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Orb Test Engineer: _____

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CUSTOMER INFORMATION:

Prepared for:	Orb Optronix 1003 7 th Ave, Suite B Kirkland, WA 98033	Ticket Number:	208 ORB001
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Evaluation For: 120 cm x 40 cm, 850 nm Infrared Illuminator

REPORT DESCRIPTION:

This report covers recommended practices for classification, labeling, and informational requirements for devices that emit optical radiation and in the 200 nm to 3000 nm range. In the ANSI/IESNA RP-27 series, Recommended Practice for Photobiological Safety for Lamps and Lamp Systems, lamp systems are categorized according to the degree of the hazard associated with them. This categorization results in either an Exempt Group or one of three Risk Group classifications. Control measures and safety performance engineering requirements become more important and more stringent with increasing risk category.

DEVICE UNDER TEST (DUT) DESCRIPTION:

A Non-General Illumination fixture containing an emission plane of 120 cm by 40 cm. Within this plane are 8 opaque panels, each of which contains rows of 9 by 30 infrared (IR) LEDs for a total of 270 LEDs per panel or 576 LEDs for the entire illumination fixture. The fixture is passively cooled by ambient air and powered by a 120VAC receptacle.

No external indicators are present to designate if the illumination fixture is operating. Due to the narrow spectral emission of 850 nm, an observer has no perceptual way to know if or when avoidance of the illumination fixture is necessary.

Fixture was tested as supplied. All evaluations were made to standard operating conditions. More complex single and double fault conditions, which may have an impact on Risk Group classification, were not considered for this evaluation. It is the responsibility of the customer to provide the capability to measure all standard and/or single or double fault conditions.



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PART A: STABILITY TESTING

STABILITY TESTING DESCRIPTION:

To assess stability of emitted radiant energy, a radiometer was placed on-axis with the Device Under Test (DUT) and driven in Continuous-Wave (CW) mode for one hour. The irradiance of the DUT was monitored at 1 second intervals and plotted as irradiance verses time as shown in Figure 1 below. The stability (Elapsed Time) axis is based upon the ratio of the recorded irradiance from a single point in time to the maximum single recorded irradiance where time = 0.

Test Conditions		Environmental Conditions	
Current:	Regulated 1.43 ± 0.01 A	Lab Temp:	$21.6^\circ \pm 0.5^\circ$ C
Voltage:	Regulated 120 ± 0.01 VAC		
Temperature:	NA, Internally Controlled		

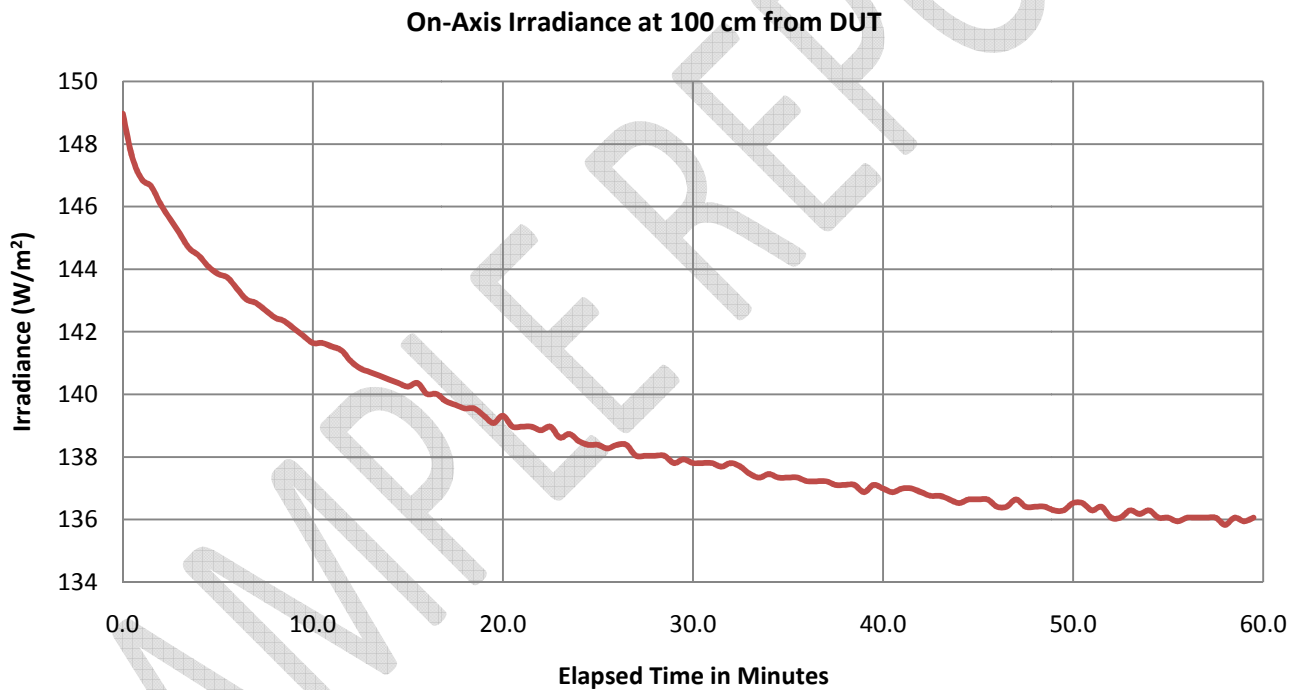


Figure 1: Output Stability at 100 cm from DUT

Stability testing found the DUT reached relative stability after a 60 minute warm-up period. The total output power of the device was found to decrease by a nominal 3.5% over this period of time due to self heating. This decrease in output was taken into account in Risk Group Classification assessment.



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PART B: IRRADIANCE MEASUREMENT

IRRADIANCE MEASUREMENT DESCRIPTION:

Irradiance measurements were taken at the closest point of human exposure for the DUT’s application. In operation, users can come within 0 distance (in contact with) the aperture of the DUT. However, this measurement distance defaults to 20 cm as the Human eye cannot accommodate a sharply focused light source at a distance of less than 20 cm. Angle resolution for this measurement was limited to 2.0 degrees per step. Irradiance measurements are in units of W/m² (Watts per meter sq.)

Test Conditions		Environmental Conditions	
Current:	Regulated 1.43 ± 0.01 A	Lab Temp:	21.6° ± 0.5° C
Voltage:	Regulated 120 ± 0.01 VAC		
Temperature:	NA, Internally Controlled		

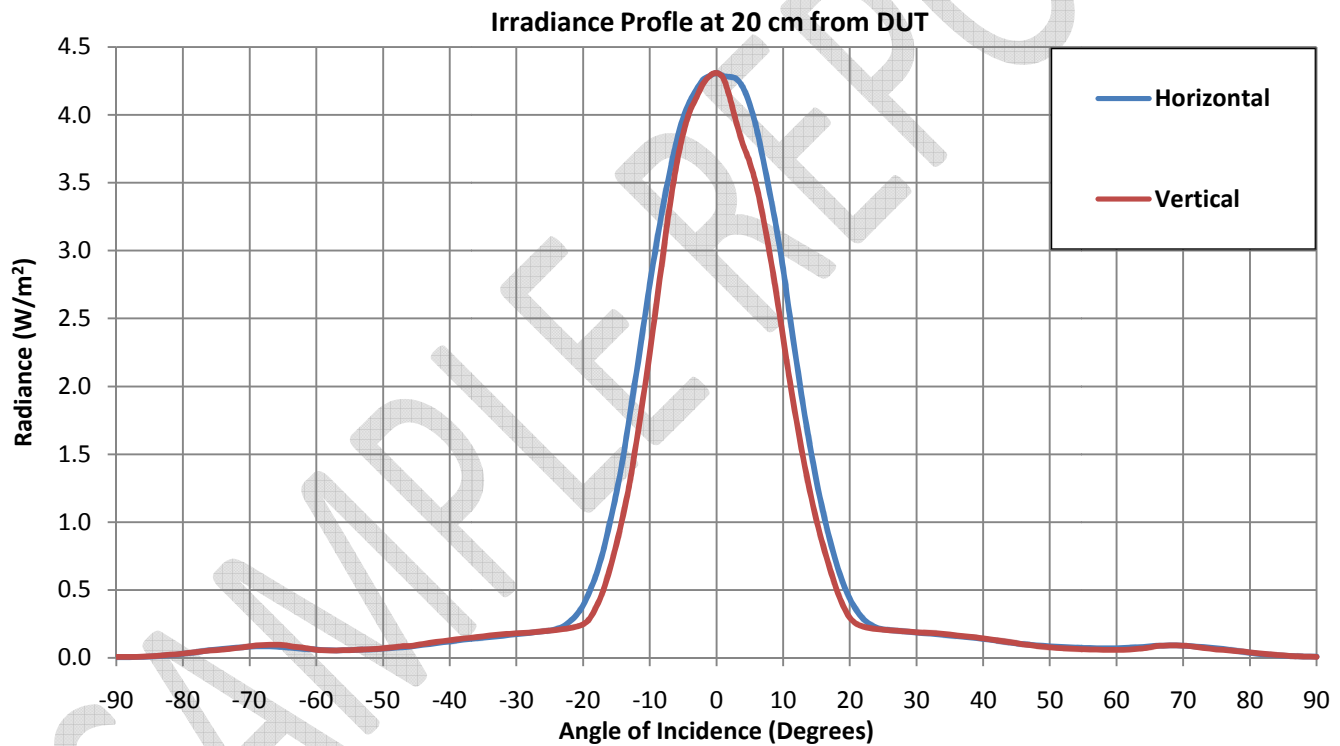


Figure 2: Irradiance Profile at 20 cm from DUT

IRRADIANCE TESTING RESULTS:

Irradiance testing found levels to exceed the Exempt Risk-Group Classification, but not to exceed a Risk-Group 1 Classification for any lamp viewing angle configuration for the DUT. Maximum Irradiance at 20 cm was found to be 4.36 W/m².



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PART C: RADIANCE MEASUREMENT

RADIANCE MEASUREMENT DESCRIPTION:

Radiance measurements were taken at a distance deemed reasonable for the field of view of the instruments used. The DUT was measured angularly in 1° increments while recording radiant intensity photographically, and radiance through use of a radiometer. All radiance measurements were recorded in units of W/cm²*sr (Watts per meter sq. per steradian)

Test Conditions		Environmental Conditions	
Current:	Regulated 1.43 ± 0.01 A	Lab Temp:	21.6° ± 0.5° C
Voltage:	Regulated 120 ± 0.01 VAC		
Temperature:	NA, Internally Controlled		

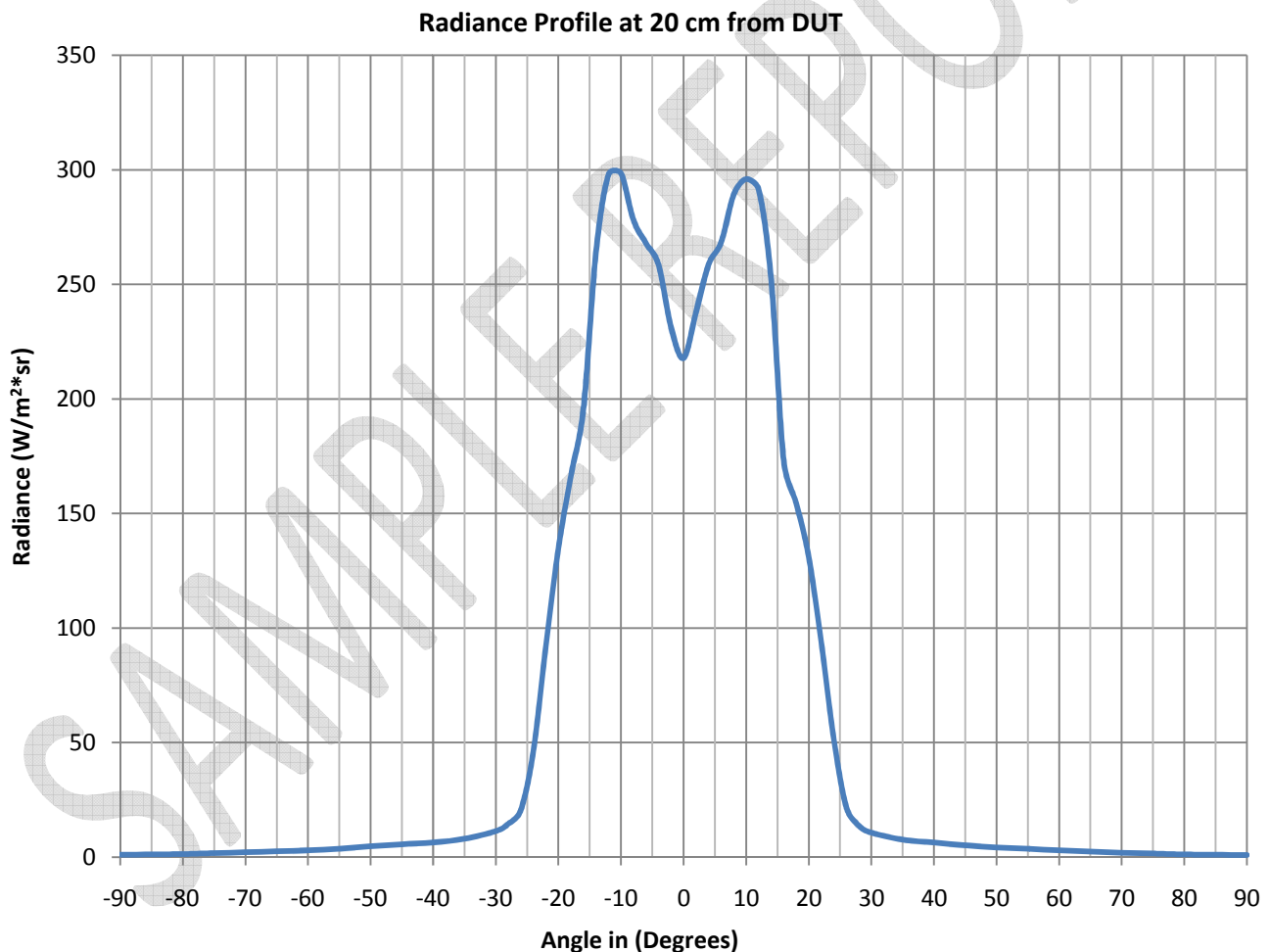


Figure 3: Radiance Profile at 20 cm



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PART C (continued): RADIANCE MEASUREMENT

RADIANCE TESTING RESULTS:

The locations of peak radiance and highest average radiance was found at the location where the incidence angle was $0^{\circ}, 0^{\circ}$ or normal to the axis of transmission. These general locations are shown as a function of pixel saturation in Figure 3. The average radiance for Figure 3 was measured as $332.5 \text{ mW/cm}^2\text{*sr}$. Using imaging techniques and examining this location for partial areas, a new peak radiance for partial areas was found as $4.311 \text{ W/cm}^2\text{*sr}$.

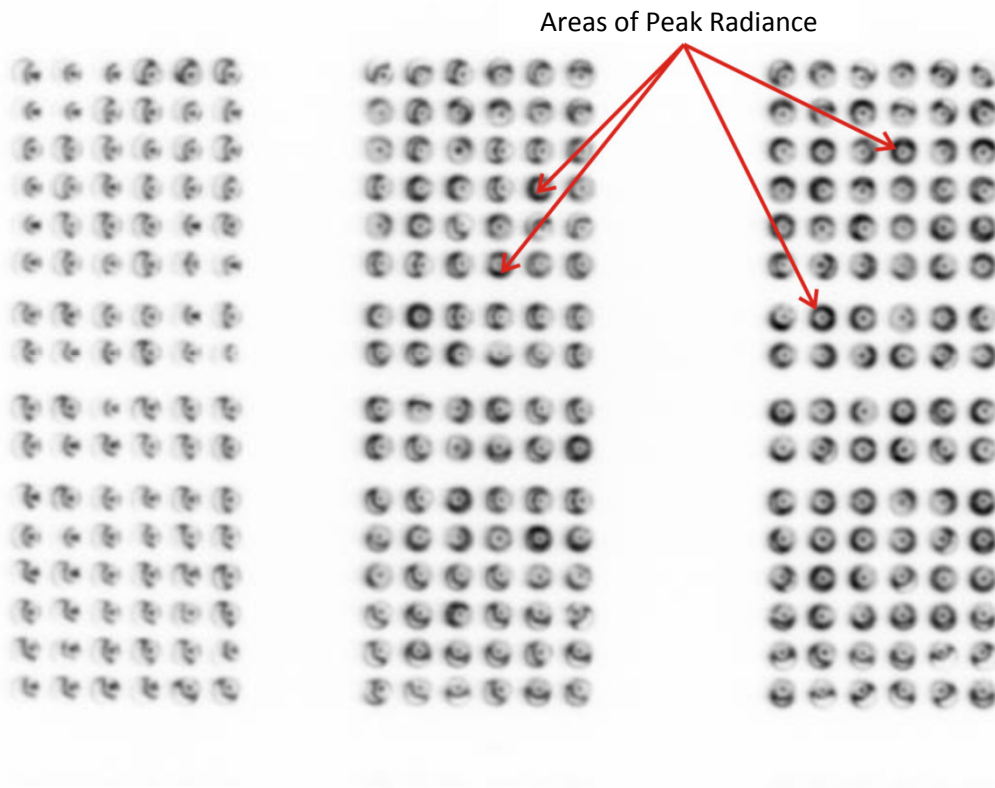


Figure 4: Peak Radiance Profile Measurement at 20 cm

**See DUT for markings indicating the orientation of measurements.*



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PART D: RISK GROUP CLASSIFICATION

RISK GROUP ASSESSMENT:

Results from the following tests were assessed against *emission limits* and *time criteria* for continuous wave (non-pulsed) lamps. In addition, because the typical conditions of use for the DUT are uncertain, the DUT is evaluated as a Non General Lighting Source for the purposes of Risk Group Assessment.

RISK GROUP EMISSION LIMITS ASSESSMENT FOR CW LAMPS:

Table 1, as shown below, provides emission risk group classifications for continuous wave (non-pulsed) lamps. Testing has shown that the DUT produced sufficient irradiance at 20 cm to warrant a RG-1 classification. This worst case condition was found to be in multiple locations at a plane 20 cm from the surface of transmission. No measured radiance values for partial areas or for the DUT as a whole were found to exceed any risk group category.

Risk	Exempt	RG-1 (Low-Risk)	RG-2 (Moderate Risk)	RG-3 (High Risk)
Actinic UV	●-----			
Near UV	●-----			
Retinal Thermal	-●-----			
Blue Light	●-----			
Blue Light Small Source	●-----			
Cornea/Lens, IR		--●-----		
Low Luminance, Retinal IR	-●-----			

Table 1: Risk Group Results for Emission Limits

RISK GROUP TIME LIMIT ASSESSMENT FOR CW LAMPS:

Table 2 provides time criteria for continuous wave (non-pulsed) lamps. Testing has shown that the DUT produced sufficient radiance to warrant a RG-1 classification. This worst case scenario was found to be on-axis to the DUT. The peak radiance was found by imaging radiant “hot-spots” within the source with a CCD camera.

Risk	Exempt	RG-1 (Low-Risk)	RG-2 (Moderate Risk)	RG-3 (High Risk)
Actinic UV	●-----			
Near UV	●-----			
Retinal Thermal	-●-----			
Blue Light	●-----			
Blue Light Small Source	●-----			
Cornea/Lens, IR			-●-----	
Low Luminance, Retinal IR	-●-----			

Table 2: Risk Group Results for Time Limits



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LABELING:

Results have shown that there is low risk (RG-1) in the Cornea/Lens, IR Hazard region of spectral emission. For this risk group classification, the following label shall accompany all product information and packaging:

RG-1: CAUTION. IR emitted from this lamp. Appropriate eye protection should be used when daily exposure at short distances is greater than 15 minutes.

Figure 4: Caution Label Example

**For further instructions on this labels usage, see part G, Labeling Usage*

SPECTRAL DISTRIBUTION DATA:

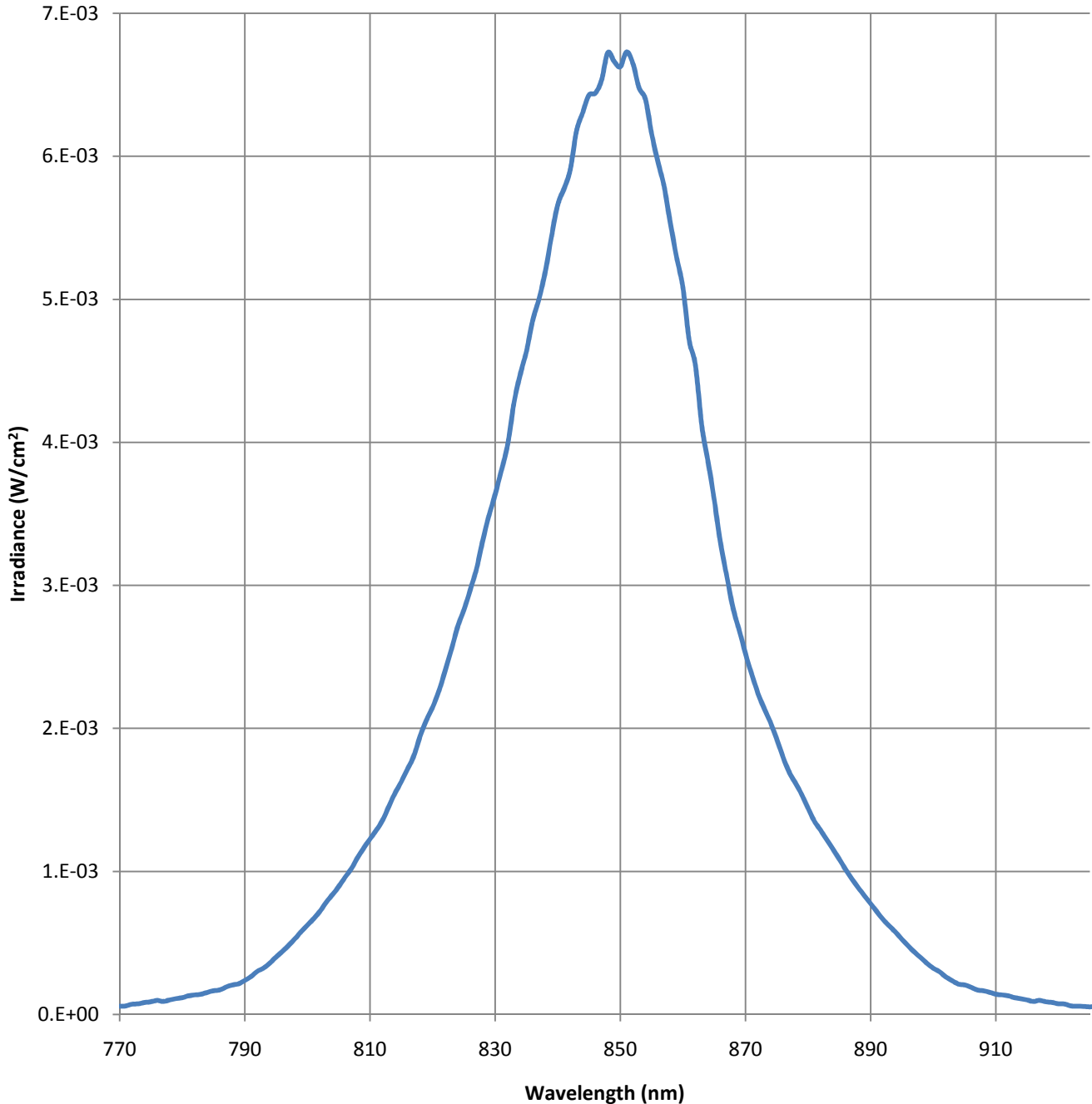
As a lamp manufacture, you may be asked upon request to provide a representative spectral distribution data for your lamp systems. On the following page is a graph of spectral power in irradiance (W/m^2), on axis (0, 0 degrees) at a distance of 20 cm from the fixtures emission plane.



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PART F: SPECTRAL DISTRIBUTION DATA

Irradiance per unit Wavelength



LOCATION OF MEASUREMENT:

Measurement taken at 20cm on-axis from emission plane with calibrated spectral irradiance detector.



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PART G: LABELING USAGE

***Following excerpt from: ANSI/IESNA RP-27.3-07, Section 6.2 (ISBN-13 # 978-0-87995-220-4)**

LABELING USE:

1. Caution labels are intended to inform and instruct end users regarding pertinent safety related information that should be communicated for lamps that are classified by the manufacture under Risk Groups 1, 2, or 3.
2. A caution label shall provide these elements of information in an abbreviate or simplified manner, and, in variations specific language shall still convey the same basic information elements to be considered "equivalent". These elements are:
 - a. A statement of "caution" or "warning", sometimes called the signal word.
 - b. A statement of the potential hazard. This should simply advise as to what might be expected to occur (i.e., skin irritation, or eye injury)
 - c. A list of what precautions could or should be taken to avoid the risk. Examples include information on shielding or a warning against staring at a particular source.
 - d. An abbreviated statement that specifies the Risk Group Classification for Risk Groups, 1, 2, or 3, (i.e., ANSI RG1, ANSI RG2, ANSI RG3 or RG-1, RG-2, RG-3).
3. The spectral emissions from the DUT does not influence its photochemical effectiveness at wavelengths below 400nm. Therefore, no unique coding, designation, or other identifications (with the exception of the above warning of caution) is necessary for product information, catalogs, lamp packaging, or other information provided to the user or purchaser.



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PART H: CALIBRATED EQUIPMENT USED

	<u>MANUFACTURE/MODEL</u>	<u>MODEL DESCRIPTION</u>	<u>SERIAL NUMBER</u>	<u>DUE DATE</u>
1	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
2	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
3	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
4	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
5	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

SAMPLE REPORT



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