Picture – T_s point



In-Situ Picture – Array location



Location of measured T_c point.

RESULTS OF TESTS (cont'd)

LED Identified as Philips Luxeon LEDA REBEL PC-AMBER 1812 LXM2-PL01-0000

In-Situ Maximum Measured LED Source Temperature

Maximum Junction Temperature from LED specification (T_j) = 130°C

Thermal Resistance Formula from LED specification = 10 °C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51

Measured LED Current = 442.0 mA

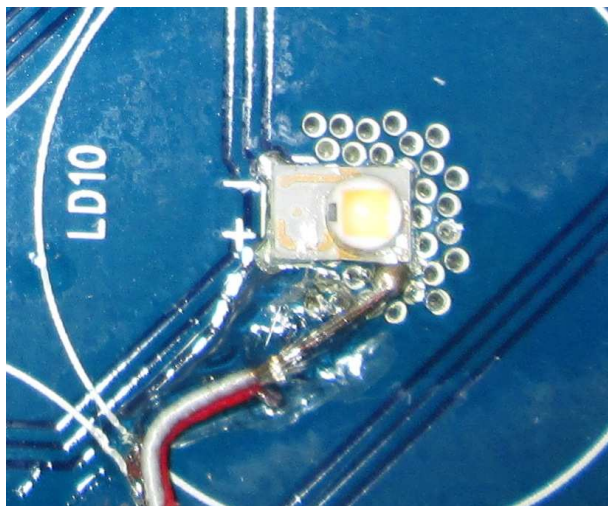
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.550

Maximum Source Temperature (T_s) = 114 C°

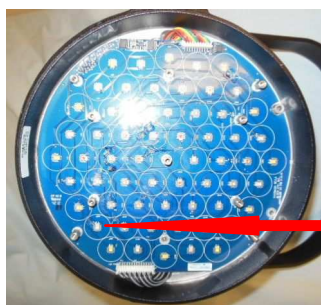
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013123956	Philips Luxeon LEDA REBEL PC-AMBER 1812 LXM2-PL01- 0000	57.5	Per diagram above	114

In-Situ Picture – T_s point



In-Situ Picture – Array location



Location of measured T_c point.

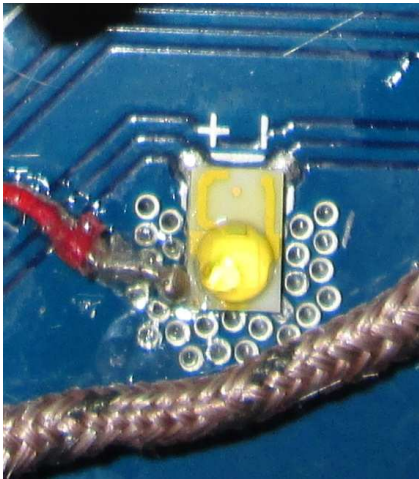
RESULTS OF TESTS (cont'd)
 LED Identified as Philips Luxeon LEDW REBEL 4300K WHT binTO/TN 1812 LXML-PWN1-0100

In-Situ Maximum Measured LED Source Temperature
 Maximum Junction Temperature from LED specification (Tj) = 150°C
 Thermal Resistance Formula from LED specification = 10 °C/W
 Maximum Forward Voltage (Vf) from LED specification = 3.99
 Measured LED Current = 468.0 mA
 Calculated LED Wattage = Vf x Measured LED Current = 1.868
 Maximum Source Temperature (Ts) = 131 C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013123956	Philips Luxeon LEDW REBEL 4300K WHT binTO/TN 1812 LXML-PWN1-0100	57.3	Per diagram above	131

In-Situ Picture – Ts point



In-Situ Picture – Array location



Location of measured Tc point.

RESULTS OF TESTS (cont'd)

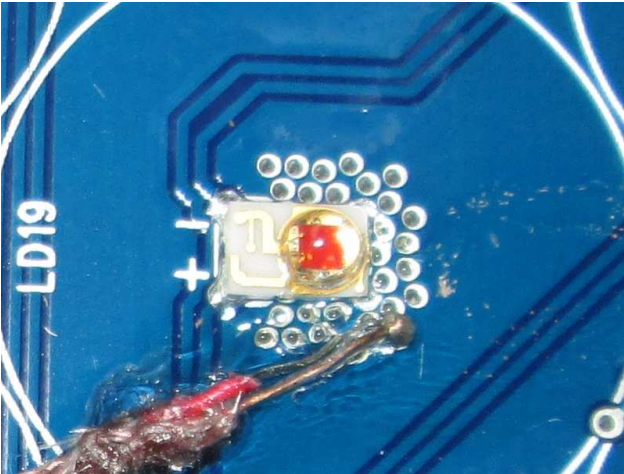
LED Identified as Philips Luxeon LEDR REBEL RED LOW Vf 1812 LXM2-PD01-0050-2000RL(T/R)

In-Situ Maximum Measured LED Source Temperature
Maximum Junction Temperature from LED specification (Tj) = 135°C
Thermal Resistance Formula from LED specification = 8 °C/W
Maximum Forward Voltage (Vf) from LED specification = 2.8Vdc
Measured LED Current = 401.0 mA
Calculated LED Wattage = Vf x Measured LED Current = 1.122
Maximum Source Temperature (Ts) = 126 C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013123956	Philips Luxeon LEDR REBEL RED LOW Vf 1812 LXM2-PD01- 0050-2000RL(T/R)	54.6	Per diagram above	126

In-Situ Picture – Ts point



In-Situ Picture – Array location



Location of measured Tc point.

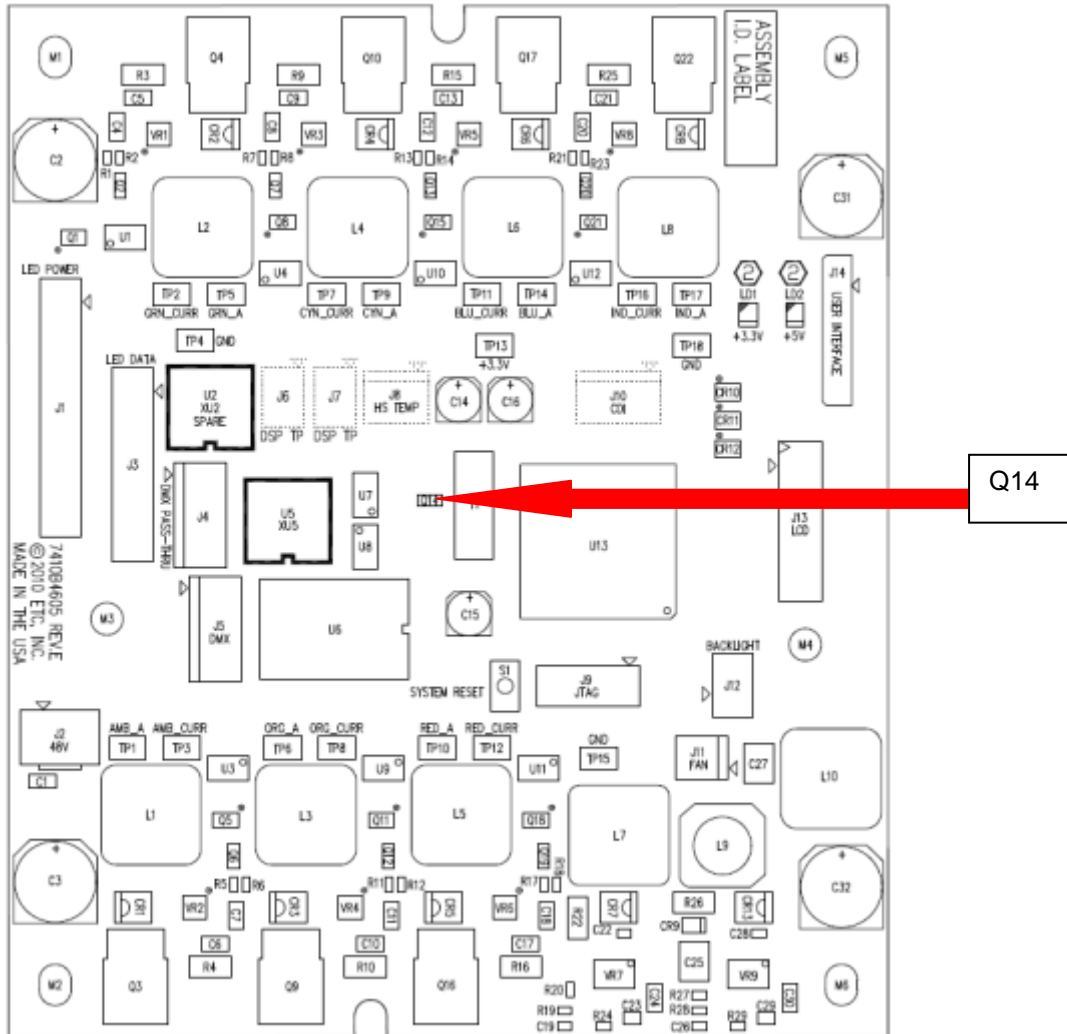
RESULTS OF TESTS (cont'd)

Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation:

Driver identified as: Model No. 7410B4605

For the Desire control card, measure the temperature at Q14.

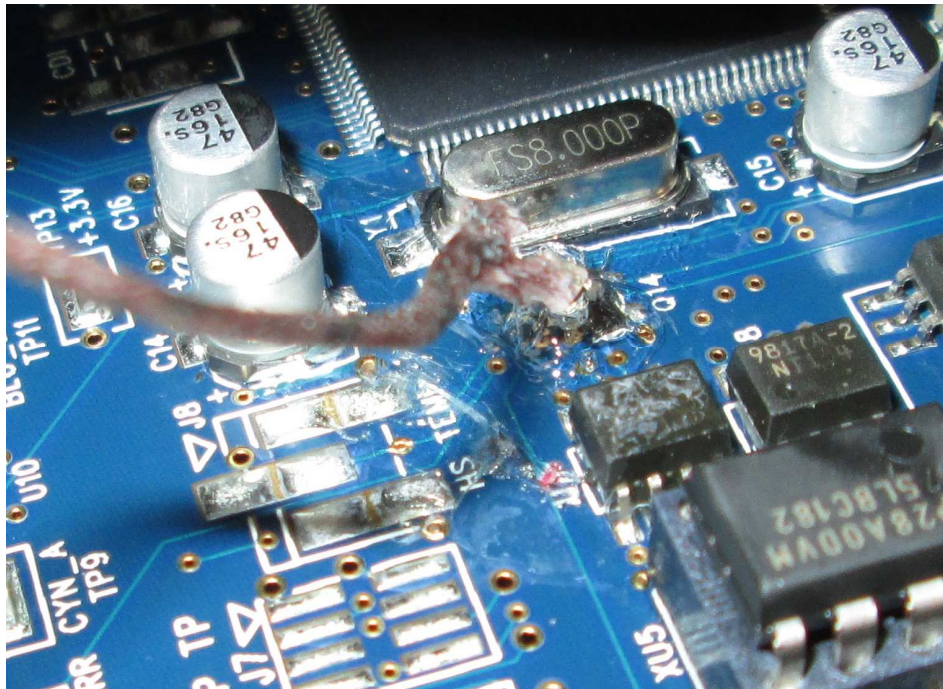


Measured Power Supply Case Temperature

Sample No.	Model No.	Measured Power Supply Case Temperature (C°)	Location	Maximum Power Supply Case Temperature (C°)
01162013123956	7410B4605	57.0	Q14	100

RESULTS OF TESTS (cont'd)

Power Supply Picture



Pictures (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

Tim Quigley

Tim Quigley
Engineer
Lighting Division

Attachment: None

Report Reviewed By:

Jacki Swiernik

Jacki Swiernik
Staff Engineer
Lighting Division



REPORT

545 EAST ALGONQUIN ROAD ARLINGTON HEIGHTS, IL 60005

Project No. G101042610

Date: March 5, 2013

REPORT NO. 101042610CHI-001

TEST OF ONE LED STAGE LUMINAIRE

FIXTURE MODEL NO. DESIRE D60
LED MODEL NO. PHILIPS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500428350.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79: 2008 Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products

ANSI ANSLG C38.377: 2012 Specifications of the Chromaticity of Solid State Lighting Products

DESCRIPTION OF SAMPLE: The client submitted one prototype sample of model number Desire D60. The sample was received by Intertek on January 16, 2013, in undamaged condition, and one sample was tested as received. The sample designation was 01162013123956

DATES OF TESTS: February 13, 2013 through February 16, 2013

SUMMARY

Model No.:	Desire D60
Description:	LED Stage and Theatre Luminaire

Criteria	Sphere	Goniometer
Total Lumen Output (Lumens)	3469	3282
Total Power (W)	88.23	89.18
Luminaire Efficacy (LPW)	39.32	36.80

Criteria	Result
Power Factor – 120VAC	0.995
Power Factor – 240VAC	0.923
Current ATHD – 120VAC	2.31%
Current ATHD – 240VAC	7.32%
Correlated Color Temperature (CCT)	6579K
Color Rendering Index (CRI) - Ra	66.8
Color Rendering Index (CRI) - R9	-49.4
Duv	0.028
Chromaticity Coordinate (x)	0.319
Chromaticity Coordinate (y)	0.280
Chromaticity Coordinate (u')	0.223
Chromaticity Coordinate (v')	0.440

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
Yokogawa Power Meter	WT210	146919	12/21/12	12/21/13
Omega Thermometer	DPI8-C24	146920	11/15/12	11/15/13
LSI High Speed Mirror Goniometer	6440T	146928	VBU	VBU
Newport Hygrometer	iServer	146961	2/23/12	2/23/13
Elgar, AC Power Supply	CW1251P	146918	VBU	VBU
Cole-Parmer Triple Timer	94440-00	CHI0041	7/19/12	7/19/13
Labsphere Spectroradiometer	CDS1100	CHI0091	VBU	VBU
3 Meter Sphere	SPR600	CHI0088	VBU	VBU
Elgar AC Power Supply	CW1251M	146112	VBU	VBU
Sorenson DC Power Supply	XFR150-8	146846	4/20/12	4/20/13
Newport Temperature and Humidity Recorder	iTHX-SD	146958	2/23/12	2/23/13
Yokogawa Power Meter	WT1600	146769	5/18/12	5/18/13
Omega Temperature Meter	MDSi8	146139	7/19/12	7/19/13



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Three Meter Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Estimated Total Operating Time

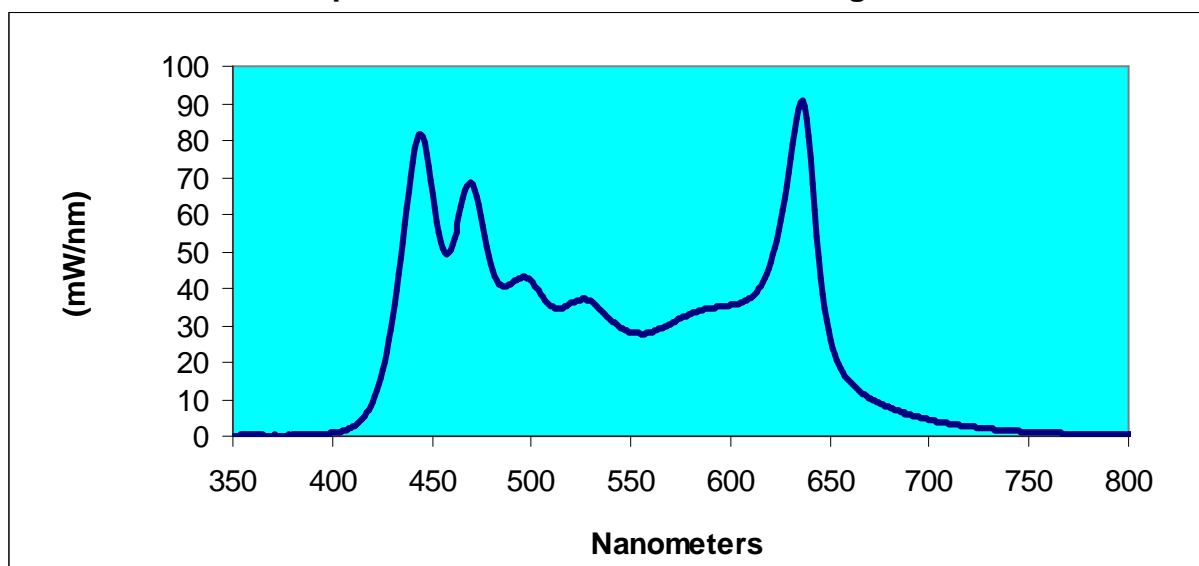
Model No.	Total Hours
Desire D60	4

RESULTS OF TESTS

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.27	460	51.79	570	30.52	680	7.69
355	0.28	465	62.19	575	31.90	685	6.72
360	0.31	470	68.56	580	33.17	690	5.88
365	0.28	475	59.63	585	34.14	695	5.15
370	0.27	480	46.55	590	34.75	700	4.51
375	0.27	485	40.97	595	35.09	705	3.96
380	0.28	490	41.33	600	35.45	710	3.47
385	0.29	495	42.90	605	36.07	715	3.03
390	0.38	500	42.15	610	37.52	720	2.66
395	0.57	505	38.51	615	40.77	725	2.34
400	0.88	510	35.18	620	47.08	730	2.05
405	1.47	515	34.66	625	58.19	735	1.79
410	2.60	520	36.00	630	74.98	740	1.58
415	4.77	525	36.94	635	90.47	745	1.39
420	9.29	530	36.50	640	74.91	750	1.23
425	18.02	535	34.26	645	42.95	755	1.08
430	32.19	540	31.52	650	25.93	760	0.97
435	52.49	545	29.34	655	18.34	765	0.85
440	74.31	550	28.16	660	14.35	770	0.74
445	81.25	555	27.82	665	11.93	775	0.66
450	65.27	560	28.18	670	10.15	780	0.59
455	50.83	565	29.16	675	8.81		

Sample No. 01162013123956
Spectral Data Over Visible Wavelengths



RESULTS OF TESTS (cont'd)

Photometric and Electrical Measurements at 25°C – Integrating Sphere Method

Intertek Sample No.	Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
01162013123956	6579	66.8	-49.4	0.028	0.319	0.280	0.223	0.440

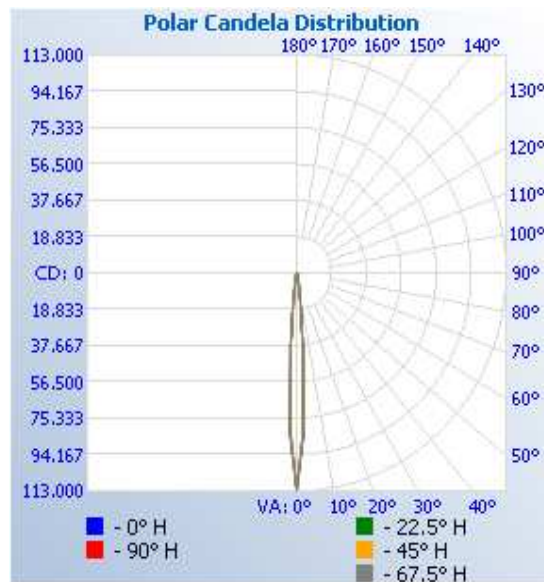
Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
01162013123956	Up	120.0	739.0	88.23	0.995	2.31	3469	39.32
		240.0			0.923	7.32		

Photometric and Electrical Measurements – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
01162013123956	Up	120.0	747.1	89.18	0.995	3282	36.80

Intensity (Candlepower) Summary at 25°C - Candelas

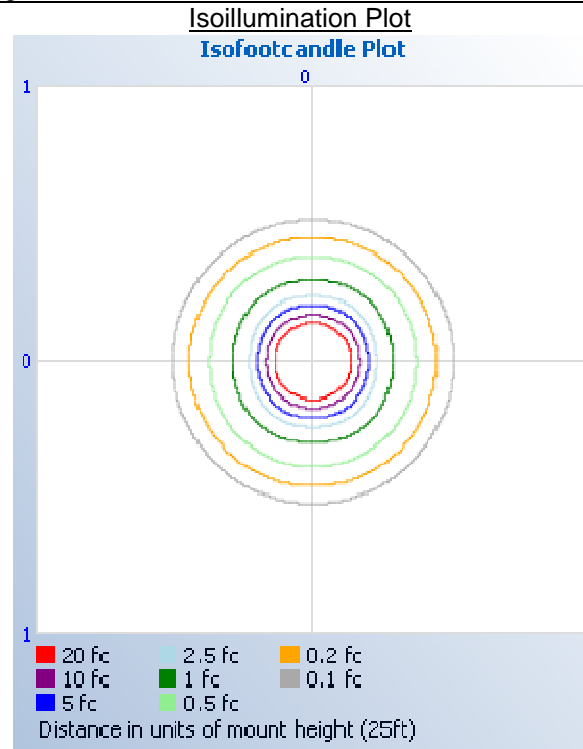
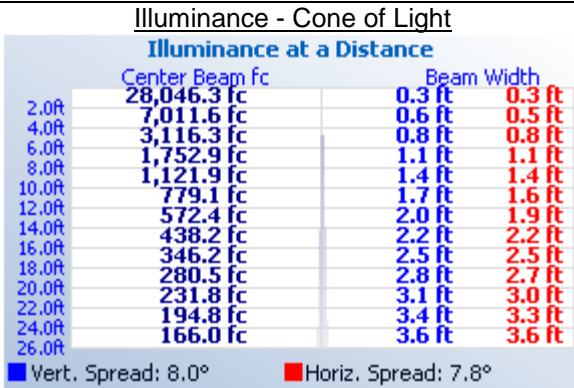
Angle	0	22.5	45	67.5	90
0	112185	112185	112185	112185	112185
5	37445	37203	37458	37022	36767
10	5525	5771	5751	5395	5182
15	904	996	1001	869	839
20	446	459	456	442	427
25	130	132	126	123	123
30	71	68	66	66	66
35	55	55	51	50	53
40	50	42	49	46	39
45	50	42	45	44	39
50	46	46	39	42	43
55	39	32	35	37	33
60	26	22	27	27	22
65	16	13	14	14	13
70	7	7	7	7	6
75	3	3	3	3	3
80	1	1	1	1	1
85	1	0	0	1	0
90	1	0	1	0	0



RESULTS OF TESTS (cont'd)

Illumination Plots

Mounting Height: 25 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	3165	96.4
0-40	3198	97.5
0-60	3264	99.4
60-90	18.4	0.6
0-90	3282	100.0
90-180	0.0	0.0
0-180	3282	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	2679	81.6
10-20	406.4	12.4
20-30	79.8	2.4
30-40	33.3	1.0
40-50	34.1	1.0
50-60	31.1	0.9
60-70	14.4	0.4
70-80	3.5	0.1
80-90	0.6	0.0

Pictures (not to scale)



Luminaire mounted on goniophotometer.

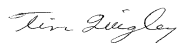


LED pattern on luminaire

CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

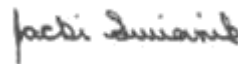
In Charge Of Tests:



Tim Quigley
Engineer
Lighting Division

Attachment: None

Report Reviewed By:



Jacki Swiernik
Staff Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: November 20 , 2013

REPORT NO. 101414036CRT-012

TEST OF ONE D60 VIVID LED FIXTURE ETL (BLK)

MODEL NO. D60 VIVID
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D60 VIVID. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-012.

DATES OF TESTS: November 13, 2013 through November 19, 2

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

SUMMARY

Model No.:	D60 VIVID
Description:	D60 VIVID LED FIXTURE ETL (BLK)

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	4340	3925
Total Power (W)	127.0	126.8
Luminaire Efficacy (LPW)	34.17	30.95

Criteria	Result
Power Factor	0.991
Current ATHD %	2.45
Correlated Color Temperature (CCT - K)	3467
Color Rendering Index (CRI - Ra)	29.1
Color Rendering Index (CRI - R9)	-85.7
DUV	0.062
Chromaticity Coordinate (x)	0.355
Chromaticity Coordinate (y)	0.256
Chromaticity Coordinate (u')	0.266
Chromaticity Coordinate (v')	0.429
Maximum In-Situ Source Temperature Point (°C)	76.4
Maximum In-Situ Driver Case Temperature (°C)	60.5

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	---	---
COLE PARMER-Thermometer	03313-85	T1469	05/31/13	05/31/14
Sorensen DC Power Supply	DLM150-20E	---	---	---
Data Precision	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14
LSI High Speed Mirror Goniometer	6440	---	10/21/13	11/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Cole Palmer Thermometer	03313-85	T1470	05/31/13	05/31/14
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Extech Hygro-Thermometer	445703	T1355	11/26/12	11/26/13
Fluke Multimeter	87 V	D590	03/28/13	03/28/14
Fluke Temperature Meter	53 II	D588	03/15/13	03/15/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

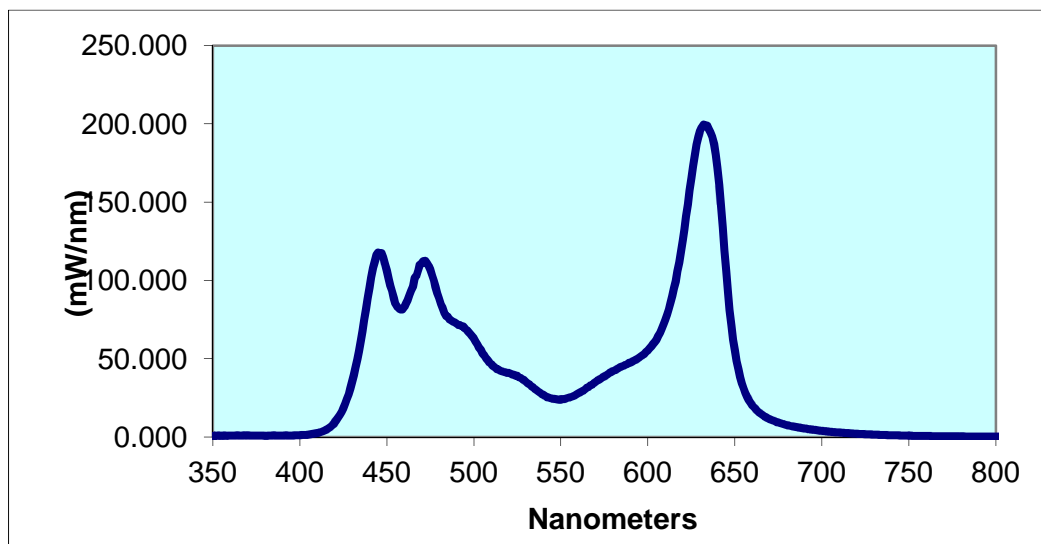
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-012	UP	120.0	1066	127.0	0.991	2.45	4340	34.17

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
3467	29.1	-85.7	0.062	0.355	0.256	0.266	0.429

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.689	440	95.24	530	35.34	620	125.5	710	2.86
355	0.817	445	117.9	535	30.7	625	165.5	715	2.45
360	0.989	450	106.3	540	26.77	630	195.6	720	2.114
365	0.848	455	85.12	545	24.46	635	196.8	725	1.789
370	1.032	460	83.02	550	24.05	640	172.2	730	1.508
375	0.917	465	96.06	555	25.22	645	105.6	735	1.338
380	0.727	470	110.8	560	27.9	650	55	740	1.108
385	1.037	475	107	565	31.47	655	31.08	745	0.959
390	0.904	480	88.79	570	35.18	660	20.18	750	0.878
395	0.983	485	76.75	575	38.65	665	14.7	755	0.733
400	1.096	490	72.51	580	42.15	670	11.41	760	0.653
405	1.53	495	69.11	585	44.99	675	9.199	765	0.579
410	2.471	500	63.06	590	47.54	680	7.539	770	0.476
415	4.503	505	53.41	595	50.77	685	6.418	775	0.438
420	9.268	510	46.61	600	55.3	690	5.441	780	0.398
425	18.35	515	42.46	605	62.28	695	4.644		
430	34.78	520	40.89	610	74.64	700	3.905		
435	61.55	525	39.04	615	94.74	705	3.346		

Spectral Data Over Visible Wavelengths



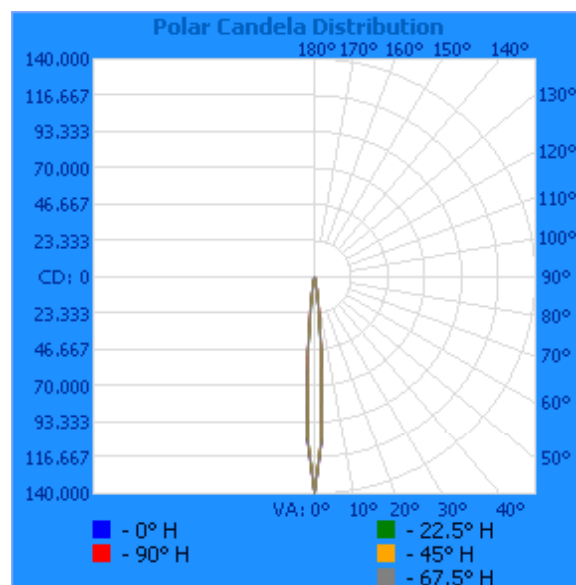
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-012	UP	120.1	1065	126.8	0.992	3925	30.95

Intensity (Candlepower) Summary at 25°C - Candelas

Angle	0	22.5	45	67.5	90
0	139057	139057	139057	139057	139057
5	47995	46665	47174	47980	51173
10	6827	6902	7162	7107	7364
15	944	1034	1083	957	924
20	341	376	400	376	337
25	9	17	21	28	24
30	0	0	0	0	0
35	0	0	0	0	0
40	0	0	0	0	0
45	0	0	0	0	0
50	0	0	0	0	0
55	0	0	0	0	0
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

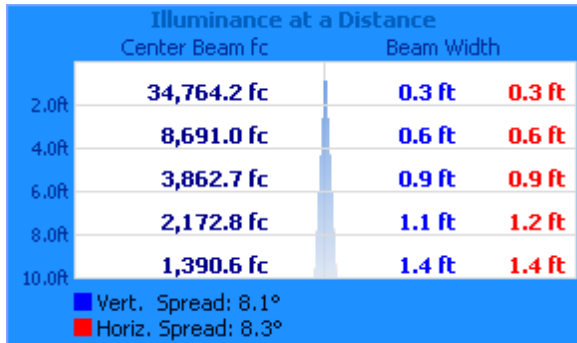


RESULTS OF TEST (cont'd)

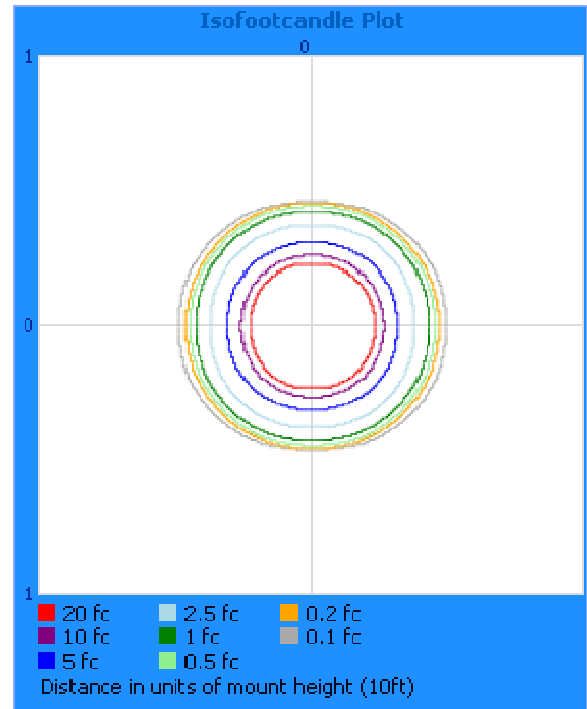
Illumination Plots

Mounting Height: 10 ft.

Illuminance - Cone of Light



Isoillumination Plot



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	3925	100.0
0-40	3925	100.0
0-60	3925	100.0
60-90	0.0	0.0
0-90	3925	100.0
90-180	0.0	0.0
0-180	3925	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	3421	87.2
10-20	464.5	11.8
20-30	39.5	1.0
30-40	0.0	0.0
40-50	0.0	0.0
50-60	0.0	0.0
60-70	0.0	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as:

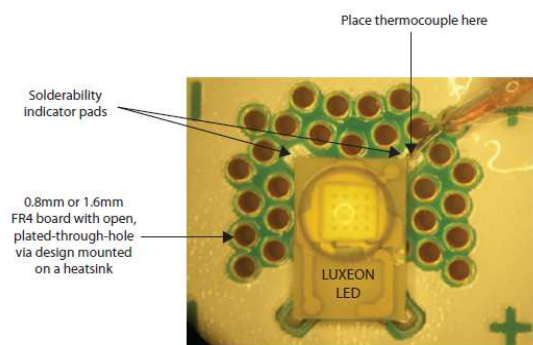


Figure 1. Solderability indicator pad and thermocouple placement.

Forward Voltage V_f ^[1]			Typical Temperature Coefficient of Forward Voltage ^[2] $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad $R\theta_{jc}$ ($^{\circ}\text{C}/\text{W}$)
Min.	Typ.	Max.		
2.55	2.90	3.51	- 2.0 to - 4.0	10
LED Junction Temperature ^[3]				150 $^{\circ}\text{C}$

Green LXML-PM01

Maximum Junction Temperature from LED specification (T_j) = 150 $^{\circ}\text{C}$

Thermal Resistance Formula from LED specification = 10 $^{\circ}\text{C}/\text{W}$

Maximum Forward Voltage (V_f) from LED specification = 3.51V

Measured LED Current = 545mA

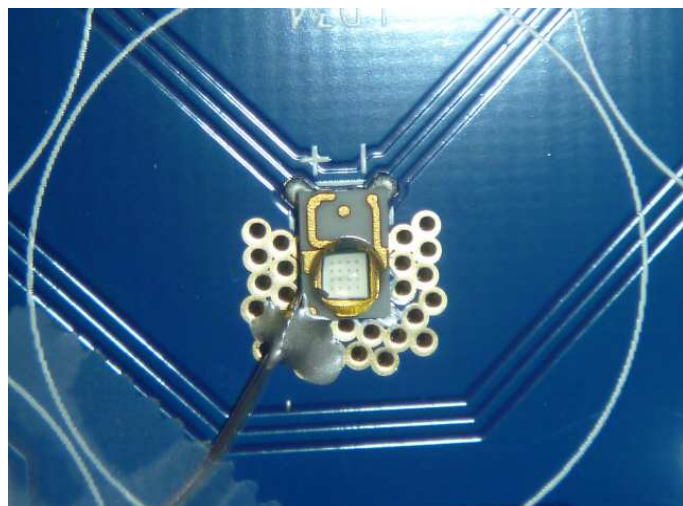
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.913W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 130.9 $^{\circ}\text{C}$

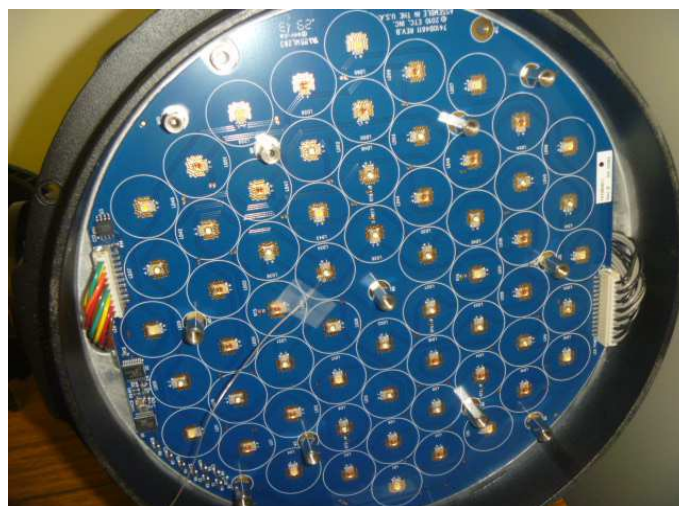
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature ($^{\circ}\text{C}$)	Location	Maximum Rated Source Temperature ($^{\circ}\text{C}$)
CRT1311071604-012	76.4	Per diagram	130.9

In-Situ Picture – T_s



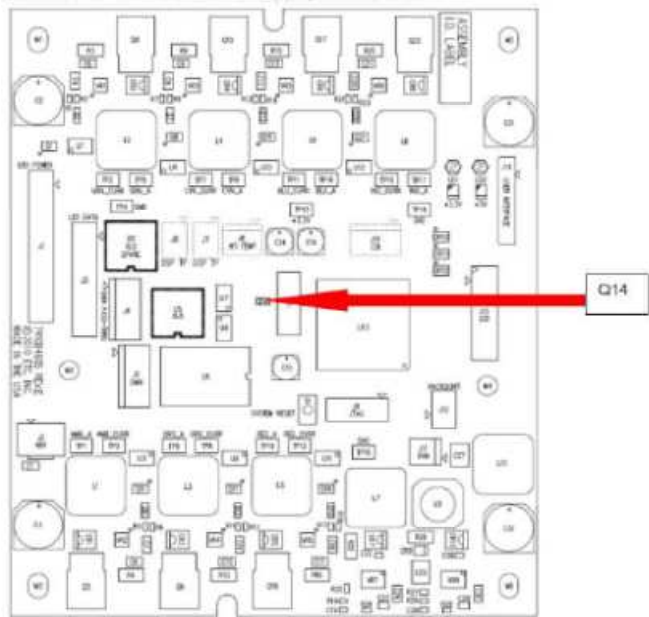
In-Situ Picture – T_s location



RESULTS OF TEST (cont'd)

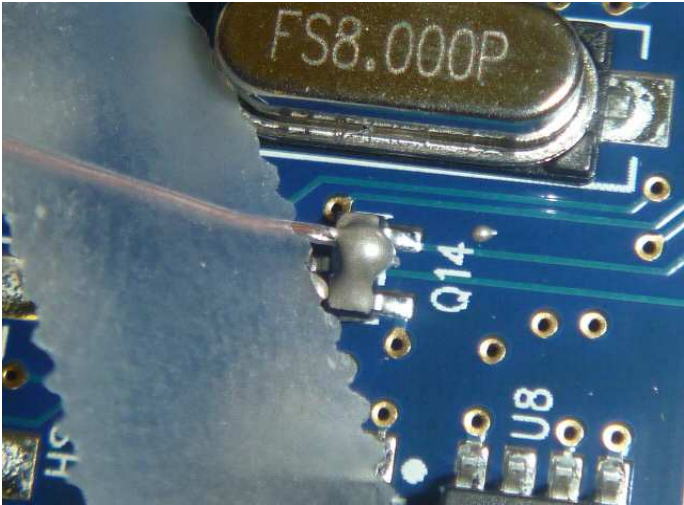
Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-009	60.5	Per diagram	100

Power Supply Picture – Tc location





CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

Melanie Brittain

Melanie Brittain
Associate Engineer
Lighting Division

Attachment: None

Report Reviewed By:

Jacki Swiernik

Jacki Swiernik
Staff Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: November 20, 2013

REPORT NO. 101414036CRT-013

TEST OF ONE D60 STUDIO LED FIXTURE ETL (BLK)

MODEL NO. D60 STUDIO
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D60 STUDIO. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-013.

DATES OF TESTS: November 13, 2013 through November 19, 2

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

SUMMARY

Model No.:	D60 STUDIO
Description:	D60 STUDIO LED FIXTURE ETL (BLK)

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	5744	5443
Total Power (W)	135.3	135.1
Luminaire Efficacy (LPW)	42.45	40.29

Criteria	Result
Power Factor	0.990
Current ATHD %	2.42
Correlated Color Temperature (CCT - K)	4071
Color Rendering Index (CRI - Ra)	84.3
Color Rendering Index (CRI - R9)	79.7
DUV	0.005
Chromaticity Coordinate (x)	0.374
Chromaticity Coordinate (y)	0.364
Chromaticity Coordinate (u')	0.226
Chromaticity Coordinate (v')	0.495
Maximum In-Situ Source Temperature Point (°C)	82.5
Maximum In-Situ Driver Case Temperature (°C)	65.0

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	---	---
COLE PARMER-Thermometer	03313-85	T1469	05/31/13	05/31/14
Sorensen DC Power Supply	DLM150-20E	---	---	---
Data Precision	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14
LSI High Speed Mirror Goniometer	6440	---	10/21/13	11/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Extech Hygro Thermometer	445703	T1359	11/08/12	11/08/13
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Extech Hygro-Thermometer	445703	T1355	11/26/12	11/26/13
Fluke Multimeter	87 V	D590	03/28/13	03/28/14
Fluke Temperature Meter	53 II	D588	03/15/13	03/15/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

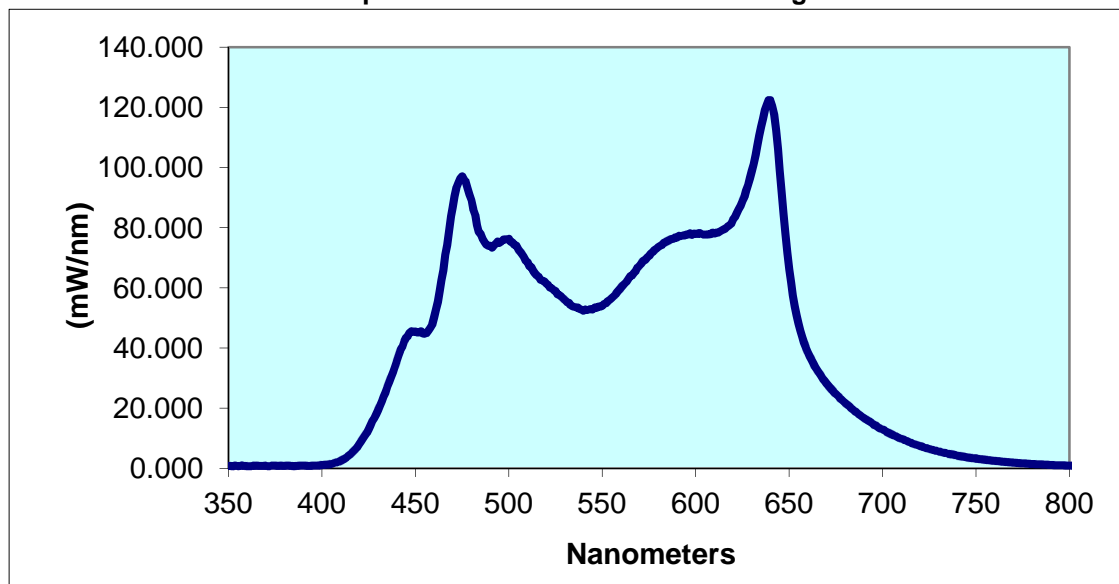
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-013	UP	120.0	1138	135.3	0.990	2.42	5744	42.45

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
4071	84.3	79.7	0.005	0.374	0.364	0.226	0.495

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.796	440	35.5	530	55.91	620	82.59	710	9.837
355	0.7	445	43.36	535	53.63	625	88.93	715	8.589
360	0.707	450	45.44	540	52.41	630	98.87	720	7.395
365	0.854	455	44.69	545	52.84	635	113.6	725	6.456
370	0.92	460	50.12	550	54.1	640	122.4	730	5.605
375	0.903	465	65.8	555	56.55	645	99.13	735	4.85
380	0.748	470	86.7	560	60.11	650	66.11	740	4.206
385	0.705	475	97.08	565	63.9	655	48.02	745	3.641
390	0.855	480	89.17	570	67.36	660	38.55	750	3.21
395	0.827	485	77.87	575	70.57	665	32.66	755	2.8
400	1.047	490	74.03	580	73.54	670	28.23	760	2.454
405	1.447	495	74.94	585	75.63	675	24.71	765	2.137
410	2.462	500	76.3	590	76.64	680	21.71	770	1.873
415	4.531	505	72.96	595	77.71	685	19.01	775	1.613
420	8.037	510	68.56	600	77.93	690	16.76	780	1.435
425	12.98	515	64.1	605	77.7	695	14.64		
430	19.27	520	61.43	610	78.01	700	12.89		
435	27.08	525	58.87	615	79.4	705	11.24		

Spectral Data Over Visible Wavelengths



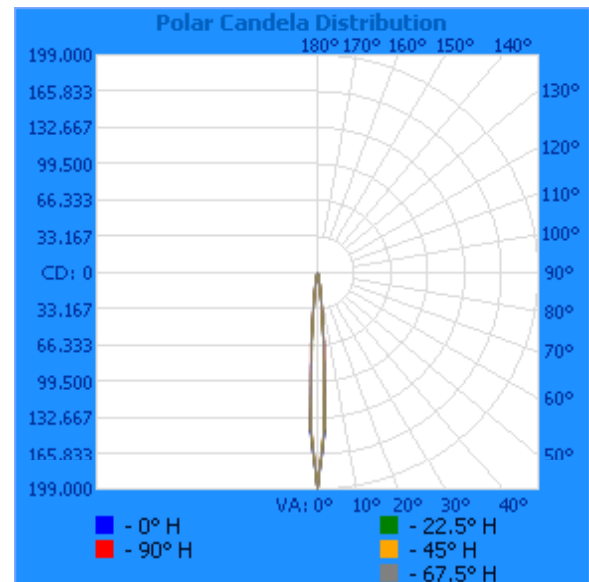
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-013	UP	120.0	1136	135.1	0.990	5443	40.29

Intensity (Candlepower) Summary at 25°C - Candelas

Angle	0	22.5	45	67.5	90
0	198042	198042	198042	198042	198042
5	61742	60888	60327	61994	65648
10	10330	10569	11042	11004	10907
15	1646	1739	1970	1866	1766
20	680	666	661	632	609
25	57	66	59	71	65
30	0	0	0	0	0
35	0	0	0	0	0
40	0	0	0	0	0
45	0	0	0	0	0
50	0	0	0	0	0
55	0	0	0	0	0
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

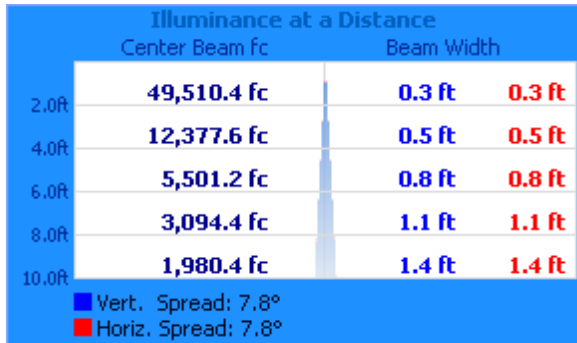


RESULTS OF TEST (cont'd)

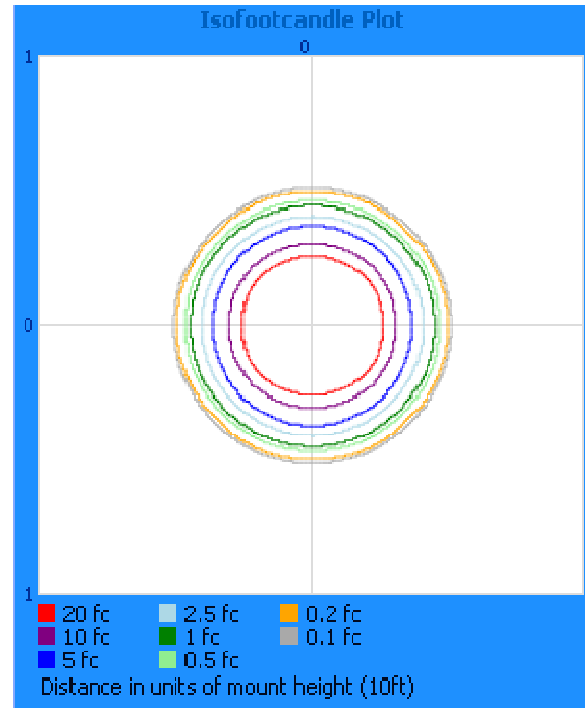
Illumination Plots

Mounting Height: 10 ft.

Illuminance - Cone of Light



Isoillumination Plot



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	5443	100.0
0-40	5443	100.0
0-60	5443	100.0
60-90	0.0	0.0
0-90	5443	100.0
90-180	0.0	0.0
0-180	5443	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	4597	84.5
10-20	779.2	14.3
20-30	66.3	1.2
30-40	0.0	0.0
40-50	0.0	0.0
50-60	0.0	0.0
60-70	0.0	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as: Luxeon Rebel

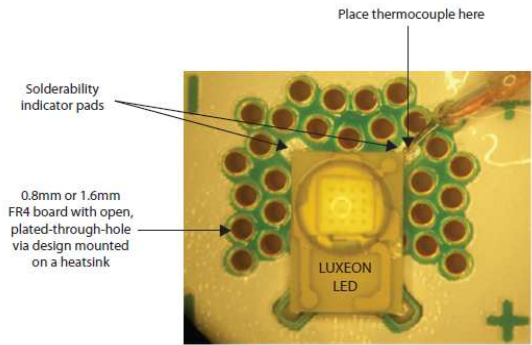


Figure 1. Solderability indicator pad and thermocouple placement.

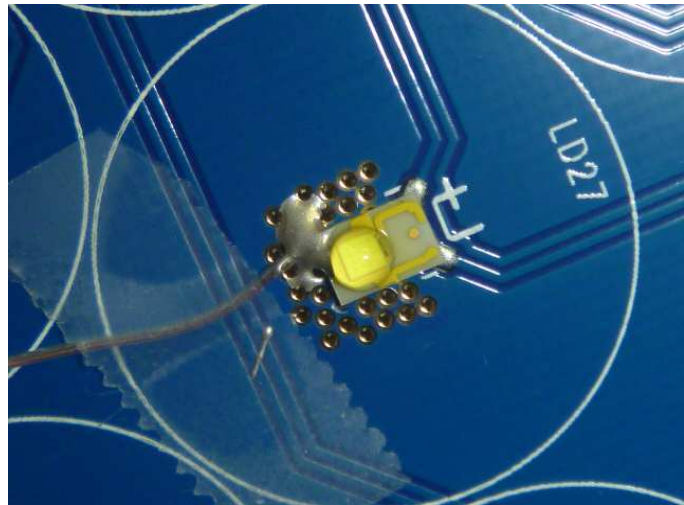
Forward Voltage V_f [1]			Typical Temperature Coefficient of Forward Voltage [2] $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad $R\theta_{jc}$ ($^{\circ}\text{C}/\text{W}$)
Min.	Typ.	Max.		
2.31	2.90	3.51	- 2.0 to - 4.0	12
LED Junction Temperature [1]				150 $^{\circ}\text{C}$
Amber LXML-PL01				

Maximum Junction Temperature from LED specification (T_j) = 150 $^{\circ}\text{C}$
 Thermal Resistance Formula from LED specification = 12 $^{\circ}\text{C}/\text{W}$
 Maximum Forward Voltage (V_f) from LED specification = 3.51V
 Measured LED Current = 588mA
 Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 2.064W
 Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 125.2 $^{\circ}\text{C}$

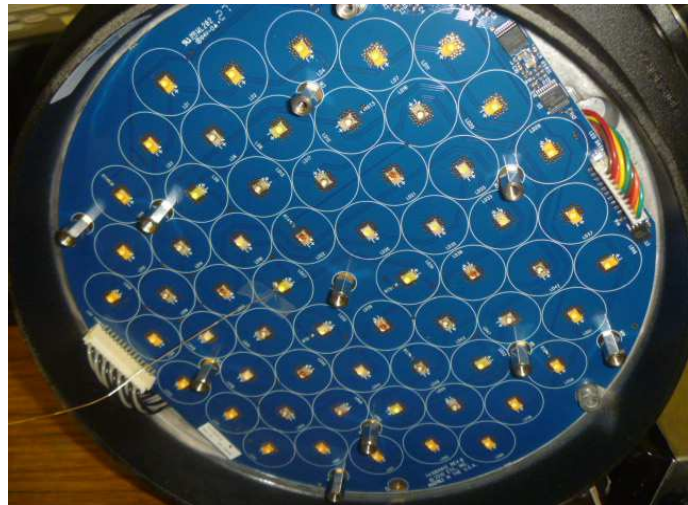
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature ($^{\circ}\text{C}$)	Location	Maximum Rated Source Temperature ($^{\circ}\text{C}$)
CRT1311071604-013	82.5	Per diagram	125.2

In-Situ Picture – T_s



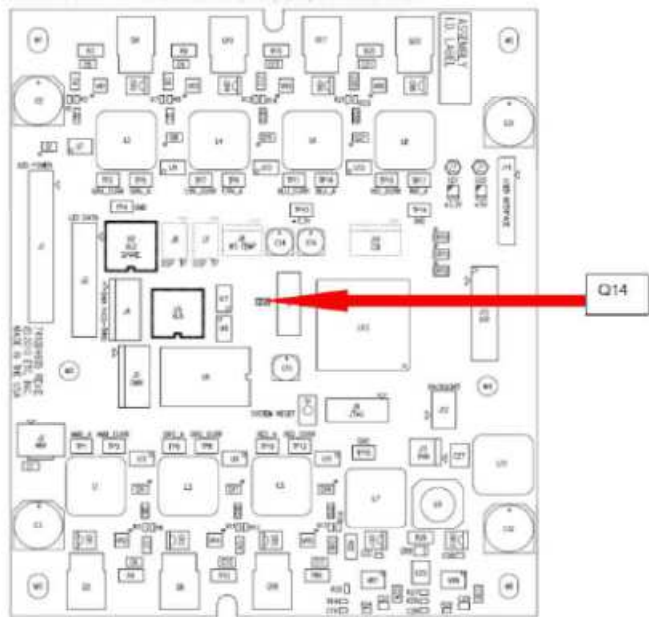
In-Situ Picture – T_s location



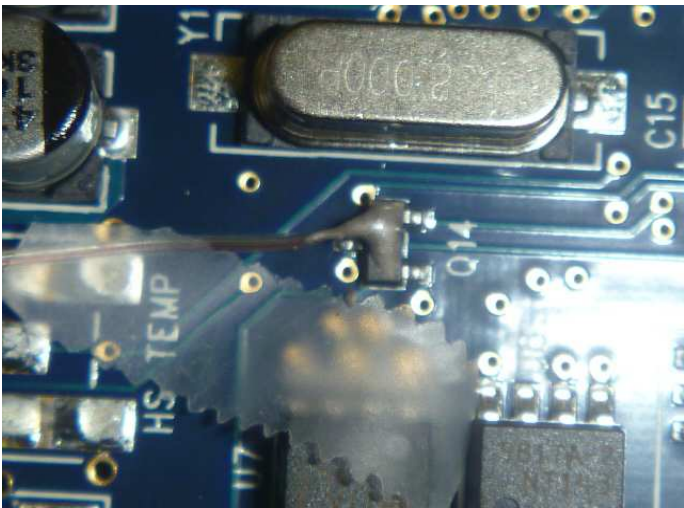
RESULTS OF TEST (cont'd)

Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-009	65.0	Per diagram	100



PICTURE (not to scale)

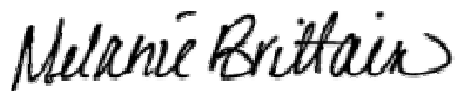


CONCLUSION

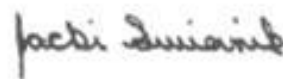
The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

Report Reviewed By:



Melanie Brittain
Associate Engineer
Lighting Division



Jacki Swiernik
Staff Engineer
Lighting Division

Attachment: None



REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: May 30, 2013

REPORT NO. 101158242CRT-006

TEST OF ONE LED WASH LIGHT

FIXTURE MODEL NO. D60 STUDIO TUNGSTEN
LED MODEL NO. LUXEON REBEL LXML-PWN2

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and LED In-Situ tests.

LABORATORY NOTE: The laboratory that conducted the testing detailed in this report has been Qualified, Verified, and Recognized for LM-79 Testing for ENERGY STAR for SSL by US DOE's CALiPER program.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

Energy Star Version 1.2 (2012): Program Requirements for Luminaires
Energy Star Manufacturer's Guide Version 2.0 (2009): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one sample of model number D60 STUDIO TUNGSTEN. The sample was received by Intertek on May 6, in undamaged condition, and one sample was tested as received. The sample designation was CRT1304251519-001.

DATES OF TESTS: May 24, 2013

SUMMARY

Model No.:	D60 STUDIO TUNGSTEN
Description:	LED WASH LIGHT

Criteria	Result
Maximum In-Situ Source Temperature Point – LXML-PM01 GREEN (°C)	67.0
Maximum In-Situ Source Temperature Point – LXML-PE01 CYAN (°C)	71.3
Maximum In-Situ Source Temperature Point – LXML-PB01 BLUE (°C)	62.5
Maximum In-Situ Source Temperature Point – LXML-PR01 ROYAL BLUE (°C)	61.3
Maximum In-Situ Source Temperature Point – LXM2-PL01 PC AMBER (°C)	58.6
Maximum In-Situ Source Temperature Point – LXM2-PD01 RED LOW VF (°C)	65.3
Maximum In-Situ Source Temperature Point – LXML-PWN1 WHITE (°C)	60.5
Maximum Power Supply Case Temperature	49.1

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Fluke Multimeter	PM2525	M127	10/17/12	10/17/13
Fluke Temp Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

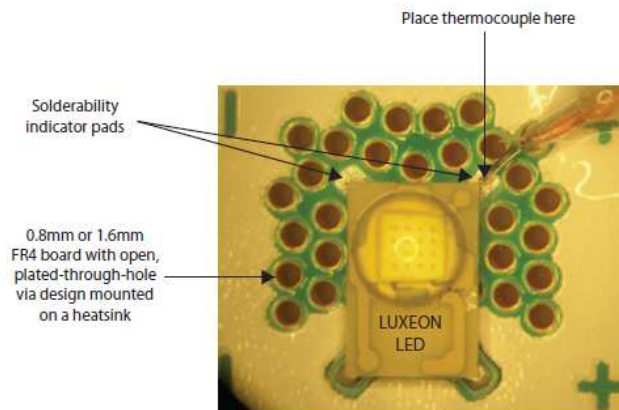
In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Agilent 34970A Data Logger. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TESTS

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED identified as: LUXEON REBEL LXML-PWN2



Electrical Characteristics at 350 mA for LUXEON Rebel color, Thermal Pad Temperature = 25°C

Table 3.

Color	Part Number	Forward Voltage V_f ⁽¹⁾ (V)			Typical Temperature Coefficient of Forward Voltage ⁽²⁾ (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R_{\theta_{jc}}$
		Min.	Typ.	Max.		
Green	LXML-PM01	2.55	2.90	3.51	- 2.0 to - 4.0	10
Cyan	LXML-PE01	2.55	2.90	3.51	- 2.0 to - 4.0	10
Blue	LXML-PB01	2.55	2.95	3.51	- 2.0 to - 4.0	10
Royal-Blue	LXML-PR01	2.55	2.95	3.51	- 2.0 to - 4.0	10
Red	LXML-PD01	2.31	2.90	3.51	- 2.0 to - 4.0	12
Red	LXM2-PD01	1.80	2.10	2.80	- 2.0 to - 4.0	8
Deep Red	LXM3-PD01	1.80	2.10	2.80	- 2.0 to - 4.0	8
Red-Orange	LXML-PH01	2.31	2.90	3.51	- 2.0 to - 4.0	12
Red-Orange	LXM2-PH01	1.80	2.10	2.80	- 2.0 to - 4.0	8
PC Amber	LXM2-PL01	2.55	3.05	3.51	- 2.0 to - 4.0	10
Amber	LXML-PL01	2.31	2.90	3.51	- 2.0 to - 4.0	12

Absolute Maximum Ratings

Table 5.

Parameter	Green/Cyan/Blue/Royal Blue	LUXEON Rebel ES Royal Blue/ES Blue	Red/Deep-Red Red-Orange/Amber	PC Amber
DC Forward Current (mA)	1000	1000	700	700
Peak Pulsed Forward Current (mA)	1000	1200	700	700
Average Forward Current (mA)	1000	1000	700	700
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3A IESD22-A114-B			
LED Junction Temperature ⁽¹⁾	150°C	150°C	135°C	130°C

RESULTS OF TESTS (cont'd)

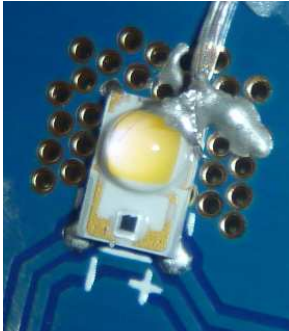
In-Situ Maximum Measured LED Source Temperature - LXML-PM01 GREEN

Maximum Junction Temperature from LED specification (Tj) = 150°C
 Thermal Resistance Formula from LED specification = 10°C/W
 Maximum Forward Voltage (Vf) from LED specification = 3.5 V
 Measured LED Current = 590 mA
 Calculated LED Wattage = Vf x Measured LED Current = 2.071W
 Maximum Source Temperature (Ts) = Tj – (LED Wattage x Thermal Resistance) = 129°C

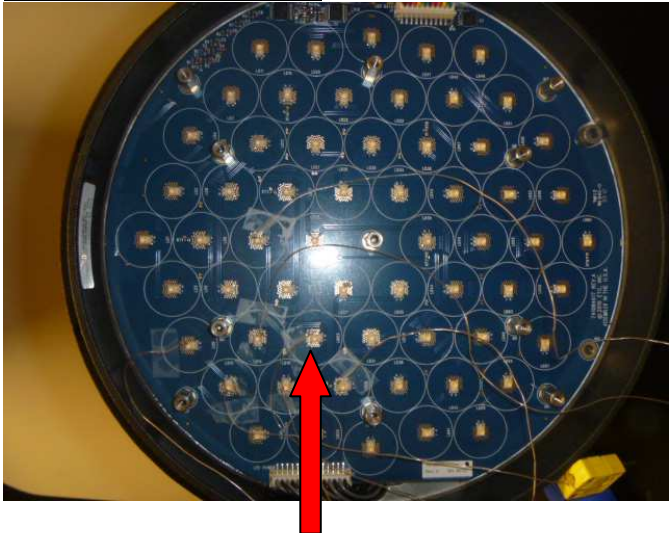
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-001	67.0	Per diagram above	129

In-Situ Picture – Ts



In-Situ Picture – Ts location



RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXML-PE01 CYAN

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.5 V

Measured LED Current = 595 mA

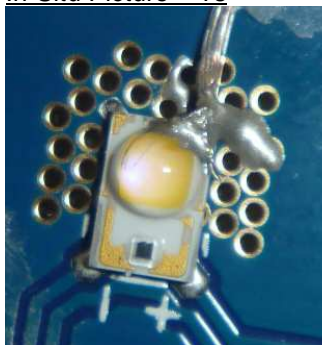
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 2.089W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 129°C

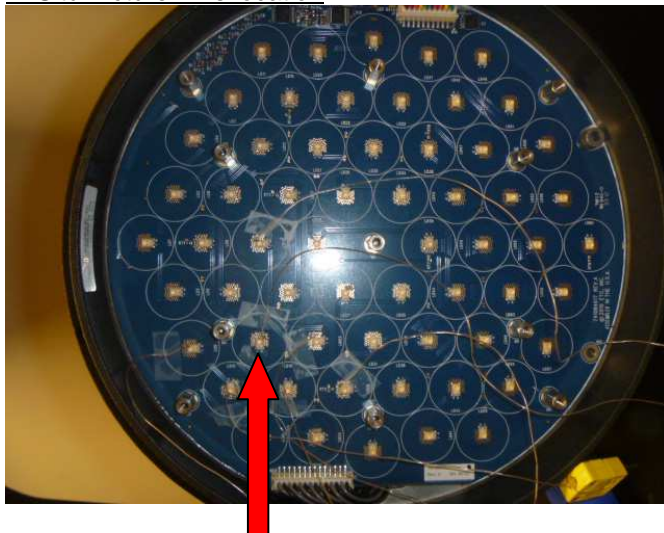
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-001	71.3	Per diagram above	129

In-Situ Picture – T_s



In-Situ Picture – T_s location



RESULTS OF TESTS (cont'd)

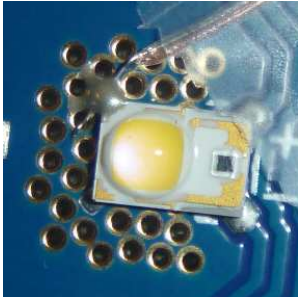
In-Situ Maximum Measured LED Source Temperature - LXML-PB01 BLUE

Maximum Junction Temperature from LED specification (Tj) = 150°C
 Thermal Resistance Formula from LED specification = 10°C/W
 Maximum Forward Voltage (Vf) from LED specification = 3.51 V
 Measured LED Current = 590 mA
 Calculated LED Wattage = Vf x Measured LED Current = 2.071W
 Maximum Source Temperature (Ts) = Tj – (LED Wattage x Thermal Resistance) = 129°C

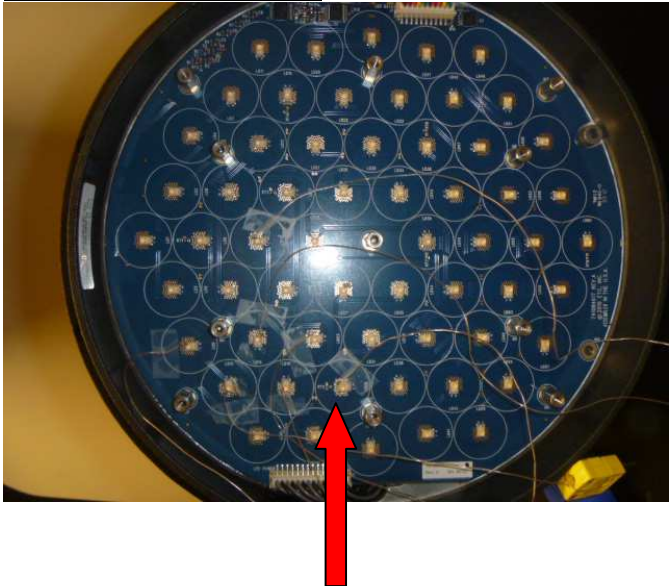
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-001	62.5	Per diagram above	129

In-Situ Picture – Ts



In-Situ Picture – Ts location



RESULTS OF TESTS (cont'd)

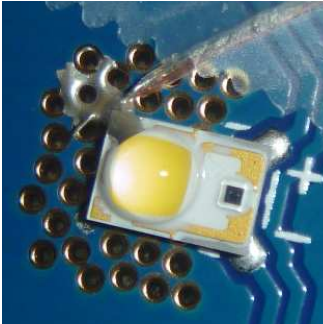
In-Situ Maximum Measured LED Source Temperature - LXML-PR01 ROYAL BLUE

Maximum Junction Temperature from LED specification (Tj) = 150°C
 Thermal Resistance Formula from LED specification = 10°C/W
 Maximum Forward Voltage (Vf) from LED specification = 3.51 V
 Measured LED Current = 590 mA
 Calculated LED Wattage = Vf x Measured LED Current = 2.071W
 Maximum Source Temperature (Ts) = Tj – (LED Wattage x Thermal Resistance) = 129°C

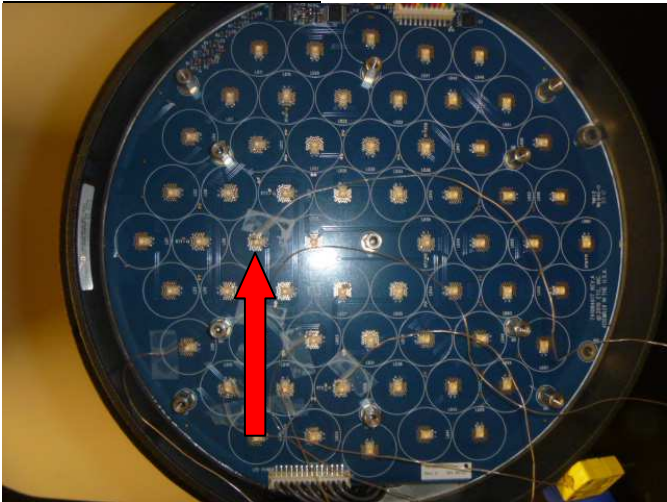
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-001	61.3	Per diagram above	129

In-Situ Picture – Ts



In-Situ Picture – Ts location



RESULTS OF TESTS (cont'd)

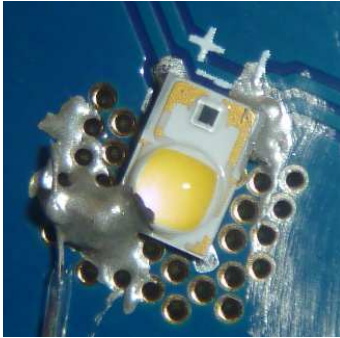
In-Situ Maximum Measured LED Source Temperature - LXM2-PL01 PC AMBER

Maximum Junction Temperature from LED specification (T_j) = 130°C
 Thermal Resistance Formula from LED specification = 10°C/W
 Maximum Forward Voltage (V_f) from LED specification = 3.51 V
 Measured LED Current = 585 mA
 Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 2.053W
 Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 109°C

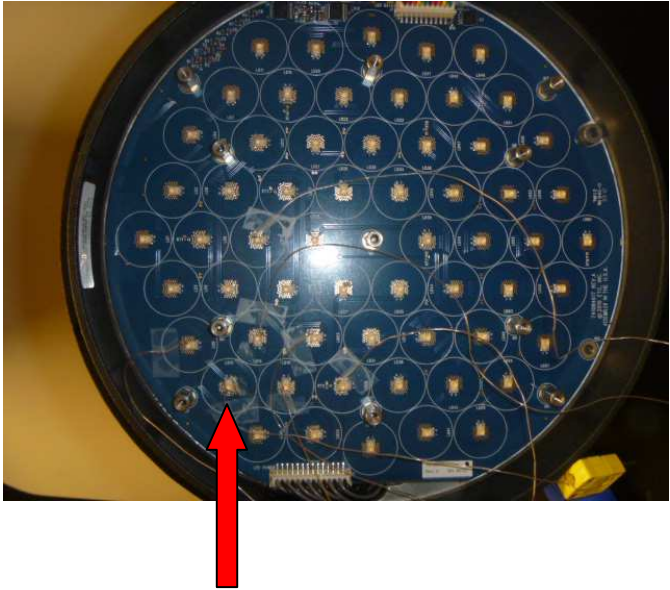
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-001	58.6	Per diagram above	109

In-Situ Picture – T_s



In-Situ Picture – T_s location



RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXM2-PD01 RED LOW VF

Maximum Junction Temperature from LED specification (T_j) = 135°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 2.8V

Measured LED Current = 588 mA

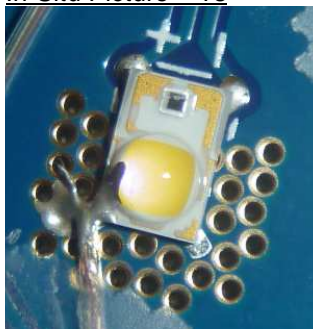
Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 1.646\text{W}$

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 122^\circ\text{C}$

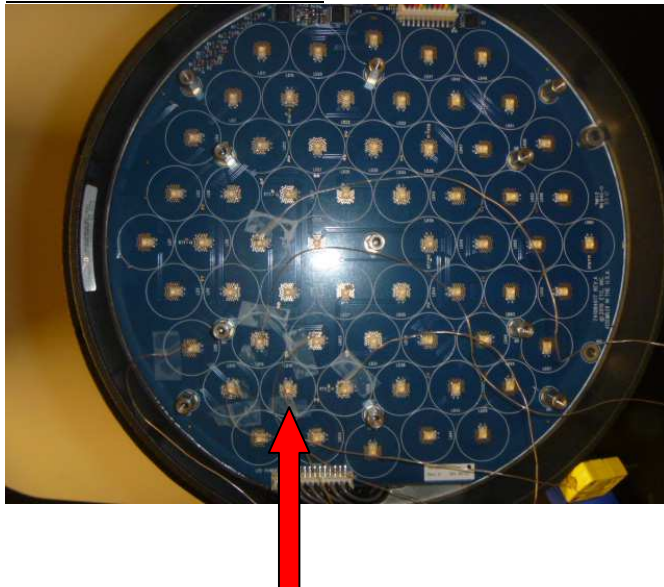
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-001	65.3	Per diagram above	122

In-Situ Picture – T_s



In-Situ Picture – T_s location



RESULTS OF TESTS (cont'd)

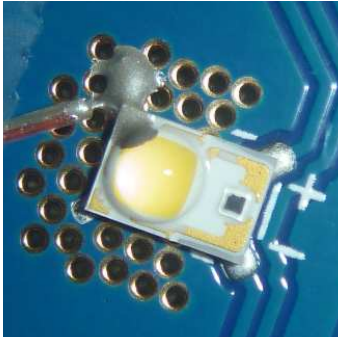
In-Situ Maximum Measured LED Source Temperature - LXML-PWN1 WHITE

Maximum Junction Temperature from LED specification (Tj) = 150°C
 Thermal Resistance Formula from LED specification = 10°C/W
 Maximum Forward Voltage (Vf) from LED specification = 3.99V
 Measured LED Current = 589 mA
 Calculated LED Wattage = Vf x Measured LED Current = 2.350W
 Maximum Source Temperature (Ts) = Tj – (LED Wattage x Thermal Resistance) = 126°C

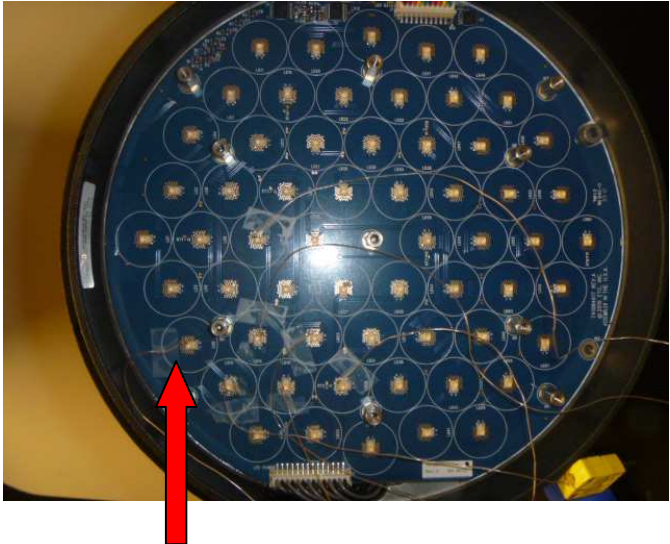
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1304251519-001	60.5	Per diagram above	126

In-Situ Picture – Ts



In-Situ Picture – Ts location



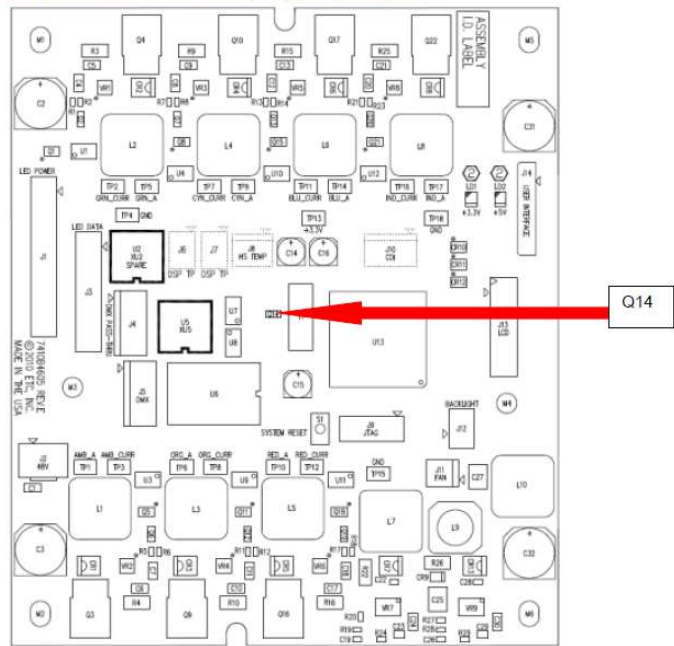


RESULTS OF TESTS (cont'd)

Maximum Measured Power Supply Case Temperature

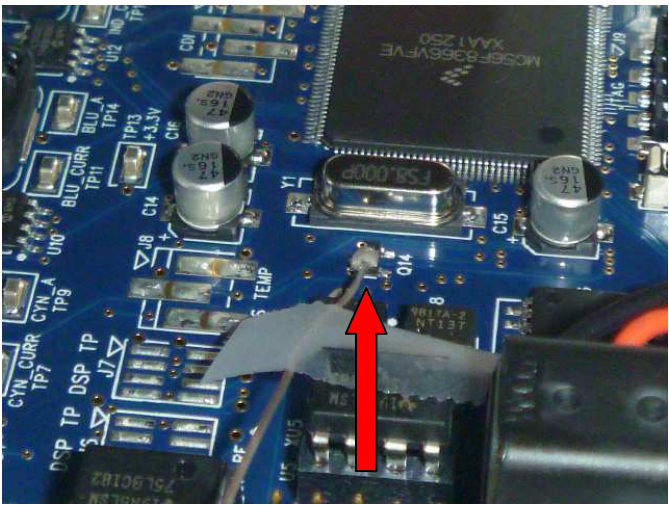
Manufacturer Supplied Documentation:
Driver identified as: Model No. 7410B4605

For the Desire control card, measure the temperature at Q14.



Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Measured Power Supply Case Temperature (°C)	Location	Maximum Power Supply Case Temperature (°C)
CRT1304251519-001	49.1	Q14	100





Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink, appearing to read "K R".

Kenda Branch
Engineer
Lighting Division

Attachment: None

Report Reviewed By:

A handwritten signature in black ink, appearing to read "David Ellis".

David Ellis
Senior Project Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: May 23, 2013

REPORT NO. 101158242CRT-001

TEST OF ONE LED WASH LIGHT

FIXTURE MODEL NO. D60 STUDIO TUNGSTEN

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

LABORATORY NOTE: The laboratory that conducted the testing detailed in this report has been Qualified, Verified, and Recognized for LM-79 Testing for ENERGY STAR for SSL by US DOE's CALiPER program.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79: 2008 Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products

ANSI ANSLG C38.377: 2012 Specifications of the Chromaticity of Solid State Lighting Products

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D60 STUDIO TUNGSTEN. The sample was received by Intertek on May 6, 2013, in undamaged condition, and one sample was tested as received. The sample designation was CRT1304251519-001.

DATES OF TESTS: May 15, 2013 through May 22, 2013

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SUMMARY

Model No.:	D60 STUDIO TUNGSTEN
Description:	LED WASH LIGHT

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	7390	6971
Total Power (W)	137.5	136.8
Luminaire Efficacy (LPW)	53.74	50.96

Criteria	Result
Power Factor	0.991
Current ATHD (%)	2.76
Correlated Color Temperature (CCT - K)	3049
Color Rendering Index (CRI) – Ra	85.4
Color Rendering Index (CRI) - R9	22.6
Duv	0.001
Chromaticity Coordinate (x)	0.435
Chromaticity Coordinate (y)	0.407
Chromaticity Coordinate (u')	0.248
Chromaticity Coordinate (v')	0.522

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
LSI High Speed Mirror Goniometer	6440	---	05/20/13	06/20/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Extech Hygro Thermometer	445703	T1359	11/08/12	11/08/13
Fisher Scientific	---	N1132	04/22/13	04/22/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Yokogawa Power Analyzer	WT1600	E462	07/06/12	07/06/13
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temp Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	NA	NA	NA
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Sorensen DC Power Supply	DLM150-20E	N/A	N/A	N/A
FLUKE	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

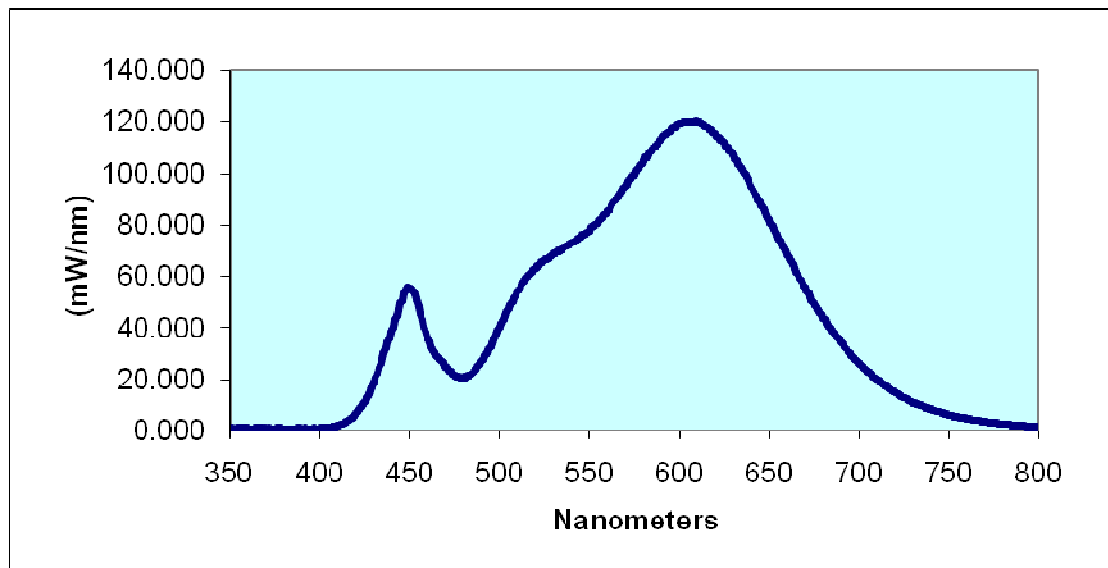
The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

RESULTS OF TESTS

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.845	460	35.938	570	94.720	680	43.791
355	0.765	465	29.072	575	99.549	685	38.922
360	0.772	470	24.958	580	104.844	690	34.191
365	0.879	475	21.485	585	109.463	695	29.908
370	0.824	480	20.693	590	113.118	700	26.292
375	0.743	485	22.540	595	116.234	705	22.804
380	0.682	490	26.516	600	119.102	710	19.847
385	0.713	495	32.605	605	119.687	715	17.227
390	0.720	500	40.210	610	119.666	720	14.878
395	0.740	505	47.357	615	118.149	725	12.793
400	0.808	510	54.179	620	115.532	730	10.928
405	1.058	515	59.046	625	111.870	735	9.505
410	1.758	520	63.083	630	106.881	740	8.145
415	3.364	525	66.188	635	101.029	745	7.069
420	6.298	530	68.678	640	94.931	750	6.024
425	11.294	535	70.320	645	88.539	755	5.311
430	18.919	540	72.536	650	81.936	760	4.518
435	28.264	545	74.927	655	74.853	765	0.000
440	38.187	550	77.691	660	68.310	770	3.366
445	49.441	555	81.338	665	61.720	775	2.890
450	55.250	560	85.490	670	55.594	780	2.493
455	47.782	565	89.872	675	49.406		

Sample No. CRT1304251519-001
Spectral Data Over Visible Wavelengths



RESULTS OF TESTS (cont'd)

Photometric and Electrical Measurements at 25°C – Integrating Sphere Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1304251519-001	UP	120.0	1157	137.5	0.991	2.76	7390	53.74

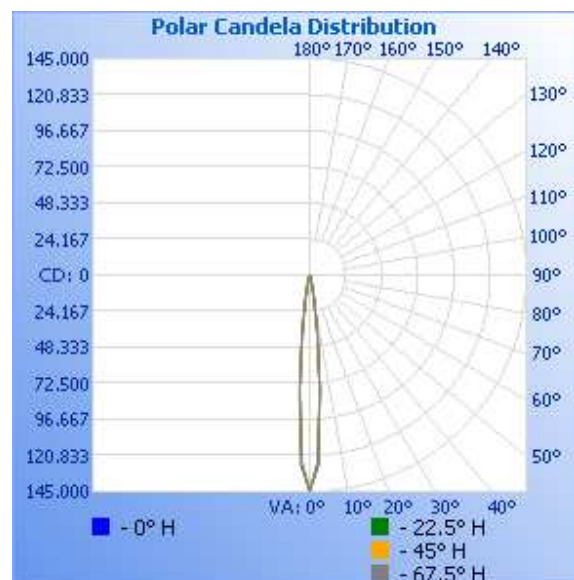
Intertek Sample No.	Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
CRT1304251519-001	3049	85.4	22.6	0.001	0.435	0.407	0.248	0.522

Photometric and Electrical Measurements – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1304251519-001	UP	119.9	1151	136.8	0.991	6971	50.96

Intensity (Candlepower) Summary at 25°C - Candelas

Angle	0	22.5	45	67.5	90
0	144469	144469	144469	144469	144469
5	77131	76356	77037	78701	80853
10	17519	17648	18046	18290	18453
15	3806	3777	3677	3795	3961
20	1186	1161	1165	1198	1193
25	294	285	298	298	286
30	23	19	12	24	26
35	0	0	0	0	0
40	0	0	0	0	0
45	0	0	0	0	0
50	0	0	0	0	0
55	0	0	0	0	0
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

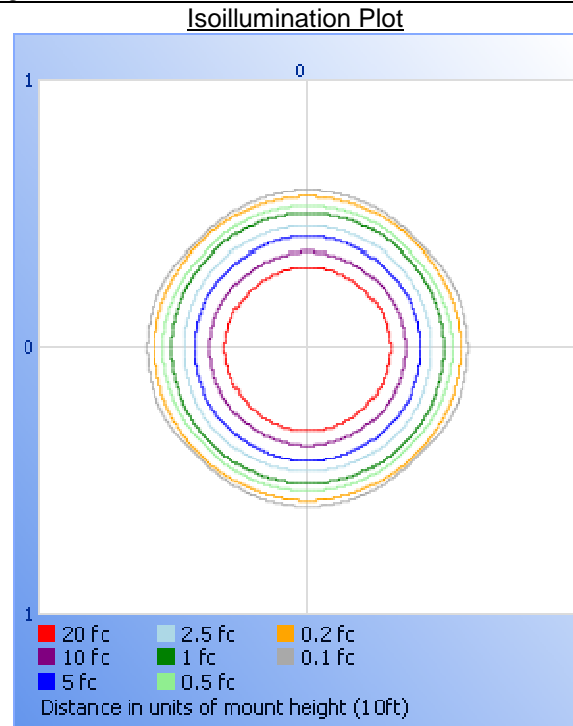
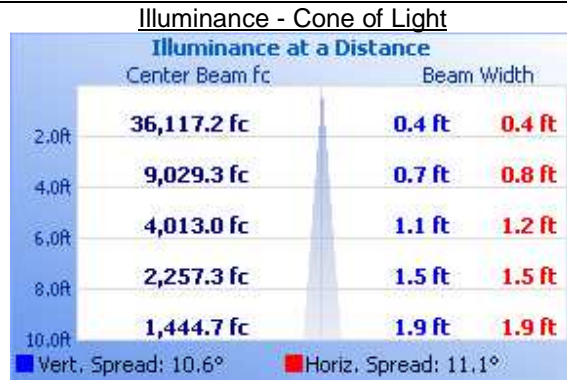




RESULTS OF TESTS (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	6969	100.0
0-40	6971	100.0
0-60	6971	100.0
60-90	0.0	0.0
0-90	6971	100.0
90-180	0.0	0.0
0-180	6971	100.0



Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink, appearing to read "Kenda Branch".

Kenda Branch
Engineer
Lighting Division

Attachment: None

Report Reviewed By:

A handwritten signature in black ink, appearing to read "David Ellis".

David Ellis
Senior Project Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: November 20, 2013

REPORT NO. 101414036CRT-009

TEST OF ONE D60 DAYLIGHT LED FIXTURE ETL (BLK)

MODEL NO. D60 DAYLIGHT
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number D60 DAYLIGHT. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-009.

DATES OF TESTS: November 13, 2013 through November 19, 2

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SUMMARY

Model No.:	D60 DAYLIGHT
Description:	D60 DAYLIGHT LED FIXTURE ETL (BLK)

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	8943	8620
Total Power (W)	133.1	132.6
Luminaire Efficacy (LPW)	67.19	65.01

Criteria	Result
Power Factor	0.991
Current ATHD %	2.98
Correlated Color Temperature (CCT - K)	5539
Color Rendering Index (CRI - Ra)	70.7
Color Rendering Index (CRI - R9)	-3.7
DUV	0.003
Chromaticity Coordinate (x)	0.332
Chromaticity Coordinate (y)	0.347
Chromaticity Coordinate (u')	0.204
Chromaticity Coordinate (v')	0.480
Maximum In-Situ Source Temperature Point (°C)	60.1
Maximum In-Situ Driver Case Temperature (°C)	47.0

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	---	---
COLE PARMER-Thermometer	03313-85	T1469	05/31/13	05/31/14
Sorensen DC Power Supply	DLM150-20E	---	---	---
Data Precision	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14
LSI High Speed Mirror Goniometer	6440	---	10/21/13	11/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Extech Hygro Thermometer	445703	T1359	11/08/12	11/08/13
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Extech Hygro-Thermometer	445703	T1355	11/26/12	11/26/13
Fluke Multimeter	87 V	D590	03/28/13	03/28/14
Fluke Temperature Meter	53 II	D588	03/15/13	03/15/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

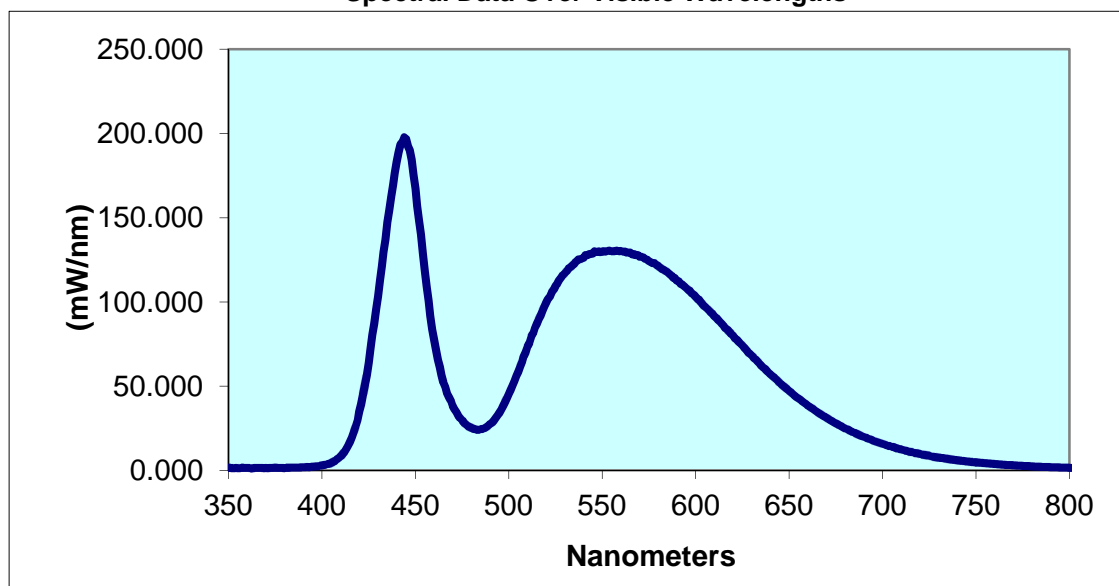
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-009	UP	120.0	117.4	133.1	0.991	2.98	8943	67.19

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
5539	70.7	-3.7	0.003	0.332	0.347	0.204	0.480

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	1.615	440	183	530	117.2	620	79.99	710	12.33
355	1.171	445	197	535	122.4	625	74.03	715	10.94
360	1.352	450	167.4	540	126	630	68.15	720	9.672
365	1.394	455	118.5	545	128.8	635	62.27	725	8.518
370	1.463	460	77.57	550	129.9	640	57.06	730	7.53
375	1.498	465	52.14	555	130.1	645	51.91	735	6.7
380	1.207	470	38.18	560	130.3	650	47.02	740	5.921
385	1.546	475	29.7	565	129.3	655	42.6	745	5.256
390	1.774	480	25.18	570	126.9	660	38.42	750	4.658
395	2.112	485	24.36	575	124.1	665	34.65	755	4.165
400	2.822	490	27.46	580	121.3	670	31.13	760	3.721
405	4.39	495	34.1	585	117.5	675	27.78	765	3.223
410	8.246	500	45.49	590	112.5	680	24.8	770	2.926
415	16.85	505	58.41	595	108.1	685	22.26	775	2.597
420	34.8	510	73.45	600	103	690	19.81	780	2.332
425	63.83	515	86.92	605	97.18	695	17.57		
430	103.2	520	99.4	610	91.43	700	15.7		
435	147.4	525	109.6	615	85.7	705	13.91		

Spectral Data Over Visible Wavelengths



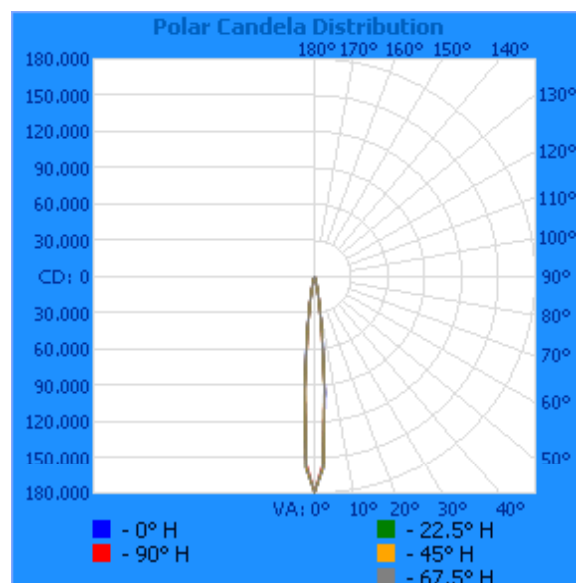
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-009	UP	120.0	1115	132.6	0.991	8620	65.01

Intensity (Candlepower) Summary at 25°C - Candelas

Angle	0	22.5	45	67.5	90
0	179133	179133	179133	179133	179133
5	95790	94049	92779	91308	93244
10	22610	22053	21704	21630	21783
15	5441	5621	5790	5417	5304
20	1567	1592	1630	1568	1524
25	299	288	280	269	291
30	51	46	49	45	41
35	1	9	7	4	23
40	0	0	8	11	0
45	0	0	0	0	0
50	0	0	0	0	0
55	0	0	0	0	0
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

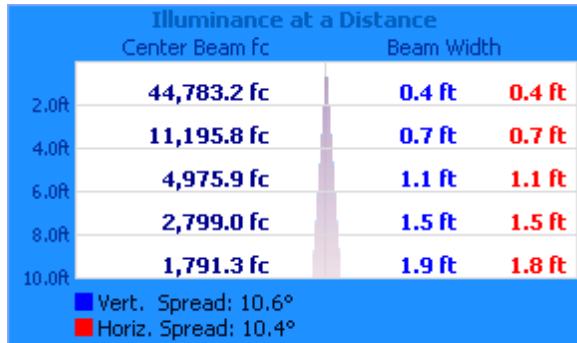


RESULTS OF TEST (cont'd)

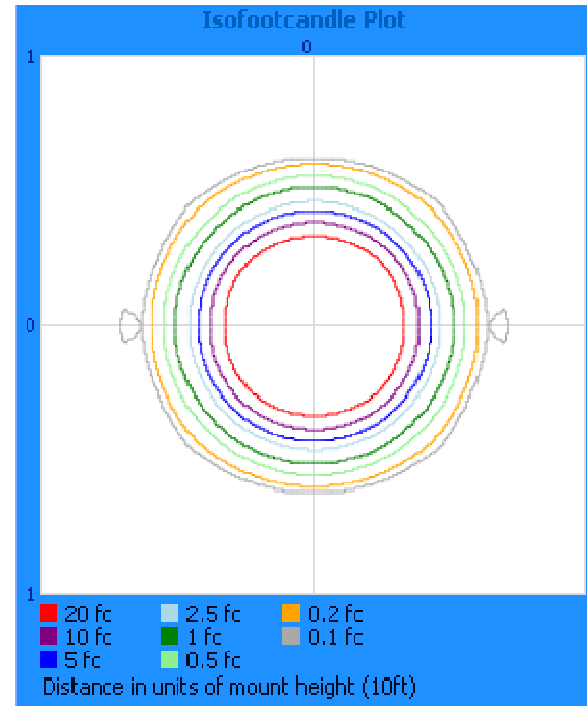
Illumination Plots

Mounting Height: 10 ft.

Illuminance - Cone of Light



Isoillumination Plot



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	8612	99.9
0-40	8619	100.0
0-60	8620	100.0
60-90	0.0	0.0
0-90	8620	100.0
90-180	0.0	0.0
0-180	8620	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	6493	75.3
10-20	1908	22.1
20-30	210.7	2.4
30-40	7.5	0.1
40-50	1.2	0.0
50-60	0.0	0.0
60-70	0.0	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as: Luxeon Rebel

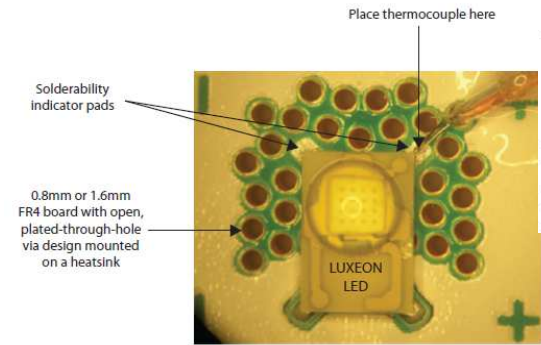


Figure 1. Solderability indicator pad and thermocouple placement.

Nominal ANSI CCT	Forward Voltage V_f ^[1] (V)		Typical Temperature Coefficient of Forward Voltage ^[2] (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R_{\theta j\zeta}$
	Min.	Max.		
2700K	2.5	3.5	-1.8 to -2.4	6
3000K	2.5	3.5	-1.8 to -2.4	6
4000K	2.5	3.5	-1.8 to -2.4	6
5000K	2.5	3.5	-1.8 to -2.4	6

LED Junction Temperature ^[3] 150°C

Maximum Junction Temperature from LED specification (T_j) = 150°C
 Thermal Resistance Formula from LED specification = 6°C/W
 Maximum Forward Voltage (V_f) from LED specification = 3.51V
 Measured LED Current = 589mA
 Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 2.067W
 Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 137.6°C

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature (°C)
CRT1311071604-009	60.1	Per diagram	137.6

In-Situ Picture – T_s



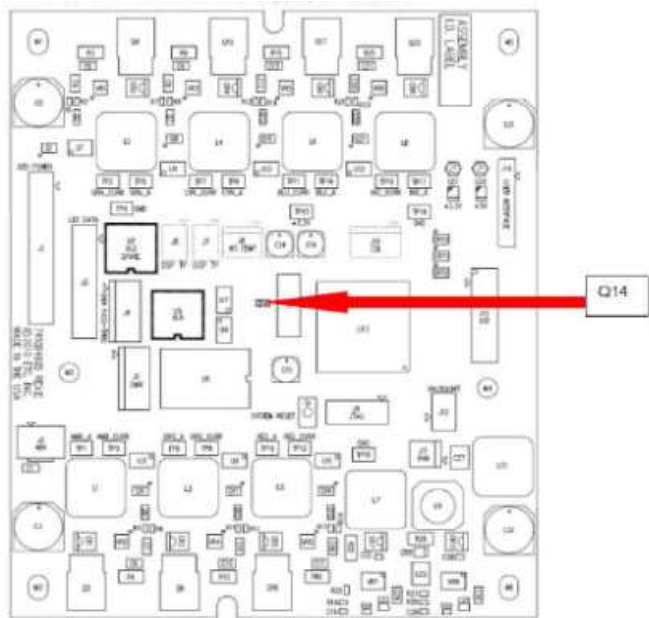
In-Situ Picture – T_s location



RESULTS OF TEST (cont'd)

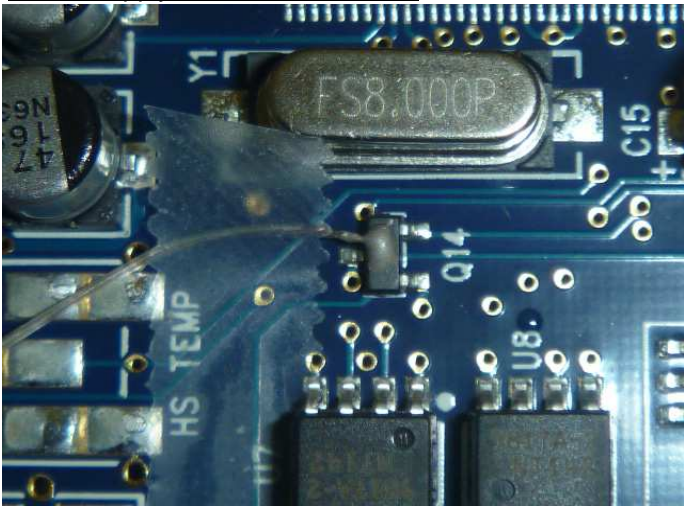
Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-009	47.0	Per diagram	100

Power Supply Picture – Tc location



PICTURE (not to scale)

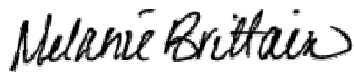


CONCLUSION

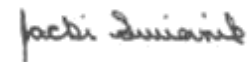
The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

Report Reviewed By:



Melanie Brittain
Associate Engineer
Lighting Division



Jacki Swiernik
Staff Engineer
Lighting Division

Attachment: None

SECTION 5 - Selador Classic

Lustr 11"

Luster 21"

Vivid-R 11"

Paletta 11"

Pearl 11"



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: December 6, 2013

REPORT NO. 101414036CRT-010

TEST OF ONE LUSTR SL3 LED FIXTURE 11

MODEL NO. LUSTR SL3 11
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number LUSTR SL3 11. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-010.

DATES OF TESTS: December 3, 2013 through December 5, 2013

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

SUMMARY

Model No.:	LUSTR SL3 11
Description:	LUSTR SL3 LED FIXTURE 11

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	2416	2643
Total Power (W)	95.97	96.00
Luminaire Efficacy (LPW)	25.17	27.53

Criteria	Result
Power Factor	0.970
Current ATHD %	19.05
Correlated Color Temperature (CCT - K)	7370
Color Rendering Index (CRI - Ra)	47.1
Color Rendering Index (CRI - R9)	-107.3
DUV	0.025
Chromaticity Coordinate (x)	0.310
Chromaticity Coordinate (y)	0.278
Chromaticity Coordinate (u')	0.217
Chromaticity Coordinate (v')	0.438
Maximum In-Situ Source Temperature Point (°C)	72.9
Maximum In-Situ Driver Case Temperature (°C)	56.5

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fuke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	---	---
Extech Hygro-Thermometer	445703	T1366	11/27/13	11/27/14
Sorensen DC Power Supply	DLM150-20E	---	---	---
Data Precision	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14
LSI High Speed Mirror Goniometer	6440	---	11/21/13	12/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Cole-Palmer Hygro Thermometer	03313-85	T1469	05/31/13	05/31/14
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Extech Hygro-Thermometer	445703	T1360	11/27/13	11/27/14
Fuke Multimeter	87 V	D590	03/28/13	03/28/14
Fuke Temperature Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

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A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

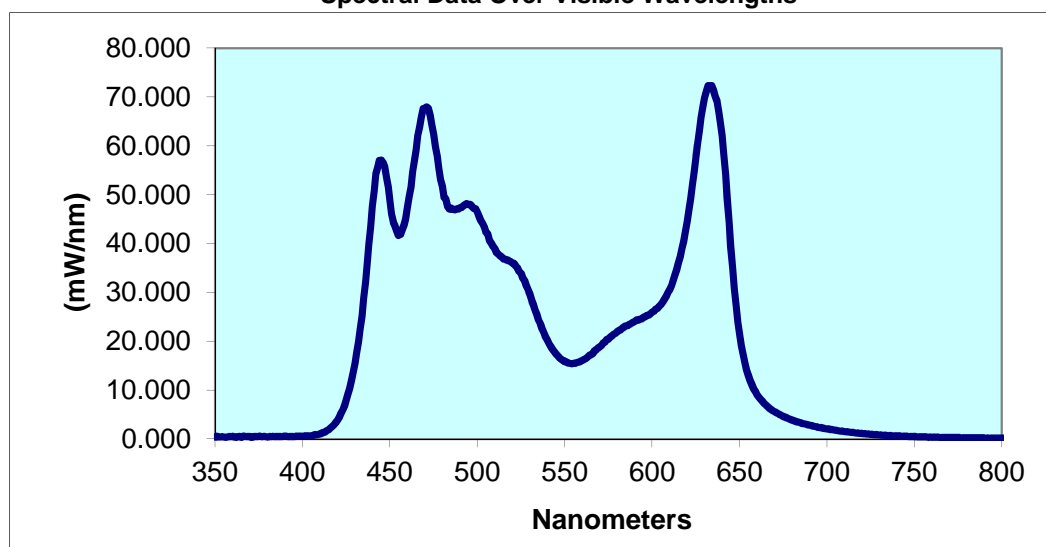
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-010	UP	120.0	823.6	95.97	0.970	19.05	2416	25.17

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
7370	47.1	-107.3	0.025	0.310	0.278	0.217	0.438

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.422	440	47.65	530	29.68	620	44.54	710	1.505
355	0.391	445	57.1	535	24.39	625	57.64	715	1.311
360	0.511	450	48.77	540	20.2	630	69.87	720	1.111
365	0.364	455	41.66	545	17.37	635	71.36	725	0.938
370	0.452	460	47.56	550	15.86	640	62.04	730	0.804
375	0.521	465	59.25	555	15.46	645	39.46	735	0.685
380	0.374	470	67.7	560	16.05	650	21.22	740	0.59
385	0.441	475	62.27	565	17.26	655	12.99	745	0.53
390	0.512	480	51.72	570	18.91	660	9.032	750	0.466
395	0.455	485	47.26	575	20.46	665	6.937	755	0.407
400	0.527	490	47.31	580	21.96	670	5.599	760	0.358
405	0.686	495	47.98	585	23.12	675	4.614	765	0.304
410	1.052	500	46.47	590	24.05	680	3.862	770	0.281
415	1.937	505	42.31	595	24.91	685	3.299	775	0.241
420	3.828	510	38.91	600	25.96	690	2.825	780	0.219
425	7.887	515	36.86	605	27.56	695	2.4		
430	15.46	520	36.08	610	30.57	700	2.065		
435	28.83	525	33.9	615	35.97	705	1.765		

Spectral Data Over Visible Wavelengths



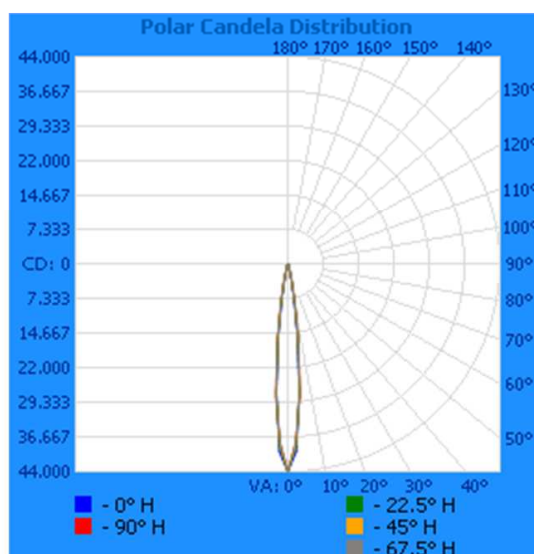
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-010	UP	120.0	822.5	96.00	0.972	2643	27.53

Intensity (Candlepower) Summary at 25°C - Candelas

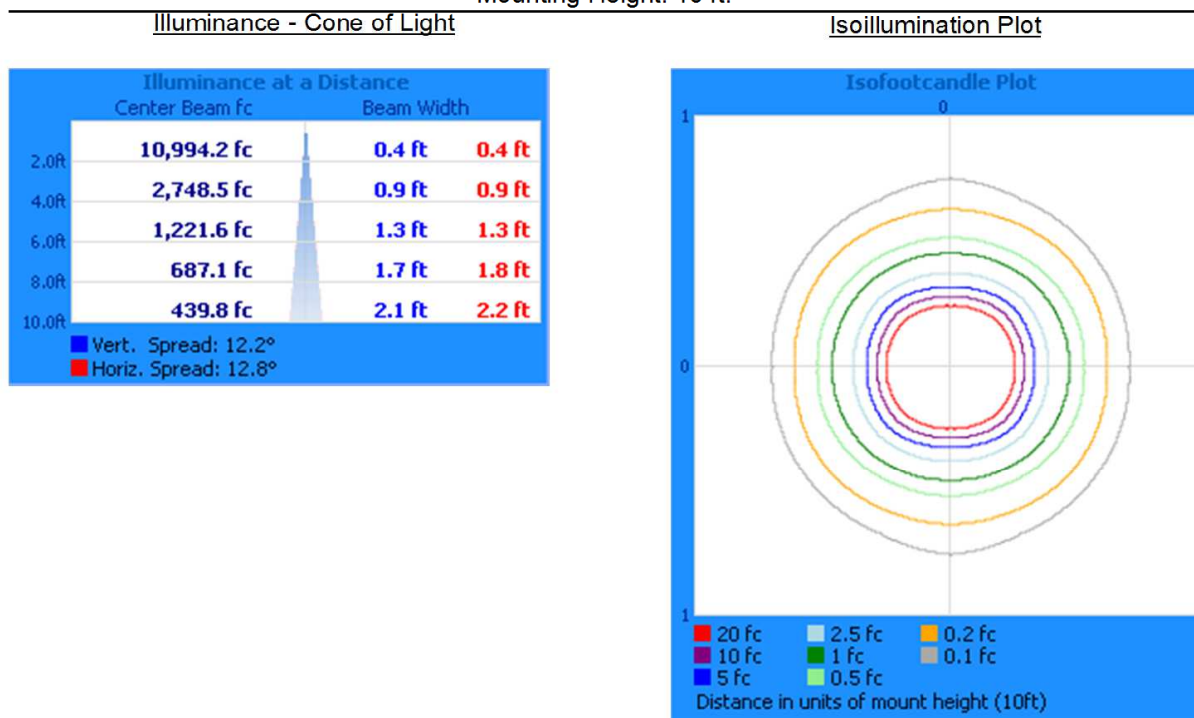
Angle	0	22.5	45	67.5	90
0	43977	43977	43977	43977	43977
5	27192	27476	27765	28078	28240
10	7202	7691	8365	8451	8309
15	1322	1488	1813	1610	1467
20	332	359	416	384	357
25	114	122	133	136	134
30	46	45	48	47	44
35	24	21	21	20	18
40	13	10	8	5	6
45	6	3	0	0	0
50	2	1	0	0	0
55	0	0	0	0	0
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TEST (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	2627	99.4
0-40	2641	99.9
0-60	2643	100.0
60-90	0.0	0.0
0-90	2643	100.0
90-180	0.0	0.0
0-180	2643	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	1951	73.8
10-20	607.6	23.0
20-30	68.3	2.6
30-40	14.1	0.5
40-50	2.0	0.1
50-60	0.1	0.0
60-70	0.0	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as: Luxeon Rebel ES (Amber)

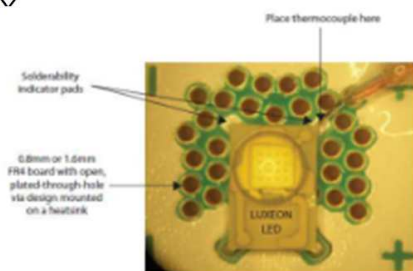


Figure 1. Solderability indicator pad and thermocouple placement.

Color	Part Number	forward voltage V_f [1]			Typical Temperature Coefficient of Forward Voltage [2] ($\text{mV}/^\circ\text{C}$) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad ($^\circ\text{C}/\text{W}$) $R\theta_{jc}$
		Min.	Typ.	Max.		
Amber	LXML-PL01	2.31	2.90	3.51	- 2.0 to - 4.0	12

Maximum LED Junction Temperature 135°C

Maximum Junction Temperature from LED specification (T_j) = 135°C

Thermal Resistance Formula from LED specification = $12^\circ\text{C}/\text{W}$

Maximum Forward Voltage (V_f) from LED specification = 3.51V

Measured LED Current = 585mA

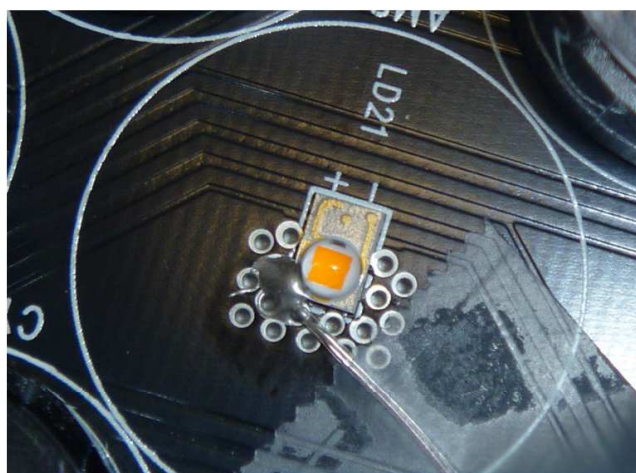
Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 2.053\text{W}$

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 110.4^\circ\text{C}$

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature ($^\circ\text{C}$)	Location	Maximum Rated Source Temperature ($^\circ\text{C}$)
CRT1311071604-010	72.9	Per diagram	110.4

In-Situ Picture – T_s



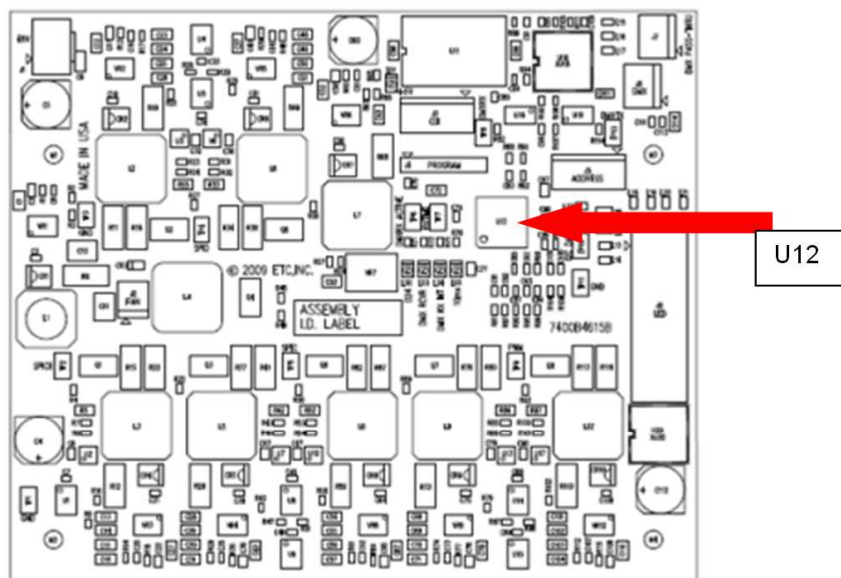
In-Situ Picture – T_s location



RESULTS OF TEST (cont'd)

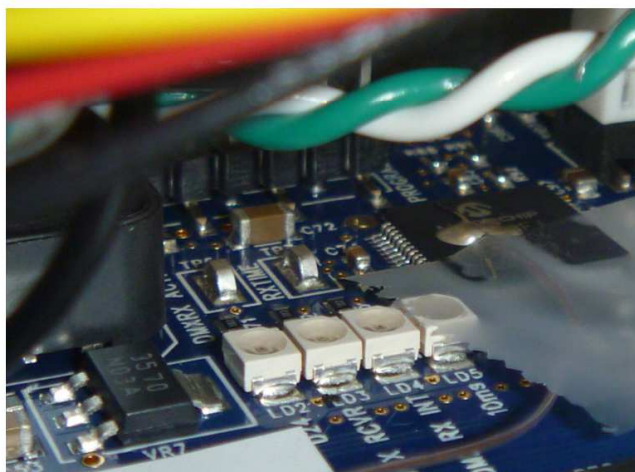
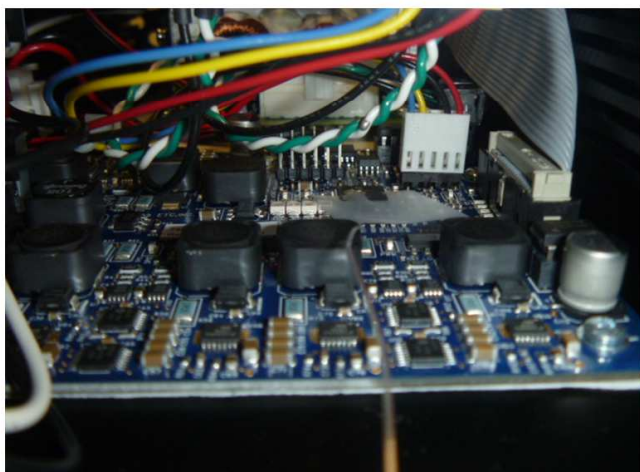
Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-010	52.9	Per diagram	100

Power Supply Picture – Tc location



PICTURE (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

Melanie Brittain

Melanie Brittain
Associate Engineer
Lighting Division

Attachment: None

Report Reviewed By:

Jeffrey Davis

Jeffrey Davis
Engineering Manager
Lighting Division



REPORT

545 E. ALGONQUIN ROAD ARLINGTON HEIGHTS, IL 60005

Project No. G101042657

Date: March 13, 2013

REPORT NO. 101042657CHI-001

IN-SITU TEST OF ONE LED STAGE LIGHT

FIXTURE MODEL NO. LUSTR 21
LED MODEL NO. PHILIPS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

AUTHORIZATION: The testing performed was authorized by signed quote number 500428362.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

Energy Star Version 1.1 (2008): Program Requirements for Solid-State Lighting Luminaires
Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one sample of model number Lustr 21
The sample was received by Intertek on January 16, 2013, in undamaged condition, and one sample was tested as received. The sample designation was 01162013124204.

DATE OF TESTS: February 28, 2013

SUMMARY

Model No.:	Lustr 21
Description:	LED Stage and theatre luminaire

Criteria	Result	
LEDR REBEL RED 1812 LXML-PD01-0040	80.3	Compliant
LEDO REBEL ORG 1812 LXML-PH01-0050	80.4	Compliant
LEDG REBEL GRN 1812 LXML-PM01-0090	79.3	Compliant
LEDC REBEL CYAN 1812 LXML-PE01-0070	77.4	Compliant
LEDB REBEL BLUE 1812 LXML-PB01-0030	77.6	Compliant
LEDI REBEL INDIGO 1812 LXML-PR01-0350	79.0	Compliant
LEDA REBEL PC-AMBER 1812 LXM2-PL01-0000	77.0	Compliant
Maximum Power Supply Case Temperature	63.5	Compliant

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
Agilent Data Logger	34970A	146763	4/23/12	4/23/13
Weather Station	DBAR880	146558	7/23/12	7/23/13
Yokogawa Power Meter	WT210	146761	4/19/12	4/19/13
	561			
Fluke IR Thermometer	HVACPRO	146578	VBU	VBU
Staco Variac	3PN1510B	146345	VBU	VBU

TEST METHODS

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Agilent 34970A Data Logger. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

Estimated Total Operating Time

Model No.	Total Hours
Lustr 21	24

RESULTS OF TESTS

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED identified as: Philips Luxeon Rebel

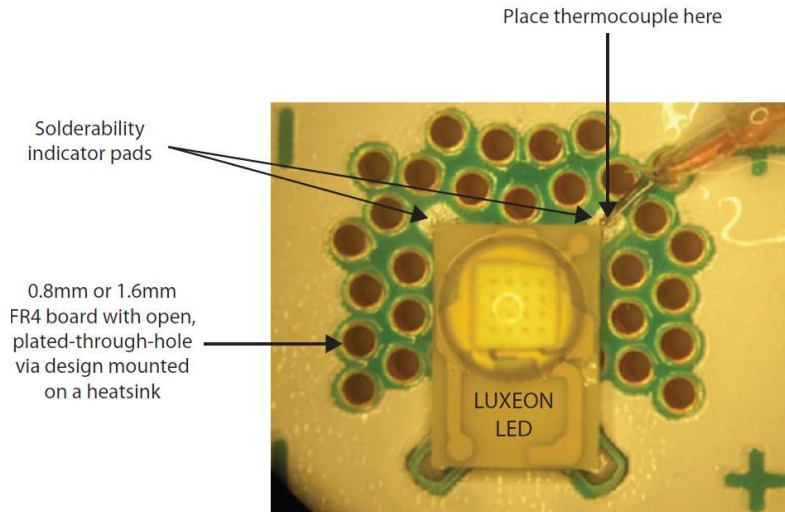


Figure 1. Solderability indicator pad and thermocouple placement.

CR9177-F	LEDR REBEL RED 1812	LXML-PD01-0040 (C-BIN 4)
CR9177-F	LEDR REBEL RED 1812	LXML-PD01-0040 (C-BIN 5)
CR9178-F	LEDO REBEL ORG 1812	LXML-PH01-0050 (C-BIN 2)
CR9180-F	LEDG REBEL GRN 1812	LXML-PM01-0090 (C-BIN 4)
CR9180-F	LEDG REBEL GRN 1812	LXML-PM01-0090 (C-BIN 5)
CR9180-F	LEDG REBEL GRN 1812	LXML-PM01-0090 (C-BIN 6)
CR9180-F	LEDG REBEL GRN 1812	LXML-PM01-0090 (C-BIN 3)
CR9181-F	LEDC REBEL CYAN 1812	LXML-PE01-0070 (C-BIN 1)
CR9181-F	LEDC REBEL CYAN 1812	LXML-PE01-0070 (C-BIN 2)
CR9181-F	LEDC REBEL CYAN 1812	LXML-PE01-0070 (C-BIN 3)
CR9182-F	LEDB REBEL BLUE 1812	LXML-PB01-0030 (C-BIN 3)
CR9182-F	LEDB REBEL BLUE 1812	LXML-PB01-0030 (C-BIN 4)
CR9182-F	LEDB REBEL BLUE 1812	LXML-PB01-0030 (C-BIN 5)
CR9183-F	LEDI REBEL INDIGO 1812	LXML-PR01-0350 (C-BIN 1)
CR9183-F	LEDI REBEL INDIGO 1812	LXML-PR01-0350 (C-BIN 2)
CR9183-F	LEDI REBEL INDIGO 1812	LXML-PR01-0350 (C-BIN 3)
CR9183-F	LEDI REBEL INDIGO 1812	LXML-PR01-0350 (C-BIN 4)
CR9183-F	LEDI REBEL INDIGO 1812	LXML-PR01-0425 (C-BIN 1)
CR9183-F	LEDI REBEL INDIGO 1812	LXML-PR01-0425 (C-BIN 2)
CR9183-F	LEDI REBEL INDIGO 1812	LXML-PR01-0425 (C-BIN 3)
CR9183-F	LEDI REBEL INDIGO 1812	LXML-PR01-0425 (C-BIN 4)
CR9184-F	LEDA REBEL PC-AMBER 1812	LXM2-PL01-0000

RESULTS OF TESTS (cont'd)

Manufacturer Supplied Documentation:

Electrical Characteristics at 350 mA for LUXEON Rebel color, Thermal Pad Temperature = 25°C

Table 3.

Color	Part Number	Forward Voltage V_f ^[1] (V)			Typical Temperature Coefficient of Forward Voltage ^[2] (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R\theta_{j-c}$
		Min.	Typ.	Max.		
Green	LXML-PM01	2.55	2.90	3.51	- 2.0 to - 4.0	10
Cyan	LXML-PE01	2.55	2.90	3.51	- 2.0 to - 4.0	10
Blue	LXML-PB01	2.55	2.95	3.51	- 2.0 to - 4.0	10
Royal-Blue	LXML-PR01	2.55	2.95	3.51	- 2.0 to - 4.0	10
Red	LXML-PD01	2.31	2.90	3.51	- 2.0 to - 4.0	12
Red	LXM2-PD01	1.80	2.10	2.80	- 2.0 to - 4.0	8
Deep Red	LXM3-PD01	1.80	2.10	2.80	- 2.0 to - 4.0	8
Red-Orange	LXML-PH01	2.31	2.90	3.51	- 2.0 to - 4.0	12
Red-Orange	LXM2-PH01	1.80	2.10	2.80	- 2.0 to - 4.0	8
PC Amber	LXM2-PL01	2.55	3.05	3.51	- 2.0 to - 4.0	10
Amber	LXML-PL01	2.31	2.90	3.51	- 2.0 to - 4.0	12

Absolute Maximum Ratings

Table 5.

Parameter	Green/Cyan/ Blue/Royal Blue	LUXEON Rebel ES Royal Blue/ES Blue	Red/Deep-Red Red-Orange/Amber	PC Amber
DC Forward Current (mA)	1000	1000	700	700
Peak Pulsed Forward Current (mA)	1000	1200	700	700
Average Forward Current (mA)	1000	1000	700	700
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3A JESD22-A114-B			
LED Junction Temperature ^[1]	150°C	150°C	135°C	130°C

Manufacturer Supplied Documentation:

Table 11. Applicable for LXML-PXXI and LXM2-PL01 (PC Amber) emitters.

Bin Code	V _f Bins	
	Minimum Forward Voltage (V)	Maximum Forward Voltage (V)
A	2.31	2.55
B	2.55	2.79
C	2.79	3.03
D	3.03	3.27
E	3.27	3.51

Table 12. Applicable for LXML-PR02-XXXX (ES Royal Blue) and LXML-PB02-XXXX (ES Blue) emitters tested at 700 mA.

Bin Code	V _f Bins	
	Minimum Forward Voltage (V)	Maximum Forward Voltage (V)
P	2.50	2.75
R	2.75	3.00
S	3.00	3.25
T	3.25	3.50

Table 13. Applicable for LXM2-PXXI (Red and Red Orange) and LXM3-PD01 (Deep Red) emitters tested at 350 mA.

Bin Code	V _f Bins	
	Minimum Forward Voltage (V)	Maximum Forward Voltage (V)
V	1.80	2.00
W	2.00	2.20
X	2.20	2.40
Y	2.40	2.60
Z	2.60	2.80

RESULTS OF TESTS (cont'd)

LED Identified as Philips Luxeon LEDR REBEL RED 1812 LXML-PD01-0040

In-Situ Maximum Measured LED Source Temperature

Maximum Junction Temperature from LED specification (T_j) = 135°C

Thermal Resistance Formula from LED specification = 12 °C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51

Measured LED Current = 557.0 mA

Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.9565

Maximum Source Temperature (T_s) = 112°C

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013124204	Philips Luxeon LEDR REBEL RED 1812 LXML-PD01-0040	80.3	Per diagram above	112

In-Situ Picture – T_s point



In-Situ Picture – Array location



Location of measured T_c point.

RESULTS OF TESTS (cont'd)

LED Identified as Philips Luxeon LEDO REBEL ORG 1812 LXML-PH01-0050

In-Situ Maximum Measured LED Source Temperature

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 12

Maximum Forward Voltage (V_f) from LED specification = 3.51

Measured LED Current = 549.0 mA

Calculated LED Wattage = $V_f \times$ Measured LED Current = 1.9256

Maximum Source Temperature (T_s) = 127 C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013124204	Philips Luxeon LEDO REBEL ORG 1812 LXML-PH01-0050	80.4	Per diagram above	127

In-Situ Picture – T_s point



In-Situ Picture – Array location



Location of measured T_c point.

RESULTS OF TESTS (cont'd)

LED Identified as Philips Luxeon LEDG REBEL GRN 1812 LXML-PM01-0090

In-Situ Maximum Measured LED Source Temperature

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10

Maximum Forward Voltage (V_f) from LED specification = 3.51

Measured LED Current = 559.0 mA

Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.9614

Maximum Source Temperature (T_s) = 130 C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013124204	Philips Luxeon LEDG Rebel GRN 1812 LXML-PM01-0090	79.3	Per diagram above	130

In-Situ Picture – T_s point



In-Situ Picture – Array location



Location of measured T_c point.

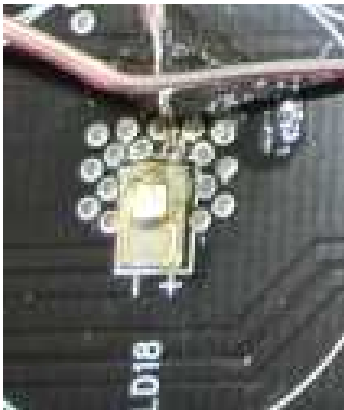
RESULTS OF TESTS (cont'd)
 LED Identified as Philips Luxeon LEDC REBEL CYAN 1812 LXML-PE01-0070

In-Situ Maximum Measured LED Source Temperature
 Maximum Junction Temperature from LED specification (Tj) = 150°C
 Thermal Resistance Formula from LED specification = 10
 Maximum Forward Voltage (Vf) from LED specification = 3.51
 Measured LED Current = 551.0 mA
 Calculated LED Wattage = Vf x Measured LED Current = 1.9351
 Maximum Source Temperature (Ts) = 131C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013124204	Philips Luxeon LEDC REBEL CYAN 1812 LXML-PE01-0070	77.4	Per diagram above	131

In-Situ Picture – Ts point



In-Situ Picture – Array location



Location of measured Tc point.

RESULTS OF TESTS (cont'd)

LED Identified as Philips Luxeon LEDB REBEL BLUE 1812 LXML-PB01-0030

In-Situ Maximum Measured LED Source Temperature

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10

Maximum Forward Voltage (V_f) from LED specification = 3.51

Measured LED Current = 567.0 mA

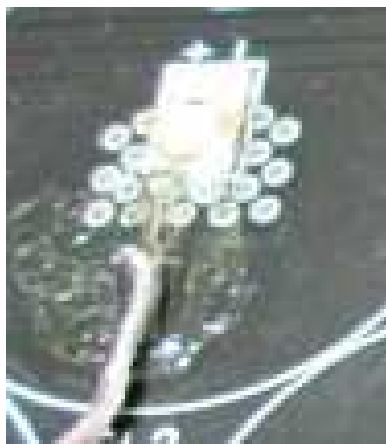
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.9909

Maximum Source Temperature (T_s) = 130 C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013124204	Philips Luxeon LEDB REBEL BLUE 1812 LXML-PB01-0030	77.6	Per diagram above	130

In-Situ Picture – T_s point



In-Situ Picture – Array location



Location of measured T_c point.

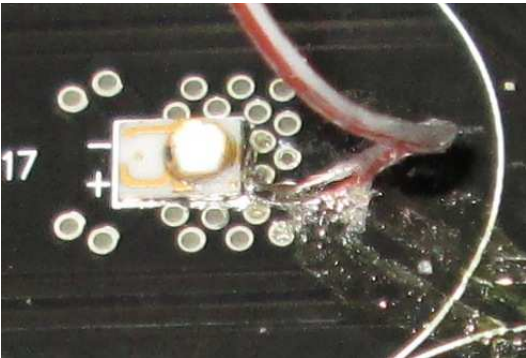
RESULTS OF TESTS (cont'd)
 LED Identified as Philips Luxeon LEDI REBEL INDIGO 1812 LXML-PR01-0350

In-Situ Maximum Measured LED Source Temperature
 Maximum Junction Temperature from LED specification (Tj) = 150°C
 Thermal Resistance Formula from LED specification = 10
 Maximum Forward Voltage (Vf) from LED specification = 3.51
 Measured LED Current = 540.0 mA
 Calculated LED Wattage = Vf x Measured LED Current = 1.8958
 Maximum Source Temperature (Ts) = 131 C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013124204	Philips Luxeon LEDI REBEL INDIGO 1812 LXML-PR01-0350	79.0	Per diagram above	131

In-Situ Picture – Ts point



In-Situ Picture – Array location



Location of measured Tc point.

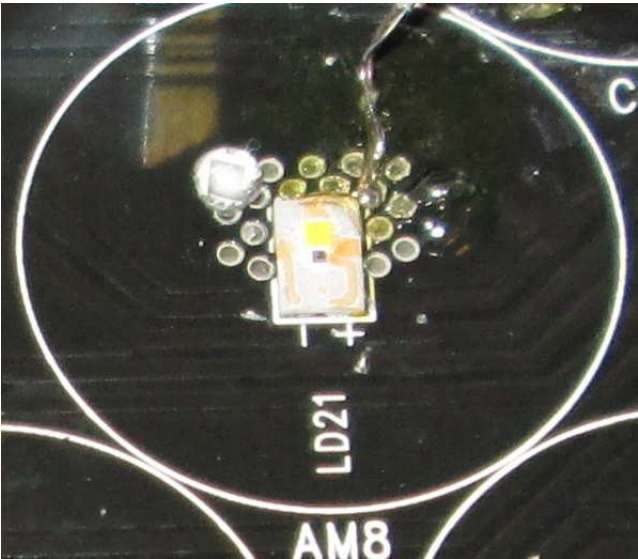
RESULTS OF TESTS (cont'd)
 LED Identified as Philips Luxeon LEDA REBEL PC-AMBER 1812 LXM2-PL01-0000

In-Situ Maximum Measured LED Source Temperature
 Maximum Junction Temperature from LED specification (Tj) = 130°C
 Thermal Resistance Formula from LED specification = 10
 Maximum Forward Voltage (Vf) from LED specification = 3.51
 Measured LED Current = 552.0 mA
 Calculated LED Wattage = Vf x Measured LED Current = 1.9379
 Maximum Source Temperature (Ts) = 111 C°

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Model No.	Maximum Measured Source Temperature (C°)	Location	Maximum Rated Source Temperature (C°)
01162013124204	Philips Luxeon LEDA REBEL PC-AMBER 1812 LXM2-PL01-0000	77.0	Per diagram above	111

In-Situ Picture – Ts point



In-Situ Picture – Array location



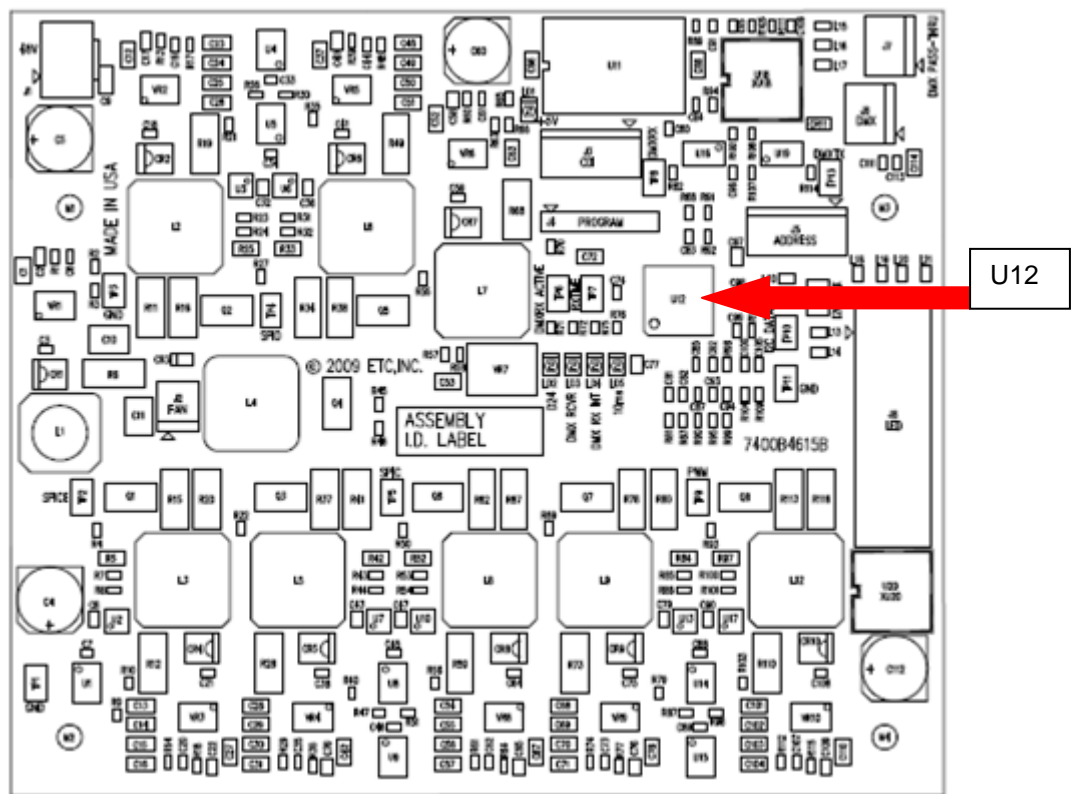
Location of measured Tc point.

RESULTS OF TESTS (cont'd)

Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation:
Driver identified as: 7400B5615, Rev. F

For Selador Classic, measure the temperature at U12.

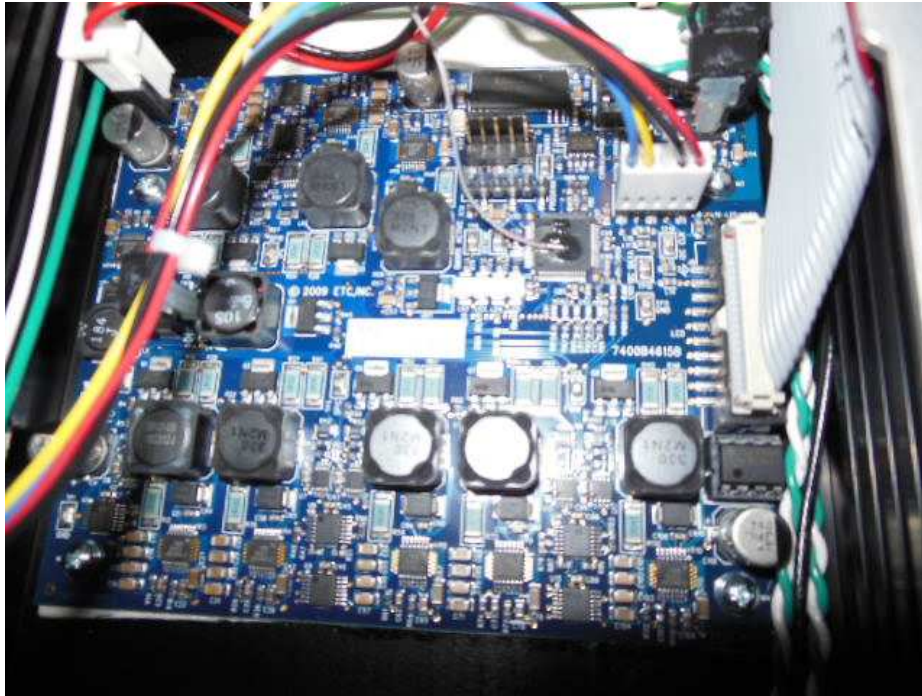


Measured Power Supply Case Temperature

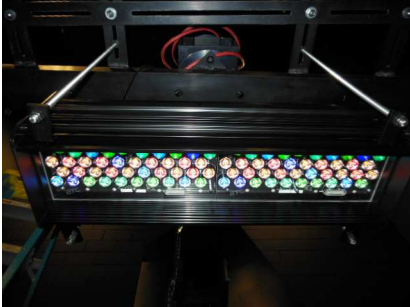
Sample No.	Model No.	Measured Power Supply Case Temperature (C°)	Location	Maximum Power Supply Case Temperature (C°)
01162013124204	7400B5615, Rev. F	63.5	U12	100

RESULTS OF TESTS (cont'd)

Power Supply Picture



Pictures (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

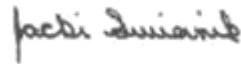
In Charge Of Tests:



Tim Quigley
Engineer
Lighting Division

Attachment: None

Report Reviewed By:



Jacki Swiernik
Staff Engineer
Lighting Division



REPORT

545 EAST ALGONQUIN ROAD ARLINGTON HEIGHTS, IL 60005

Project No. G101042643

Date: March 4, 2013

REPORT NO. 101042643CHI-001

TEST OF ONE LED STAGE LUMINAIRE

FIXTURE MODEL NO. SELADOR LUSTR LED 21
LED MODEL NO. PHILIPS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500428358.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79: 2008 Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products

ANSI ANSLG C38.377: 2012 Specifications of the Chromaticity of Solid State Lighting Products

DESCRIPTION OF SAMPLE: The client submitted one prototype sample of model number Selador Lustr LED 21. The sample was received by Intertek on January 16, 2013, in undamaged condition, and one sample was tested as received. The sample designation was 01162013124204.

DATES OF TESTS: February 11, 2013 through February 12, 2013

SUMMARY

Model No.:	Selador Lustr LED 21
Description:	21" LED Stage Lighting with two LED modules

Criteria	Sphere	Goniometer
Total Lumen Output (Lumens)	4638	4446
Total Power (W)	196.20	197.1
Luminaire Efficacy (LPW)	23.64	22.56

Criteria	Result
Power Factor – 120VAC	0.964
Power Factor – 240VAC	0.398
Current ATHD – 120VAC	23.84%
Current ATHD – 240VAC	43.02%
Correlated Color Temperature (CCT)	N/A*
Color Rendering Index (CRI) - Ra	74.5
Color Rendering Index (CRI) - R9	-17.2
Duv	0.009
Chromaticity Coordinate (x)	0.262
Chromaticity Coordinate (y)	0.283
Chromaticity Coordinate (u')	0.179
Chromaticity Coordinate (v')	0.434

* Note: CCT is a white color parameter and is not accurate for saturated colors.

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
Yokogawa Power Meter	WT210	146919	12/21/12	12/21/13
Omega Thermometer	DPI8-C24	146920	11/15/12	11/15/13
LSI High Speed Mirror Goniometer	6440T	146928	VBV	VBV
Newport Hygrometer	iServer	146961	2/23/12	2/23/13
Elgar, AC Power Supply	CW1251P	146918	VBV	VBV
Cole-Parmer Triple Timer	94440-00	CHI0041	7/19/12	7/19/13
Labsphere Spectroradiometer	CDS1100	CHI0091	VBV	VBV
3 Meter Sphere	SPR600	CHI0088	VBV	VBV
Elgar AC Power Supply	CW1251M	146112	VBV	VBV
Sorenson DC Power Supply	XFR150-8	146846	4/20/12	4/20/13
Newport Temperature and Humidity Recorder	iTHX-SD	146958	2/23/12	2/23/13
Yokogawa Power Meter	WT1600	146769	5/18/12	5/18/13
Omega Temperature Meter	MDSi8	146139	7/19/12	7/19/13



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Three Meter Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided integral driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Estimated Total Operating Time

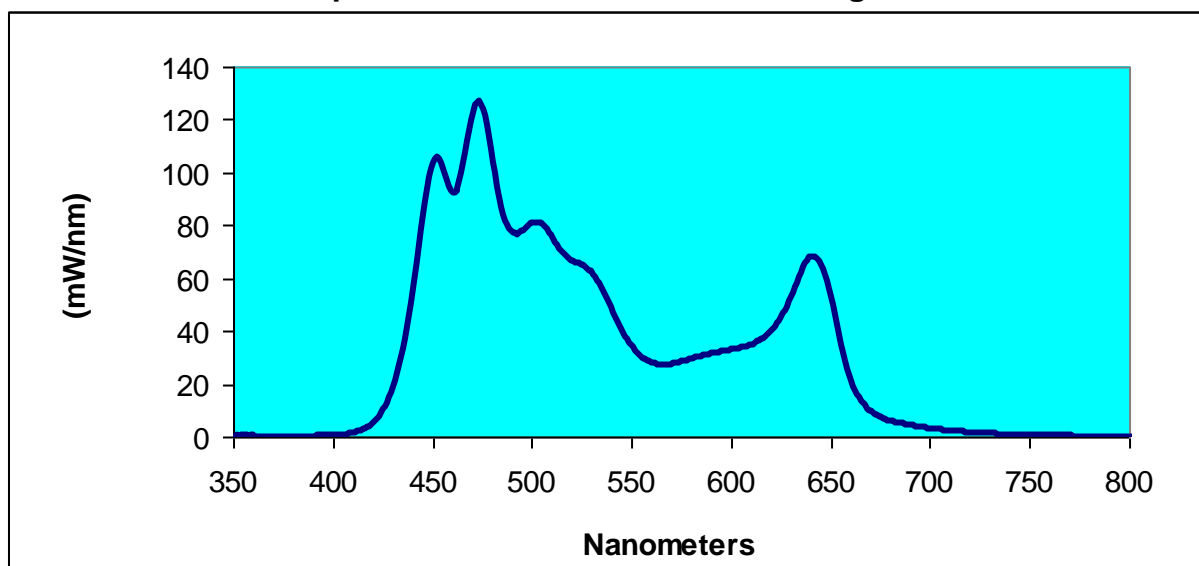
<u>Model No.</u>	<u>Total Hours</u>
Selador Lustr LED 21	5

RESULTS OF TESTS

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.35	460	92.21	570	27.49	680	5.91
355	0.39	465	100.04	575	28.40	685	5.07
360	0.39	470	119.52	580	29.55	690	4.40
365	0.38	475	125.99	585	30.63	695	3.81
370	0.35	480	108.92	590	31.55	700	3.28
375	0.34	485	87.29	595	32.26	705	2.81
380	0.32	490	77.58	600	32.99	710	2.39
385	0.31	495	77.67	605	33.70	715	2.05
390	0.37	500	80.64	610	34.81	720	1.76
395	0.44	505	80.77	615	36.89	725	1.51
400	0.59	510	76.08	620	40.11	730	1.28
405	0.92	515	70.30	625	45.27	735	1.10
410	1.57	520	66.90	630	52.82	740	0.94
415	2.81	525	65.15	635	62.31	745	0.80
420	5.31	530	62.47	640	68.35	750	0.69
425	10.23	535	56.73	645	64.93	755	0.60
430	18.95	540	48.91	650	53.06	760	0.52
435	33.63	545	40.93	655	34.89	765	0.45
440	55.79	550	34.63	660	21.06	770	0.39
445	84.07	555	30.45	665	13.66	775	0.34
450	103.92	560	28.14	670	9.58	780	0.30
455	101.60	565	27.27	675	7.24		

Sample No. 01162013124204
Spectral Data Over Visible Wavelengths



RESULTS OF TESTS (cont'd)

Photometric and Electrical Measurements at 25°C – Integrating Sphere Method

Intertek Sample No.	Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate (x)	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
01162013124204	--	74.5	-17.2	0.009	0.262	0.283	0.179	0.434

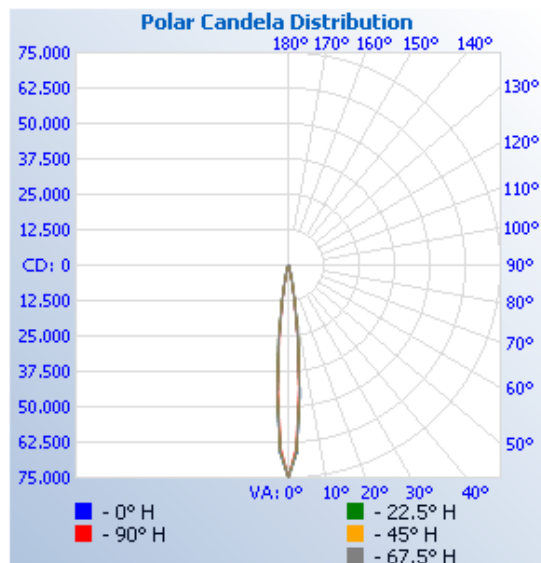
Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
01162013124204	Up	120.0	1697	196.2	0.964	23.84	4638	23.64
		240.0			0.398	43.02		

Photometric and Electrical Measurements – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
01162013124204	Up	120.1	1695	197.1	0.969	4446	22.56

Intensity (Candlepower) Summary at 25°C - Candelas

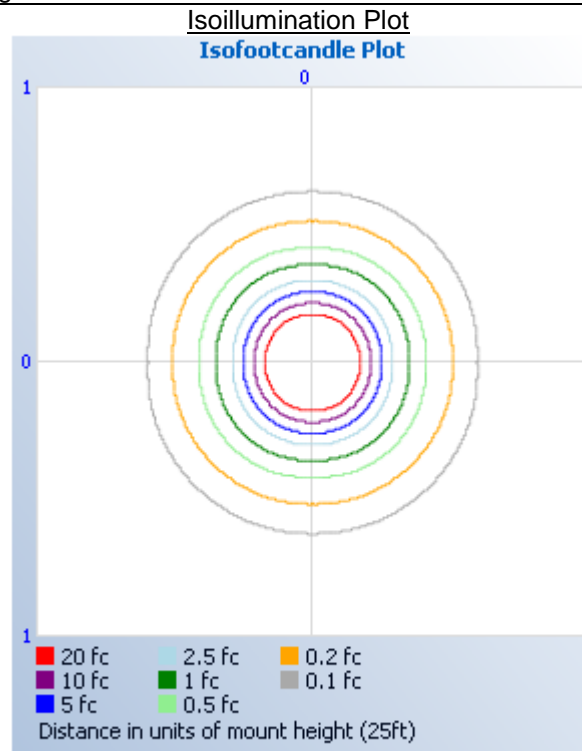
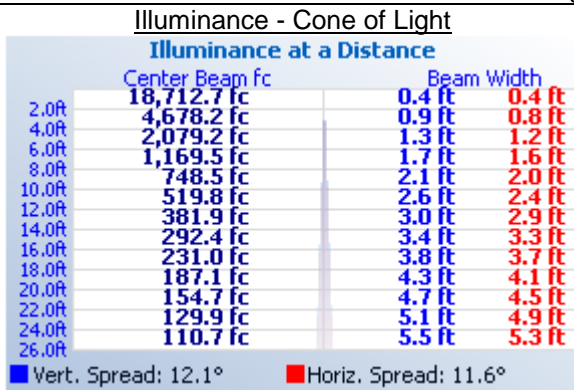
Angle	0	22.5	45	67.5	90
0	74851	74851	74851	74851	74851
5	45954	45887	45250	44972	43755
10	12975	13286	13188	12560	11990
15	2715	2864	2850	2582	2381
20	665	720	733	671	624
25	258	271	272	262	248
30	122	125	123	119	111
35	81	79	75	69	63
40	62	57	50	44	40
45	52	45	33	30	27
50	45	38	25	20	19
55	40	33	20	15	12
60	35	28	16	10	5
65	28	20	11	1	1
70	20	13	1	1	0
75	11	5	0	0	0
80	4	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TESTS (cont'd)

Illumination Plots

Mounting Height: 25 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	4333	97.4
0-40	4381	98.5
0-60	4431	99.7
60-90	15.2	0.3
0-90	4446	100.0
90-180	0.0	0.0
0-180	4446	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	3186	71.7
10-20	1008	22.7
20-30	138.3	3.1
30-40	48.1	1.1
40-50	29.1	0.7
50-60	21.2	0.5
60-70	11.5	0.3
70-80	3.3	0.1
80-90	0.3	0.0

Pictures (not to scale)



Model Selador Lustr LED 21



Luminaire mounted on goniophotometer

CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

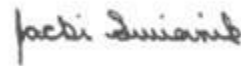
In Charge Of Tests:



Tim Quigley
Engineer
Lighting Division

Attachment: None

Report Reviewed By:



Jacki Swiernik
Staff Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: December 6, 2013

REPORT NO. 101414036CRT-007

TEST OF ONE VIVID-R SL3 LED FIXTURE 11

MODEL NO. VIVID-R SL3 11
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number VIVID-R SL3 11. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-007.

DATES OF TESTS: December 3, 2013 through December 5, 2013

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SUMMARY

Model No.:	VIVID-R SL3 11
Description:	VIVID-R SL3 LED FIXTURE 11

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	2752	3038
Total Power (W)	97.89	97.78
Luminaire Efficacy (LPW)	28.11	31.07

Criteria	Result
Power Factor	0.974
Current ATHD %	16.84
Correlated Color Temperature (CCT - K)	3065
Color Rendering Index (CRI - Ra)	32.1
Color Rendering Index (CRI - R9)	-53.6
DUV	0.066
Chromaticity Coordinate (x)	0.362
Chromaticity Coordinate (y)	0.253
Chromaticity Coordinate (u')	0.273
Chromaticity Coordinate (v')	0.428
Maximum In-Situ Source Temperature Point (°C)	70.4
Maximum In-Situ Driver Case Temperature (°C)	52.9

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fuke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	---	---
Extech Hygro-Thermometer	445703	T1366	11/27/13	11/27/14
Sorensen DC Power Supply	DLM150-20E	---	---	---
Data Precision	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14
LSI High Speed Mirror Goniometer	6440	---	11/21/13	12/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Cole-Palmer Hygro Thermometer	03313-85	T1469	05/31/13	05/31/14
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Extech Hygro-Thermometer	445703	T1360	11/27/13	11/27/14
Fuke Multimeter	87 V	D590	03/28/13	03/28/14
Fuke Temperature Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

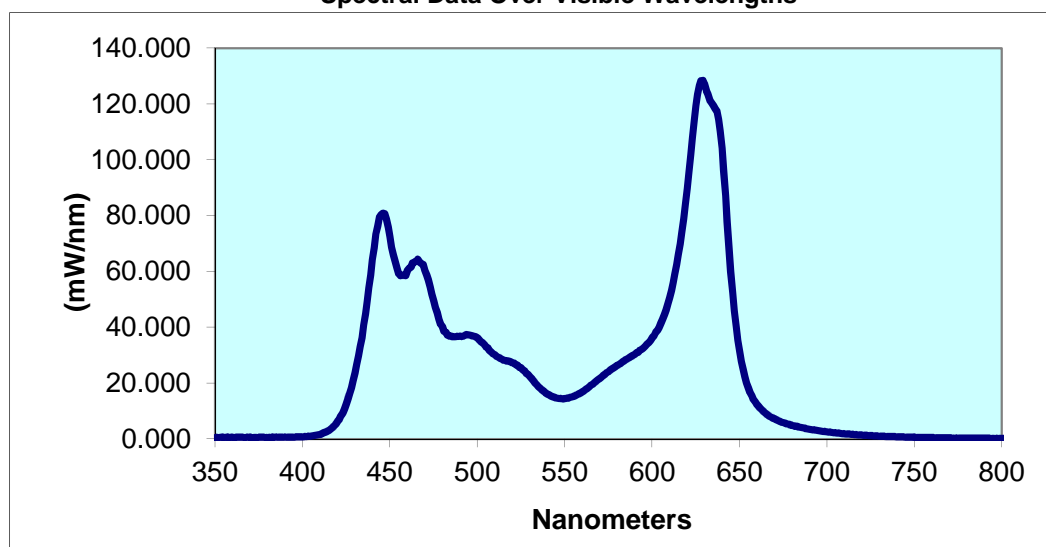
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-007	UP	120.0	837.3	97.89	0.974	16.84	2752	28.11

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
3065	32.1	-53.6	0.066	0.362	0.253	0.273	0.428

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.438	440	64.19	530	22.37	620	89.64	710	1.851
355	0.48	445	80.37	535	18.75	625	119.4	715	1.605
360	0.617	450	72.52	540	16.06	630	127.1	720	1.363
365	0.557	455	59.32	545	14.68	635	119.5	725	1.17
370	0.66	460	60.42	550	14.45	640	104.2	730	0.988
375	0.561	465	63.54	555	15.27	645	59.94	735	0.848
380	0.472	470	60.44	560	16.89	650	31.21	740	0.751
385	0.713	475	49.45	565	19.23	655	18.25	745	0.644
390	0.655	480	40.21	570	21.65	660	12.29	750	0.561
395	0.621	485	36.84	575	24.14	665	9.092	755	0.485
400	0.718	490	36.81	580	26.38	670	7.244	760	0.443
405	1.042	495	37.28	585	28.41	675	5.843	765	0.363
410	1.607	500	36.23	590	30.25	680	4.876	770	0.331
415	3.046	505	33.02	595	32.6	685	4.162	775	0.286
420	6.164	510	30.15	600	36.12	690	3.51	780	0.261
425	12.31	515	28.24	605	41.5	695	2.98		
430	23.61	520	27.36	610	50.63	700	2.584		
435	40.86	525	25.43	615	66.03	705	2.144		

Spectral Data Over Visible Wavelengths



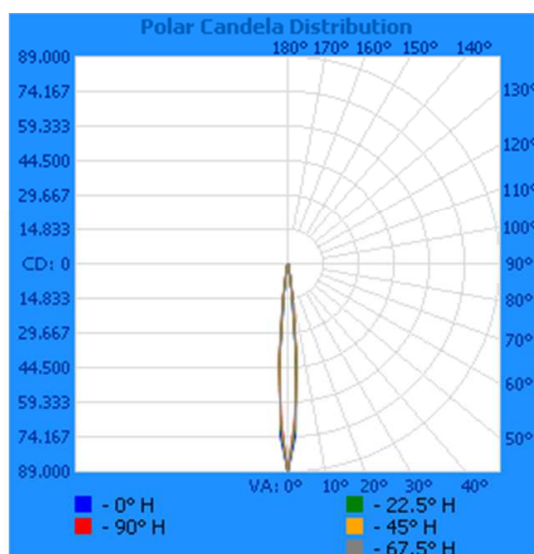
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-007	UP	120.0	835.9	97.78	0.975	3038	31.07

Intensity (Candlepower) Summary at 25°C - Candelas

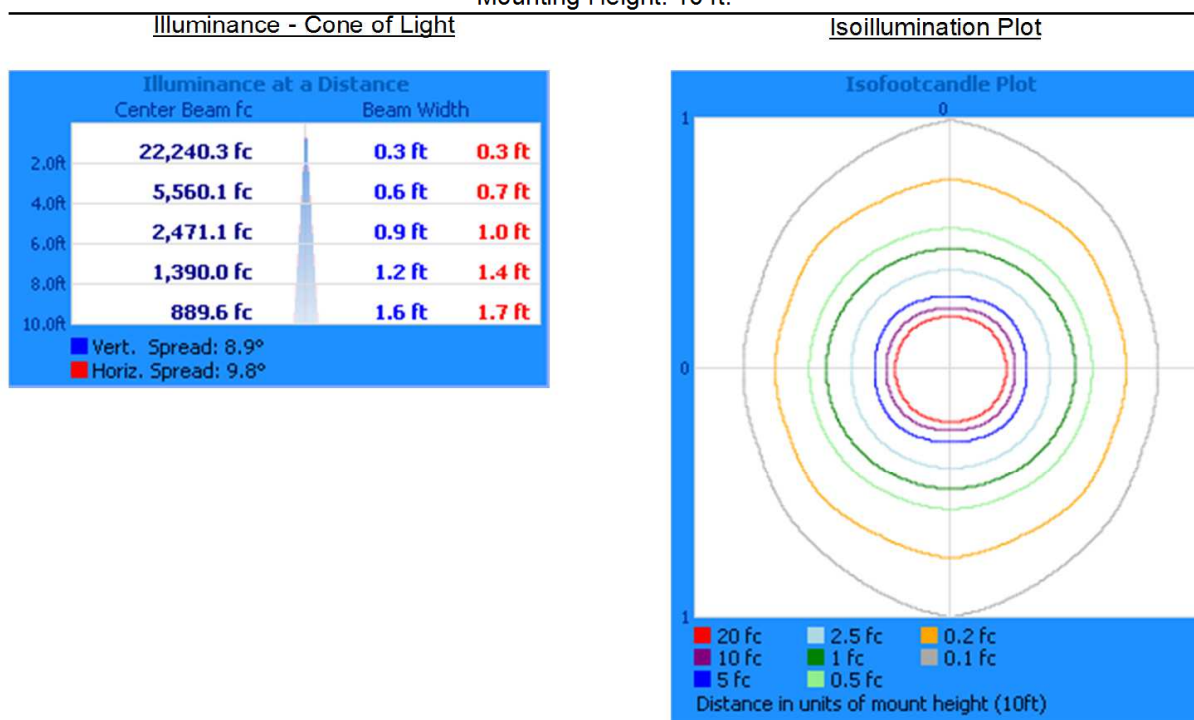
Angle	0	22.5	45	67.5	90
0	88961	88961	88961	88961	88961
5	36475	38693	40393	41500	43402
10	4093	4665	5256	5372	5579
15	652	725	854	807	744
20	384	383	399	387	348
25	152	152	158	164	170
30	70	66	66	63	62
35	46	40	40	33	34
40	33	29	26	20	19
45	28	23	16	14	10
50	24	20	13	5	5
55	16	12	5	0	0
60	7	3	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TEST (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	2992	98.5
0-40	3017	99.3
0-60	3038	100.0
60-90	0.2	0.0
0-90	3038	100.0
90-180	0.0	0.0
0-180	3038	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	2566	84.5
10-20	345.5	11.4
20-30	81.2	2.7
30-40	25.2	0.8
40-50	14.1	0.5
50-60	6.0	0.2
60-70	0.2	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as: Luxeon Rebel ES (Amber)

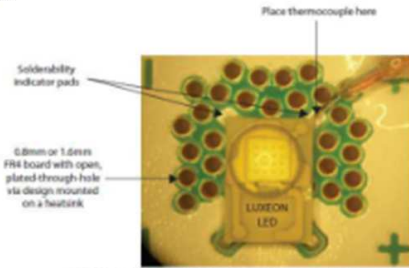


Figure 1. Solderability indicator pad and thermocouple placement.

Color	Part Number	forward voltage V_f ^[1] (V)			Typical Temperature Coefficient of Forward Voltage ^[2] (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R\theta_{jc}$
		Min.	Typ.	Max.		
Amber	LXML-PL01	2.31	2.90	3.51	- 2.0 to - 4.0	12

Maximum LED Junction Temperature 135°C

Maximum Junction Temperature from LED specification (T_j) = 135°C

Thermal Resistance Formula from LED specification = 12°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51V

Measured LED Current = 590mA

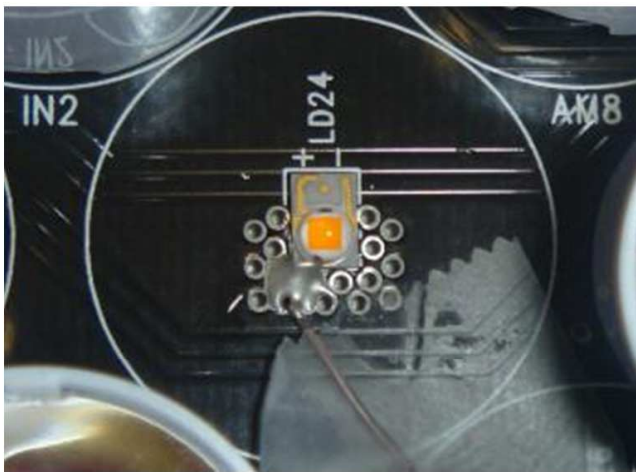
Calculated LED Wattage = $V_f \times$ Measured LED Current = 2.071W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 110.1^\circ\text{C}$

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature (°C)
CRT1311071604-007	70.4	Per diagram	110.1

In-Situ Picture – T_s



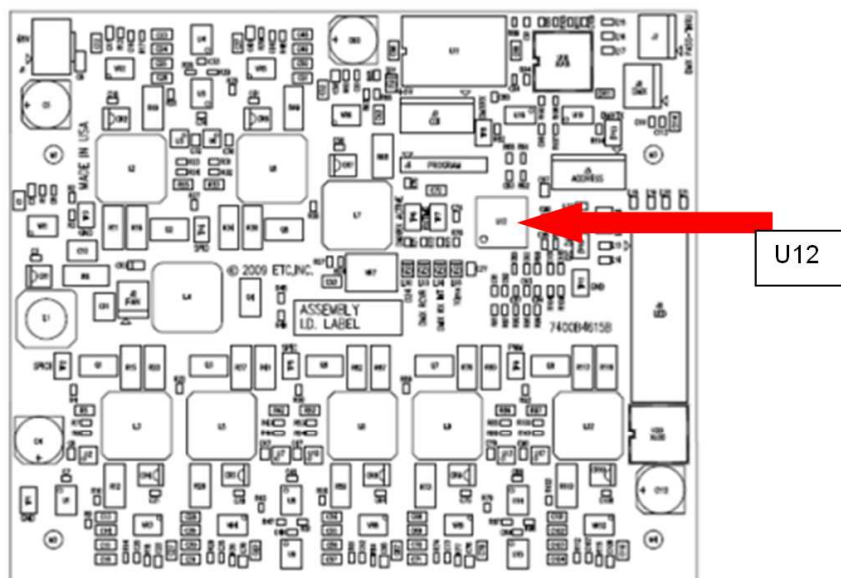
In-Situ Picture – T_s location



RESULTS OF TEST (cont'd)

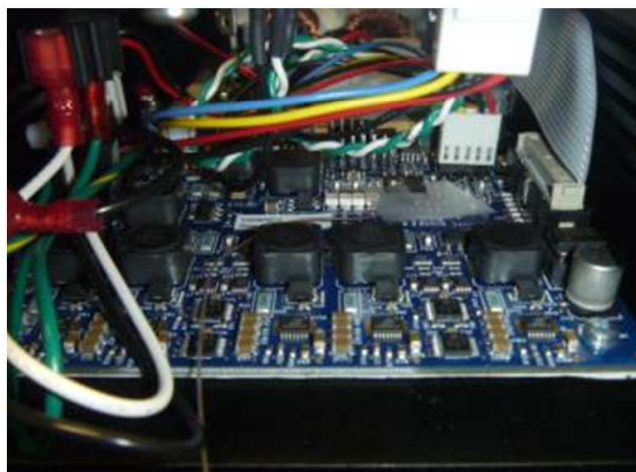
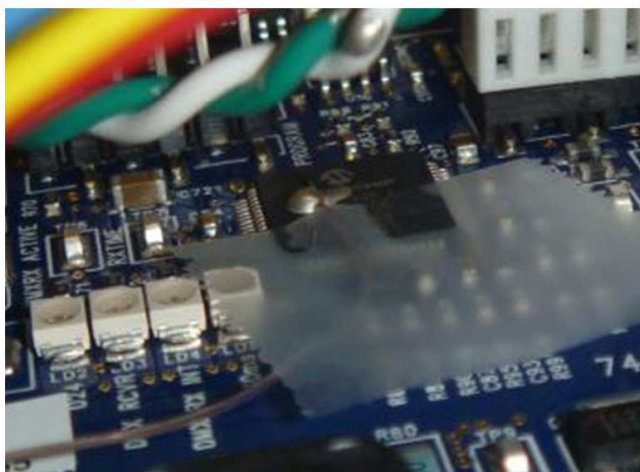
Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-004	52.9	Per diagram	100

Power Supply Picture – Tc location



PICTURE (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:



Melanie Brittain
Associate Engineer
Lighting Division

Attachment: None

Report Reviewed By:



Jeffrey Davis
Engineering Manager
Lighting Division



REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: August 20, 2013

REPORT NO. 101158242CRT-012

TEST OF ONE LED WASH LIGHT

FIXTURE MODEL NO. 11" PALETTA
LED MODEL NO. LUXEON REBEL LXML-PWN2

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and LED In-Situ tests.

LABORATORY NOTE: The laboratory that conducted the testing detailed in this report has been Qualified, Verified, and Recognized for LM-79 Testing for ENERGY STAR for SSL by US DOE's CALiPER program.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

Energy Star Version 1.2 (2012): Program Requirements for Luminaires
Energy Star Manufacturer's Guide Version 2.0 (2009): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one sample of model number 11" PALETTA. The sample was received by Intertek on August 12, in undamaged condition, and one sample was tested as received. The sample designation was CRT1308121125-001.

DATES OF TESTS: August 16, 2013 through August 20, 2013

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SUMMARY

Model No.: 11" PALETTA
Description: LED WASH LIGHT

Criteria	Result
Maximum In-Situ Source Temperature Point – LXML-PM01 GREEN (°C)	71.0
Maximum In-Situ Source Temperature Point – LXML-PE01 CYAN (°C)	68.3
Maximum In-Situ Source Temperature Point – LXML-PB01 BLUE (°C)	73.7
Maximum In-Situ Source Temperature Point – LXML-PR01 ROYAL BLUE (°C)	70.4
Maximum In-Situ Source Temperature Point – LXM2-PL01 PC AMBER (°C)	71.8
Maximum In-Situ Source Temperature Point – LXML-PD01 RED(°C)	71.8
Maximum In-Situ Source Temperature Point – LXML-PH01 ORANGE (°C)	70.3
Maximum Power Supply Case Temperature	70.6

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Fluke Multimeter	PM2525	M127	10/17/12	10/17/13
Fluke Temp Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

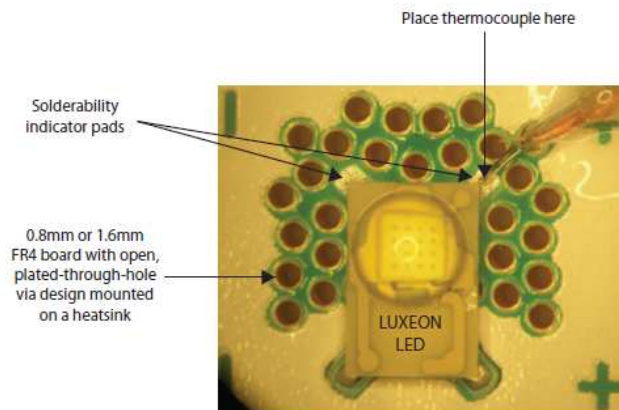
In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke Temperature Meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TESTS

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED identified as: LUXEON REBEL LXML-PWN2



Electrical Characteristics at 350 mA for LUXEON Rebel color, Thermal Pad Temperature = 25°C

Table 3.

Color	Part Number	Forward Voltage V_f ⁽¹⁾ (V)			Typical Temperature Coefficient of Forward Voltage ⁽²⁾ (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R_{\theta_{JC}}$
		Min.	Typ.	Max.		
Green	LXML-PM01	2.55	2.90	3.51	- 2.0 to - 4.0	10
Cyan	LXML-PE01	2.55	2.90	3.51	- 2.0 to - 4.0	10
Blue	LXML-PB01	2.55	2.95	3.51	- 2.0 to - 4.0	10
Royal-Blue	LXML-PR01	2.55	2.95	3.51	- 2.0 to - 4.0	10
Red	LXML-PD01	2.31	2.90	3.51	- 2.0 to - 4.0	12
Red	LXM2-PD01	1.80	2.10	2.80	- 2.0 to - 4.0	8
Deep Red	LXM3-PD01	1.80	2.10	2.80	- 2.0 to - 4.0	8
Red-Orange	LXML-PH01	2.31	2.90	3.51	- 2.0 to - 4.0	12
Red-Orange	LXM2-PH01	1.80	2.10	2.80	- 2.0 to - 4.0	8
PC Amber	LXM2-PL01	2.55	3.05	3.51	- 2.0 to - 4.0	10
Amber	LXML-PL01	2.31	2.90	3.51	- 2.0 to - 4.0	12

Absolute Maximum Ratings

Table 5.

Parameter	Green/Cyan/ Blue/Royal Blue	LUXEON Rebel ES Royal Blue/ES Blue	Red/Deep-Red Red-Orange/Amber	PC Amber
DC Forward Current (mA)	1000	1000	700	700
Peak Pulsed Forward Current (mA)	1000	1200	700	700
Average Forward Current (mA)	1000	1000	700	700
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3A IESD22-A114-B			
LED Junction Temperature ⁽¹⁾	150°C	150°C	135°C	130°C

RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXML-PM01 GREEN

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51 V

Measured LED Current = 561 mA

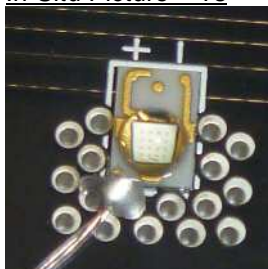
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.969W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 130°C

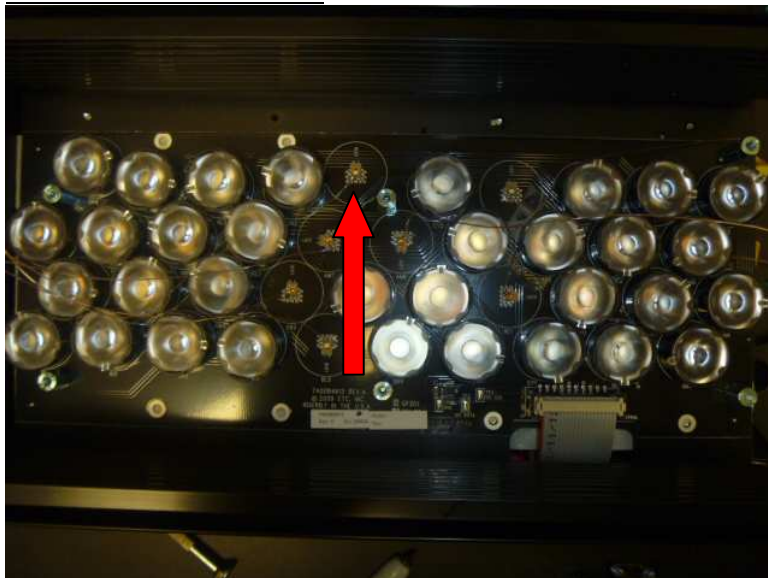
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1308121125-001	71.0	Per diagram above	130

In-Situ Picture – T_s



In-Situ Picture – T_s location



RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXML-PE01 CYAN

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51 V

Measured LED Current = 548 mA

Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 1.924\text{W}$

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 131^\circ\text{C}$

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1308121125-001	68.3	Per diagram above	131

In-Situ Picture – T_s



In-Situ Picture – T_s location



RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXML-PB01 BLUE

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 10°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51 V

Measured LED Current = 566 mA

Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 1.987\text{W}$

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 130^\circ\text{C}$

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1308121125-001	73.7	Per diagram above	130

In-Situ Picture – T_s



In-Situ Picture – T_s location



RESULTS OF TESTS (cont'd)

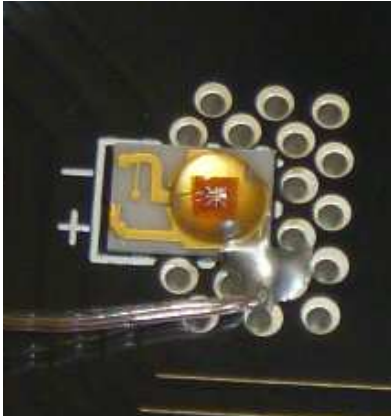
In-Situ Maximum Measured LED Source Temperature - LXML-PR01 ROYAL BLUE

Maximum Junction Temperature from LED specification (Tj) = 150°C
 Thermal Resistance Formula from LED specification = 10°C/W
 Maximum Forward Voltage (Vf) from LED specification = 3.51 V
 Measured LED Current = 540 mA
 Calculated LED Wattage = Vf x Measured LED Current = 1.895W
 Maximum Source Temperature (Ts) = Tj – (LED Wattage x Thermal Resistance) = 131°C

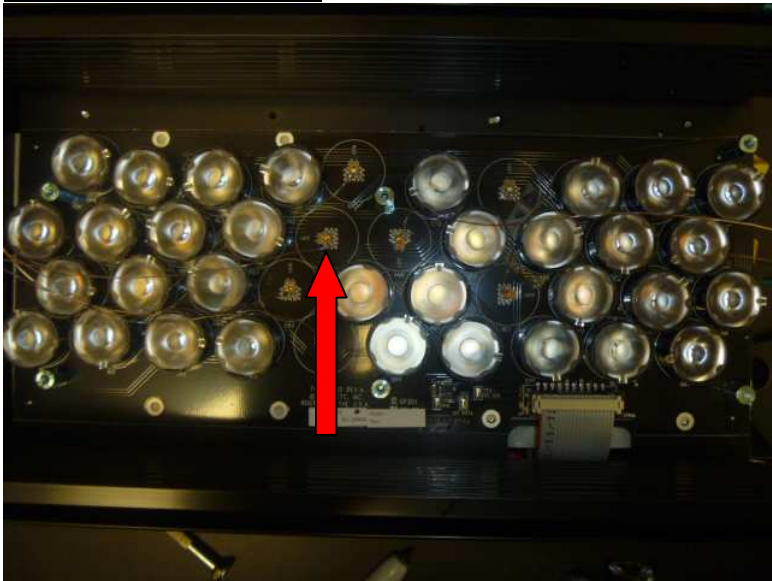
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1308121125-001	70.4	Per diagram above	131

In-Situ Picture – Ts



In-Situ Picture – Ts location





RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXM2-PL01 PC AMBER

Maximum Junction Temperature from LED specification (T_j) = 130°C

Thermal Resistance Formula from LED specification = 12°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51 V

Measured LED Current = 554 mA

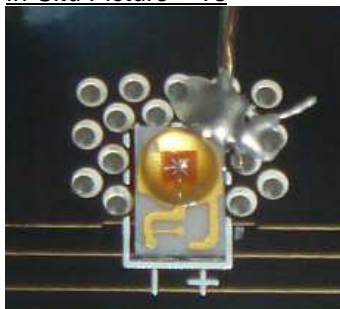
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 1.945W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 107°C

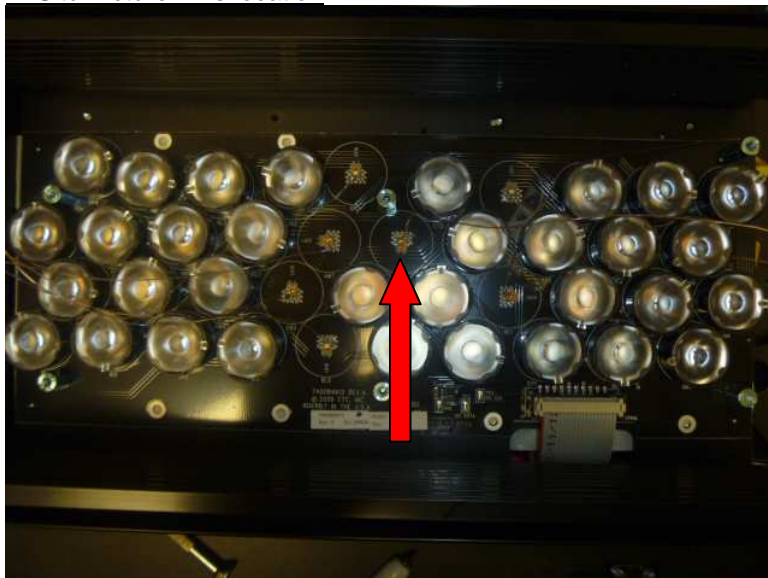
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1308121125-001	71.8	Per diagram above	107

In-Situ Picture – T_s



In-Situ Picture – T_s location



RESULTS OF TESTS (cont'd)

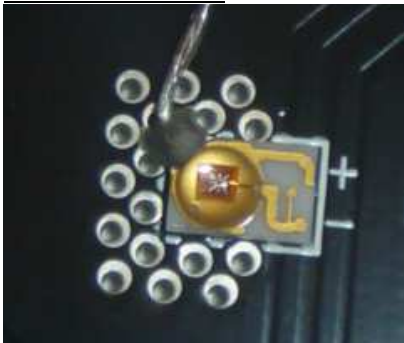
In-Situ Maximum Measured LED Source Temperature - LXM2-PD01 RED

Maximum Junction Temperature from LED specification (T_j) = 135°C
 Thermal Resistance Formula from LED specification = 12°C/W
 Maximum Forward Voltage (V_f) from LED specification = 3.51V
 Measured LED Current = 555 mA
 Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 1.948\text{W}$
 Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 112^\circ\text{C}$

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1308121125-001	71.8	Per diagram above	112

In-Situ Picture – T_s



In-Situ Picture – T_s location



RESULTS OF TESTS (cont'd)

In-Situ Maximum Measured LED Source Temperature - LXML-PH01 ORANGE

Maximum Junction Temperature from LED specification (T_j) = 135°C

Thermal Resistance Formula from LED specification = 12°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.51V

Measured LED Current = 549 mA

Calculated LED Wattage = $V_f \times \text{Measured LED Current} = 1.927\text{W}$

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance}) = 112^\circ\text{C}$

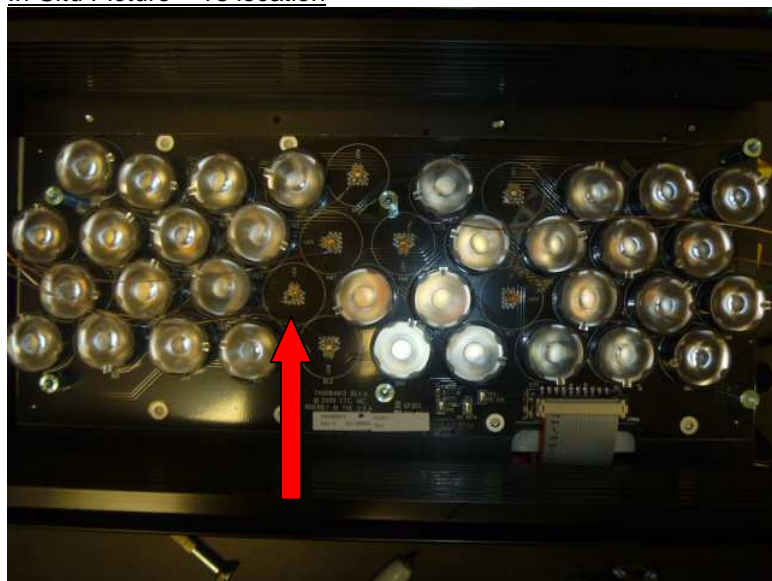
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature(°C)
CRT1308121125-001	70.3	Per diagram above	112

In-Situ Picture – T_s



In-Situ Picture – T_s location



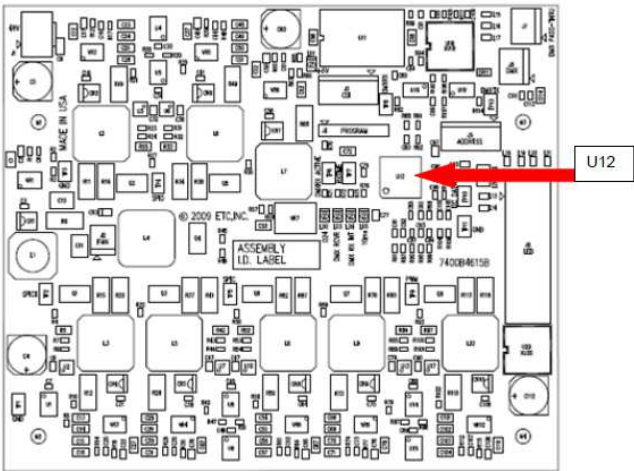
RESULTS OF TESTS (cont'd)

Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation:
Driver identified as: Model No. 7400B5615

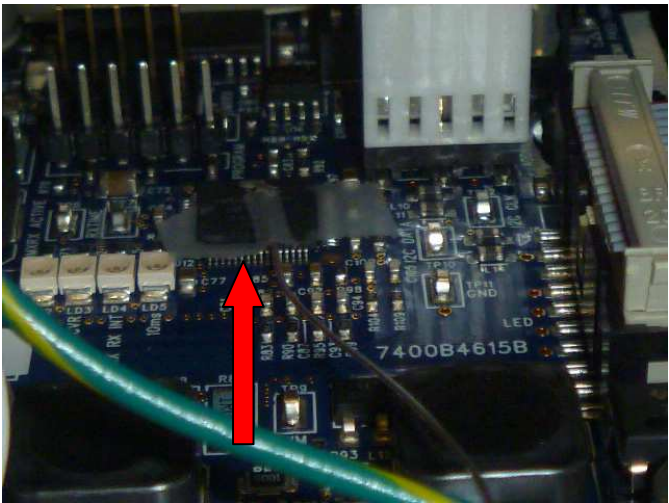
Manufacturer Supplied Documentation:
Driver Identified as: 7400B5615, Rev. F

For Selador Classic, measure the temperature at U12.



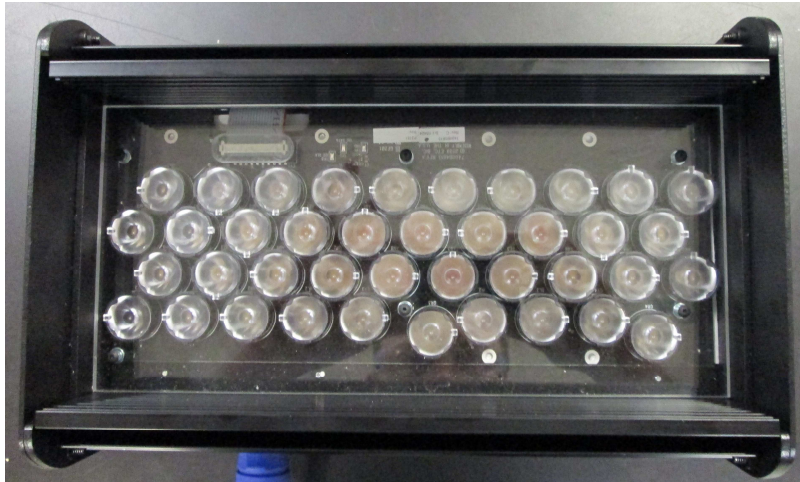
Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Measured Power Supply Case Temperature (°C)	Location	Maximum Power Supply Case Temperature (°C)
CRT1308121125-001	70.6	U12	100





Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink, appearing to be "K R", written over a white background.

Kenda Branch
Engineer
Lighting Division

Attachment: None

Report Reviewed By:

A handwritten signature in black ink, appearing to be "Denis Niggli", written over a white background.

Denis Niggli
Project Engineer
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Project No. G101158242

Date: August 16, 2013

REPORT NO. 101158242CRT-011

TEST OF ONE LED WASH LIGHT

FIXTURE MODEL NO. 11" PALETTA

RENDERED TO

ELECTRONIC THEATER CONTROLS, INC.
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

LABORATORY NOTE: The laboratory that conducted the testing detailed in this report has been Qualified, Verified, and Recognized for LM-79 Testing for ENERGY STAR for SSL by US DOE's CALiPER program.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500447562.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79: 2008 Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products

ANSI ANSLG C38.377: 2012 Specifications of the Chromaticity of Solid State Lighting Products

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number 11" PALETTA. The sample was received by Intertek on August 12, 2013, in undamaged condition, and one sample was tested as received. The sample designation was CRT1308121125-001.

DATES OF TESTS: August 15, 2013

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SUMMARY

Model No.: 11" PALETTA
Description: LED WASH LIGHT

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	1123	1098
Total Power (W)	75.30	75.15
Luminaire Efficacy (LPW)	14.91	14.61

Criteria	Result
Power Factor	0.974
Current ATHD (%)	15.51
Duv	0.064
Chromaticity Coordinate (x)	0.231
Chromaticity Coordinate (y)	0.208
Chromaticity Coordinate (u')	0.184
Chromaticity Coordinate (v')	0.372

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Calibration Date	Calibration Due Date
LSI High Speed Mirror Goniometer	6440	---	07/24/13	08/24/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Extech Hygro Thermometer	445703	T1359	11/08/12	11/08/13
Fisher Scientific	---	N1132	04/22/13	04/22/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fluke Temp Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	NA	NA	NA
Extech Hygro-Thermometer	445703	T1366	11/08/12	11/08/13
Sorensen DC Power Supply	DLM150-20E	N/A	N/A	N/A
FLUKE	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14



TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

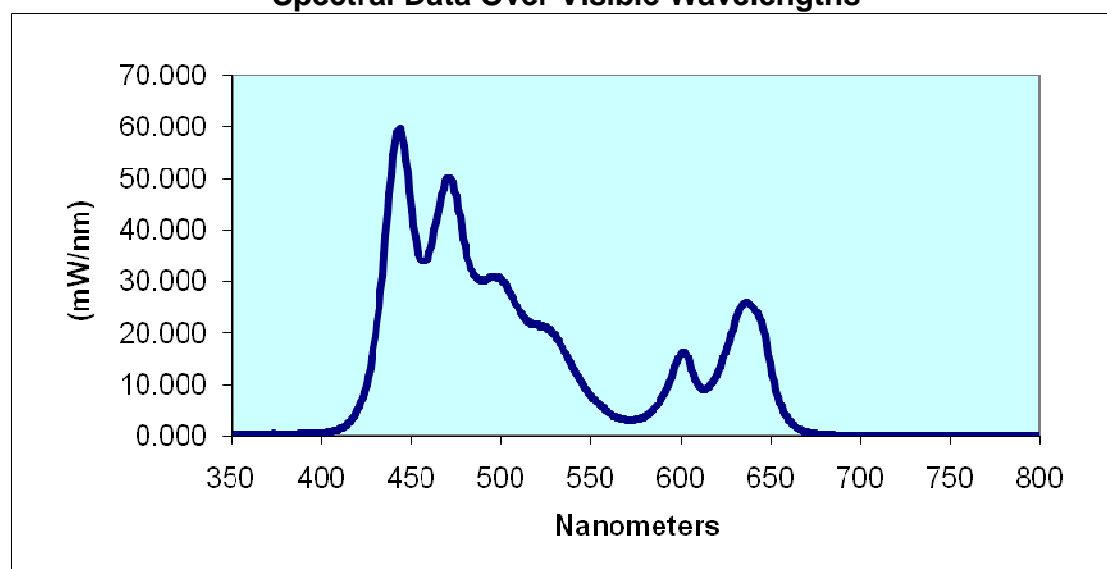
The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

RESULTS OF TESTS

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.208	460	35.595	570	2.990	680	0.231
355	0.272	465	42.888	575	3.049	685	0.150
360	0.344	470	49.978	580	3.716	690	0.103
365	0.298	475	46.458	585	5.109	695	0.082
370	0.375	480	36.856	590	7.493	700	0.067
375	0.350	485	31.155	595	11.399	705	0.055
380	0.336	490	30.234	600	15.772	710	0.049
385	0.362	495	30.702	605	14.099	715	0.046
390	0.380	500	30.364	610	9.585	720	0.040
395	0.445	505	27.596	615	9.267	725	0.040
400	0.528	510	24.525	620	11.703	730	0.037
405	0.724	515	22.144	625	16.255	735	0.030
410	1.190	520	21.536	630	21.808	740	0.031
415	2.363	525	21.010	635	25.802	745	0.023
420	4.909	530	19.536	640	25.185	750	0.027
425	9.879	535	16.575	645	22.157	755	0.028
430	19.291	540	13.275	650	13.822	760	0.028
435	35.270	545	10.239	655	6.422	765	0.000
440	54.536	550	7.754	660	3.031	770	0.028
445	58.491	555	5.858	665	1.462	775	0.028
450	43.860	560	4.418	670	0.743	780	0.024
455	34.177	565	3.450	675	0.395		

Sample No. CRT1308121125-001
Spectral Data Over Visible Wavelengths



RESULTS OF TESTS (cont'd)

Photometric and Electrical Measurements at 25°C – Integrating Sphere Method

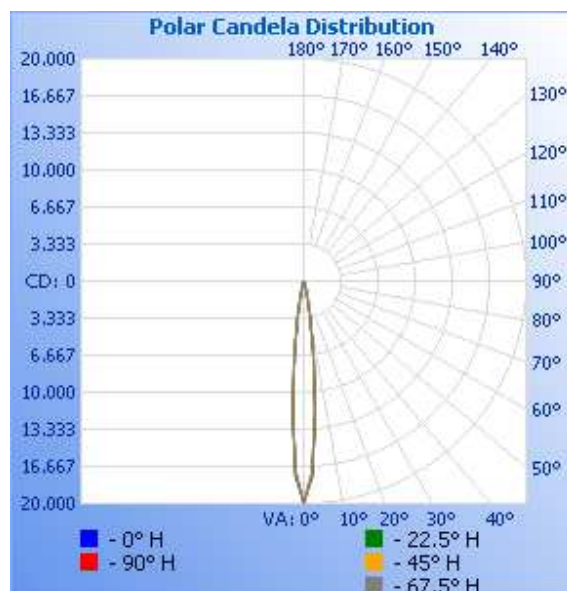
Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Absolute	Lumen
							Luminous Flux (Lumens)	Efficacy (Lumens Per Watt)
CRT1308121125-001	UP	120.0	644.3	75.30	0.974	15.51	1123	14.91
Intertek Sample No.	DUV	CIE 31'	CIE 31'	CIE 76'	CIE 76'			
		Chromaticity Coordinate (x)	Chromaticity Coordinate (y)	Chromaticity Coordinate (u')	Chromaticity Coordinate (v')			
CRT1308121125-001	0.064	0.231	0.208	0.184	0.372			

Photometric and Electrical Measurements – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage (Vac)	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1308121125-001	UP	120.0	641.5	75.15	0.976	1098	14.61

Intensity (Candlepower) Summary at 25°C - Candelas

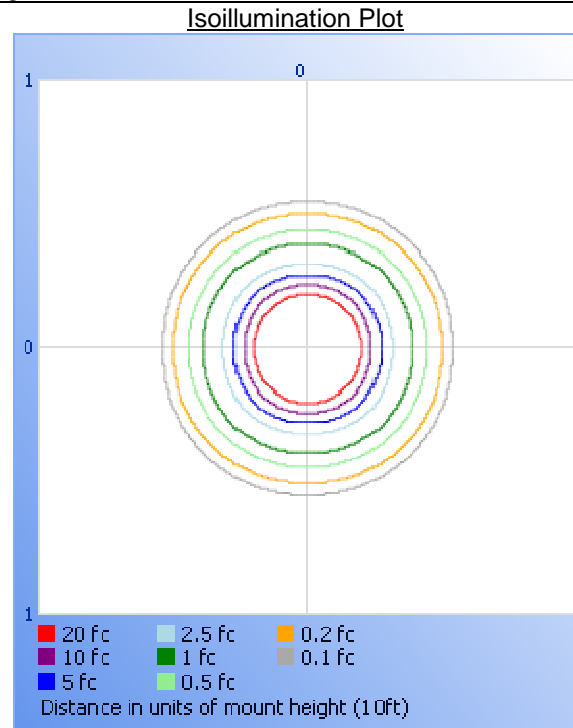
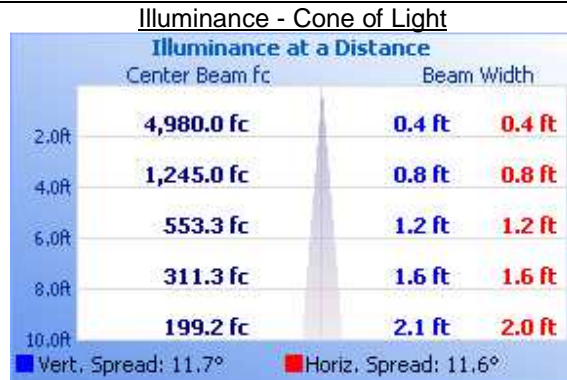
Angle	0	22.5	45	67.5	90
0	19920	19920	19920	19920	19920
5	11793	11684	11694	11652	11631
10	3162	3227	3323	3212	3095
15	615	664	712	630	596
20	162	170	181	168	159
25	47	49	51	48	47
30	10	10	8	7	6
35	0	0	0	0	0
40	0	0	0	0	0
45	0	0	0	0	0
50	0	0	0	0	0
55	0	0	0	0	0
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TESTS (cont'd)

Illumination Plots

Mounting Height: 10 ft.

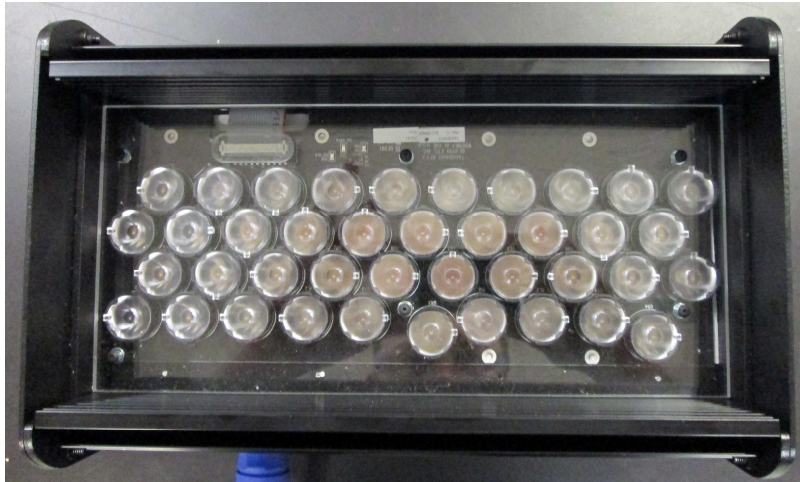


Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	1097	99.9
0-40	1098	100.0
0-60	1098	100.0
60-90	0.0	0.0
0-90	1098	100.0
90-180	0.0	0.0
0-180	1098	100.0



Picture (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:

A handwritten signature in black ink, appearing to read 'Kenda Branch'.

Kenda Branch
Engineer
Lighting Division

Attachment: None

Report Reviewed By:

A handwritten signature in black ink, appearing to read 'Jeffrey Davis'.

Jeffrey Davis
Engineering Manager
Lighting Division



FOR THE SCOPE OF
ACCREDITATION UNDER NVLAP LAB
CODE 100402-0.

REPORT

3933 US ROUTE 11, CORTLAND, NEW YORK 13045

Project No. G101414036

Date: December 6, 2013

REPORT NO. 101414036CRT-003

TEST OF ONE PEARL SL3 FIXTURE 11

MODEL NO. PEARL SL3 11
LED MODEL NO. LUMILEDS LUXEON REBEL

RENDERED TO

ELECTRONIC THEATRE CONTROLS, INC
3031 PLEASANT VIEW ROAD
MIDDLETON, WI 53562

TEST: Electrical and Photometric tests as required to the IESNA test standard.

STATEMENT OF LIMITATION: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

AUTHORIZATION: The testing performed was authorized by signed quote number 500491028.

STANDARDS USED: The following American National Standards or Illuminating Engineering Society of North America Test Guides were used in part or totally to test each specimen:

IESNA LM-79 - 2008: Electrical and Photometric Measurements of Solid State Lighting

ANSI NEMA ANSLG C78.377: 2012: Specifications of the Chromaticity of Solid State Lighting Products

Energy Star Manufacturer's Guide Version 2.1 (2010): Guide for Qualifying Solid State Lighting Luminaires

DESCRIPTION OF SAMPLE: The client submitted one production sample of model number PEARL SL3 11. The sample was received by Intertek on November 7, 2013, in undamaged condition and one sample was tested as received. The sample designation was CRT1311071604-003.

DATES OF TESTS: December 3, 2013 through December 5, 2013

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SUMMARY

Model No.:	PEARL SL3 11
Description:	PEARL SL3 FIXTURE 11

Criteria	Result	
	Sphere	Goniometer
Total Lumen Output (Lumens)	4363	4942
Total Power (W)	98.76	98.74
Luminaire Efficacy (LPW)	44.18	50.05

Criteria	Result
Power Factor	0.975
Current ATHD %	17.56
Correlated Color Temperature (CCT - K)	4338
Color Rendering Index (CRI - Ra)	80.6
Color Rendering Index (CRI - R9)	14.0
DUV	0.002
Chromaticity Coordinate (x)	0.366
Chromaticity Coordinate (y)	0.364
Chromaticity Coordinate (u')	0.221
Chromaticity Coordinate (v')	0.493
Maximum In-Situ Source Temperature Point (°C)	70.7
Maximum In-Situ Driver Case Temperature (°C)	57.3

EQUIPMENT LIST

Equipment Used	Model Number	Control Number	Last Date Calibrated	Calibration Due Date
Yokogawa Power Analyzer	WT1600	E474	03/15/13	03/15/14
LABSPHERE 3M	W/ CDS 1100	N307	VBV	VBV
Fuke Temperature Meter	53 II	T1318	03/15/13	03/15/14
Elgar Power Supply	CW1251	---	---	---
Extech Hygro-Thermometer	445703	T1366	11/27/13	11/27/14
Sorensen DC Power Supply	DLM150-20E	---	---	---
Data Precision	45	M133	02/07/13	02/07/14
Data Precision	3600	V124	02/07/13	02/07/14
Leeds & Northrup Co. Current Shunt	37637	1089	02/07/13	02/07/14
LSI High Speed Mirror Goniometer	6440	---	11/21/13	12/21/13
Elgar Power Supply	CW1251	---	VBV	VBV
Yokogawa Power Analyzer	WT210	E464	04/17/13	04/17/14
Cole-Palmer Hygro Thermometer	03313-85	T1469	05/31/13	05/31/14
Fisher Scientific	14-649-9	N1405	08/13/13	08/13/14
M-D Building Products	Smart Tool	L112	02/13/13	02/13/14
Extech Hygro-Thermometer	445703	T1360	11/27/13	11/27/14
Fuke Multimeter	87 V	D590	03/28/13	03/28/14
Fuke Temperature Meter	53 II	D588	03/15/13	03/15/14

TEST METHODS

Seasoning in Sample Orientation – LED Products

No seasoning was performed in accordance with IESNA LM-79.

Photometric and Electrical Measurements – Integrating Sphere Method

A Labsphere Model CDS 1100 CCD Array Spectroradiometer and Two Meter or Ten Foot Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation. Each SSL unit was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

The calibration of the sphere photometer-spectroradiometer system is traceable to the National Institute of Standards and Technology.

Photometric and Electrical Measurements – Distribution Method

A LSI Type C High Speed Model 6440 Mirror Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample.

Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to stabilize for at least thirty minutes before measurements were made. Electrical measurements including voltage, current, and power were measured using the Xitron or Yokogawa Power Analyzer.

Some graphics were created with Photometrics Plus software.

In-Situ Maximum Measured Power Supply Case and LED Source Point Temperature

Power supply case and/or LED source operating temperature measurements were taken on one test sample per model with a thermocouple and Fluke 87 temperature meter. The SSL sample was allowed to reach thermal equilibrium for seven and a half hours before measurements were taken. Power supply or source temperature measurements were measured at the TMPPS or TS point as indicated by the included diagram in accordance with manufacturers declared hot spot location, or at a hot spot location found with a thermal camera when no diagram from the manufacturer is given. The maximum temperature was recorded for the sample. A simulated ceiling or other enclosure may be used in accordance to UL 1598 or UL 153 as applicable.

RESULTS OF TEST

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) - Integrating Sphere Method

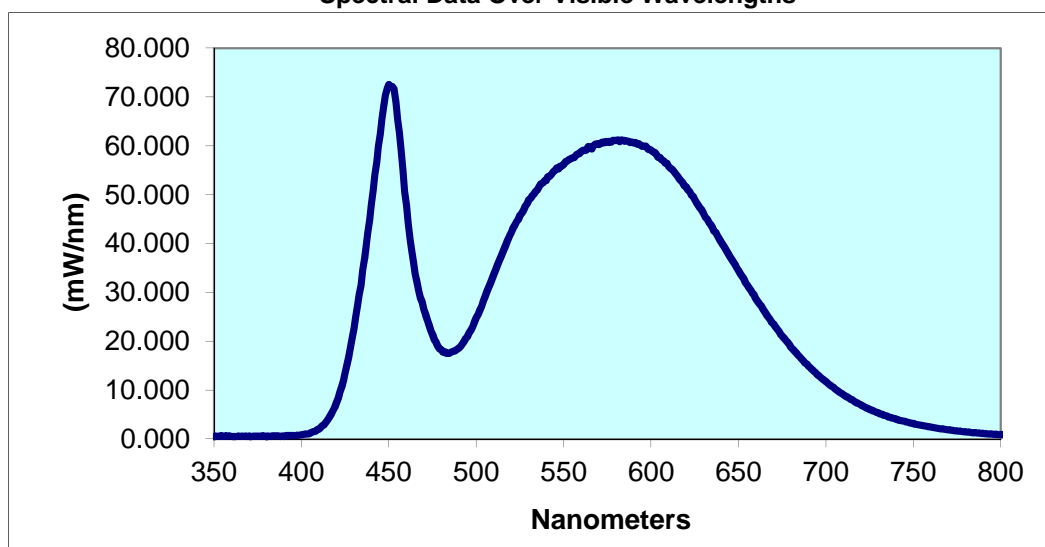
Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Current ATHD (%)	Luminous Flux (Lumens)	Lumen Efficacy (LPW)
CRT1311071604-003	UP	120.0	842.8	98.76	0.975	17.56	4363	44.18

Correlated Color Temperature (K)	CRI -Ra	CRI -R9	DUV	CIE 31' Chromaticity Coordinate	CIE 31' Chromaticity Coordinate (y)	CIE 76' Chromaticity Coordinate (u')	CIE 76' Chromaticity Coordinate (v')
4338	80.6	14.0	0.002	0.366	0.364	0.221	0.493

Spectral Distribution over Visible Wavelengths

nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm	nm	mW/nm
350	0.46	440	47.96	530	48.98	620	51.58	710	9.077
355	0.522	445	62.4	535	51.01	625	48.99	715	7.98
360	0.52	450	72.57	540	52.98	630	46.11	720	6.978
365	0.547	455	65.55	545	54.96	635	43.24	725	6.069
370	0.59	460	47.83	550	56.2	640	40.34	730	5.304
375	0.534	465	33.77	555	57.55	645	37.37	735	4.667
380	0.459	470	26.55	560	58.86	650	34.39	740	4.067
385	0.622	475	21.25	565	59.69	655	31.47	745	3.583
390	0.566	480	18.24	570	60.29	660	28.67	750	3.142
395	0.68	485	17.65	575	60.75	665	25.96	755	2.754
400	0.855	490	18.64	580	61.08	670	23.52	760	2.412
405	1.172	495	20.98	585	60.97	675	21.03	765	2.115
410	2.026	500	24.81	590	60.62	680	18.72	770	1.837
415	3.926	505	29	595	59.88	685	16.77	775	1.637
420	7.44	510	33.75	600	59.1	690	14.91	780	1.449
425	13.54	515	38.04	605	57.64	695	13.17		
430	22.65	520	42.2	610	55.76	700	11.72		
435	34.56	525	45.83	615	53.91	705	10.32		

Spectral Data Over Visible Wavelengths



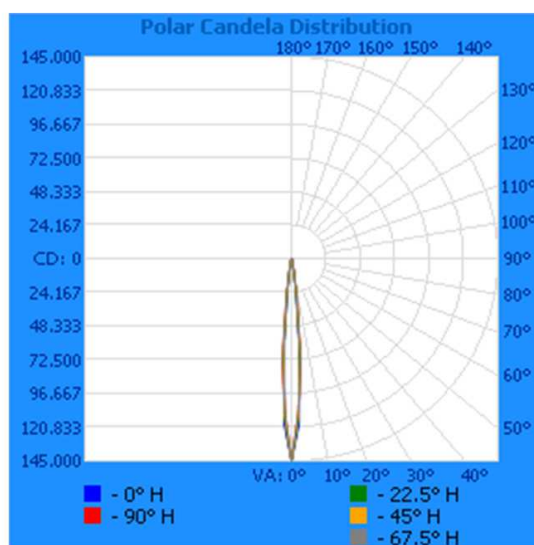
RESULTS OF TEST (cont'd)

Photometric and Electrical Measurements at Ambient Temperature (25°C +/- 1°C) – Distribution Method

Intertek Sample No.	Base Orientation	Input Voltage {Vac}	Input Current (mA)	Input Power (Watts)	Input Power Factor	Absolute Luminous Flux (Lumens)	Lumen Efficacy (Lumens Per Watt)
CRT1311071604-003	UP	120.0	842.2	98.74	0.977	4942	50.05

Intensity (Candlepower) Summary at 25°C - Candelas

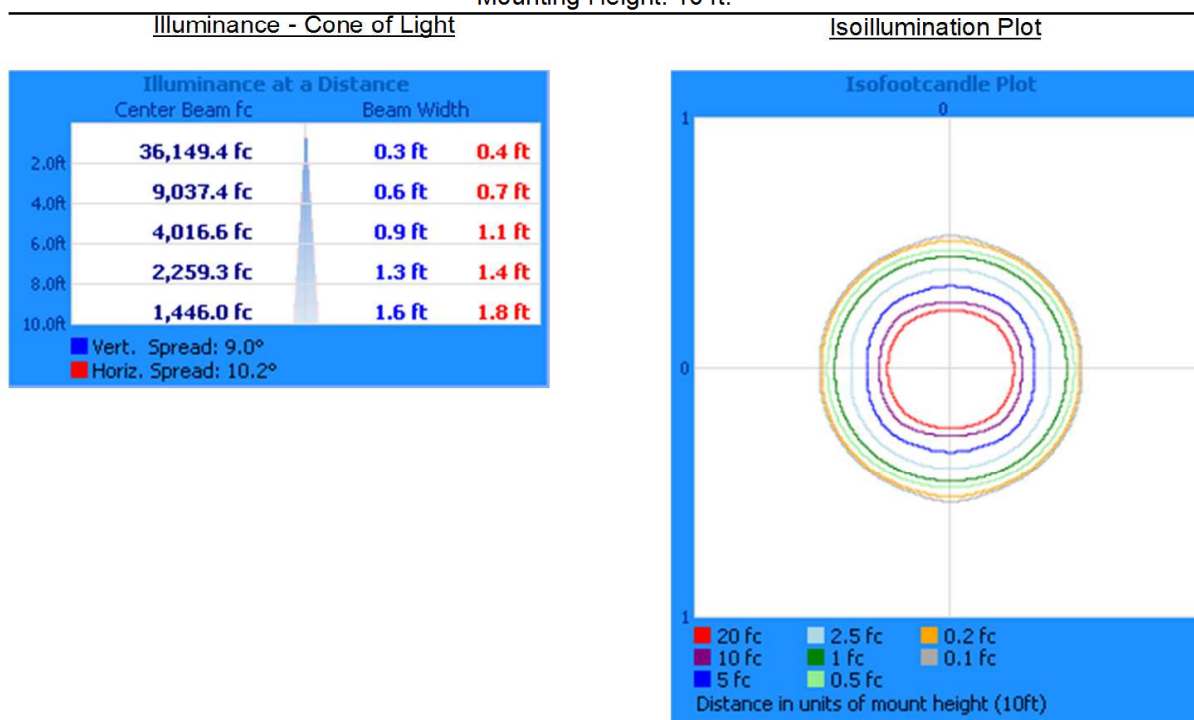
Angle	0	22.5	45	67.5	90
0	144598	144598	144598	144598	144598
5	60806	64097	68345	72110	74556
10	7221	7992	8836	9096	9425
15	1036	1183	1475	1389	1240
20	473	445	503	456	379
25	76	86	98	101	105
30	0	0	0	0	0
35	0	0	0	0	0
40	0	0	0	0	0
45	0	0	0	0	0
50	0	0	0	0	0
55	0	0	0	0	0
60	0	0	0	0	0
65	0	0	0	0	0
70	0	0	0	0	0
75	0	0	0	0	0
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



RESULTS OF TEST (cont'd)

Illumination Plots

Mounting Height: 10 ft.



Zonal Lumen Summary and Percentages at 25°C

Zone	Lumens	% Luminaire
0-30	4942	100.0
0-40	4942	100.0
0-60	4942	100.0
60-90	0.0	0.0
0-90	4942	100.0
90-180	0.0	0.0
0-180	4942	100.0

Zonal Lumens and Percentages at 25°C

Zone	Lumens	% Luminaire
0-10	4304	87.1
10-20	575.8	11.7
20-30	62.1	1.3
30-40	0.0	0.0
40-50	0.0	0.0
50-60	0.0	0.0
60-70	0.0	0.0
70-80	0.0	0.0
80-90	0.0	0.0

RESULTS OF TEST (cont'd)

In-Situ Maximum Measured LED Source Temperature

Manufacturer Supplied Documentation:

LED model identified as:

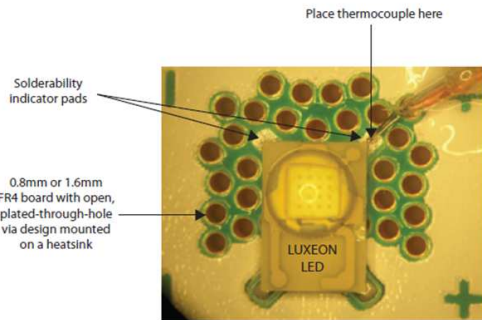


Figure 1. Solderability indicator pad and thermocouple placement.

Nominal ANSI CCT	Forward Voltage V_f ^[1] (V)		Typical Temperature Coefficient of Forward Voltage ^[2] $\Delta V_f / \Delta T$ (mV/°C)	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R_{\theta j-c}$
	Min.	Max.		
2700K	2.5	3.5	-1.8 to -2.4	6
3000K	2.5	3.5	-1.8 to -2.4	6
4000K	2.5	3.5	-1.8 to -2.4	6
5000K	2.5	3.5	-1.8 to -2.4	6

LED Junction Temperature ^[3] 150°C

Maximum Junction Temperature from LED specification (T_j) = 150°C

Thermal Resistance Formula from LED specification = 6°C/W

Maximum Forward Voltage (V_f) from LED specification = 3.5V

Measured LED Current = 579mA

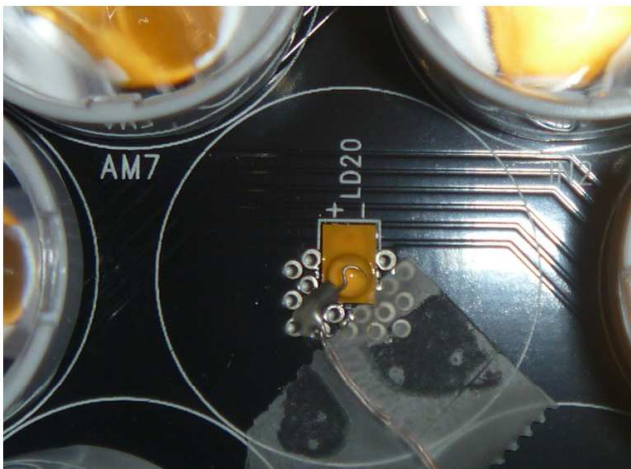
Calculated LED Wattage = $V_f \times \text{Measured LED Current}$ = 2.026W

Maximum Source Temperature (T_s) = $T_j - (\text{LED Wattage} \times \text{Thermal Resistance})$ = 137.8°C

Maximum Measured Manufacturer Designated Source Temperature

Sample No.	Maximum Measured Source Temperature (°C)	Location	Maximum Rated Source Temperature (°C)
CRT1311071604-003	70.7	Per diagram	137.8

In-Situ Picture – T_s

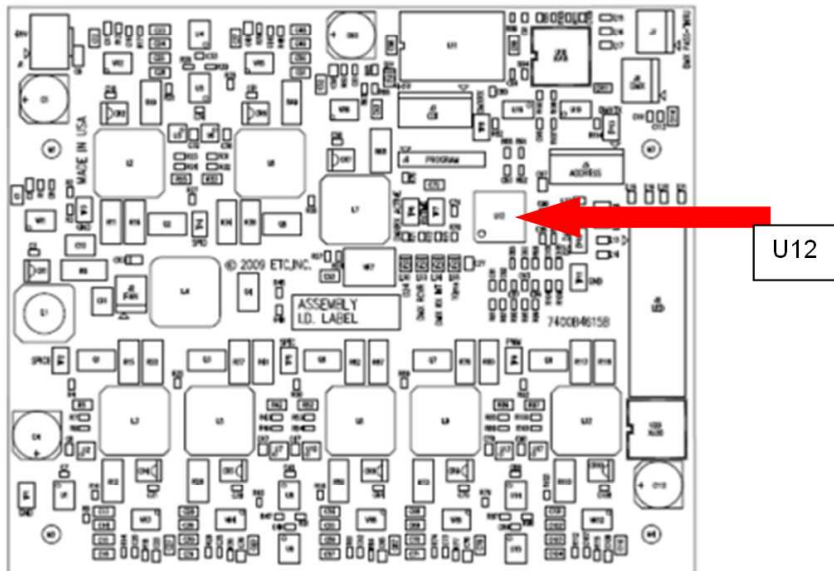


In-Situ Picture – T_s location



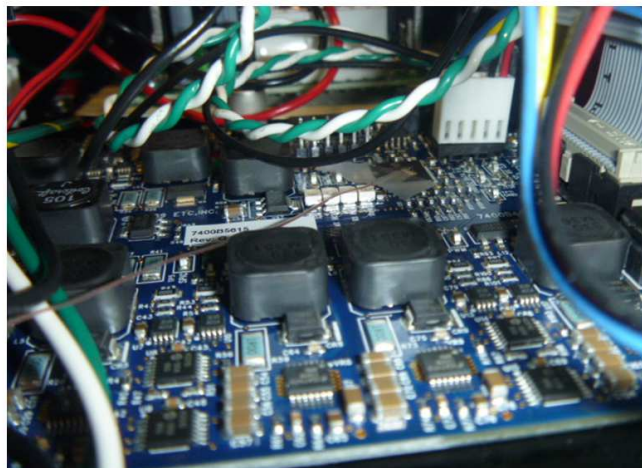
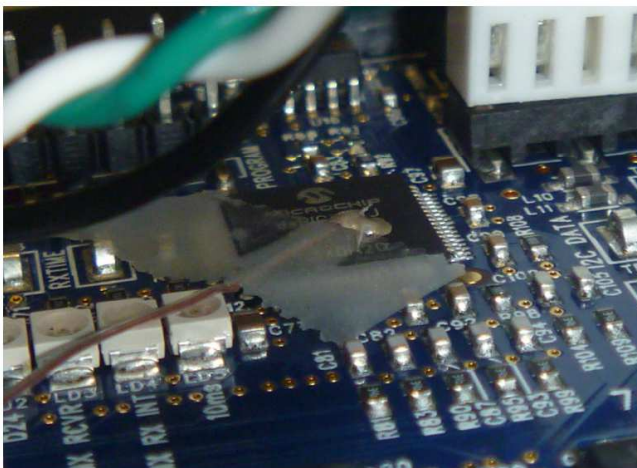
Maximum Measured Power Supply Case Temperature

Manufacturer Supplied Documentation



Sample No.	Maximum Measured Case Temperature (°C)	Location	Maximum Rated Power Supply Case Temperature (°C)
CRT1311071604-003	52.9	Per diagram	100

Power Supply Picture – Tc location



PICTURE (not to scale)



CONCLUSION

The results tabulated in this report are representative of the actual test samples submitted for this report only. The data is provided to the client for further evaluation. Compliance to the referenced specification requirements was not determined in this report.

In Charge Of Tests:



Melanie Brittain
Associate Engineer
Lighting Division

Attachment: None

Report Reviewed By:



Jeffrey Davis
Engineering Manager
Lighting Division