

## **PHOTOMETRY BY VARI-LITE**

*How we measure our luminaires*

For over 25 years, Vari-Lite has set the standards by which all automated luminaires have been judged. From the pioneering VL1™ automated luminaire, which debuted on the 1981 Genesis *Abacab* tour, to the much-anticipated VL3500™ wash luminaire, Vari-Lite has always taken pride in its transcending optical technologies. Today, for the first time, Vari-Lite will walk you through our prescribed method of calculating the lumen output of our industry-leading luminaires.

In examining Photometry, we will embark on four areas of discussion. Our first will be “What is Photometry?” Our second area encompasses “What are the biggest challenges in measuring Photometry?” Our third discussion explains “What is the Vari-Lite method of measuring Photometry?” And our final discussion covers “What are the various methods used in measuring Photometry.”

Together, we will breakdown the bare essentials of Photometry. And at the end of our discussion, we will have hopefully achieved a greater understanding of how lights are measured and how those measurements are reported in the entertainment industry today.

### **WHAT IS PHOTOMETRY?**

“Photometry is measuring light,” begins ESTA technical standards manager Karl Ruling.

Clinically defined, Photometry is the measurement of the effectiveness of radiation in stimulating normal human visualization. But what does that mean? Simply put, photometry measures how bright the normal human eye sees a light.

“Photometry deals with luminous radiation, but only radiation that the human eye can see, which is the visible spectrum,” explains Vari-Lite optical engineering manager Chris Wyatt. “More succinctly, it's the measurement of visible light, with the basic photometric unit for radiant power being the always sought after lumen.”

In defining Photometry, the terminology “normal human eye” is referenced to equate a sort of definable standard by which we see light. But in the equation, since one of the determining factors is the human eye, exact quantitative numbers can not be reached as each independent human eye will never view the same light in exactly the same manner. Therefore, the measurement is defined in a general quantitative estimate based upon the scientific standard that there is a median measuring point.

“Photometry is not absolutely exact,” states Wyatt. “But by using consistent methodology, one can be relatively repeatable.”

### **WHAT ARE THE BIGGEST CHALLENGES IN MEASURING PHOTOMETRY?**

As with the gathering of any scientific data, Photometry presents its own unique challenges. There are variables in place that will lead to differing results and with different engineers performing the various tests; a uniform outcome is simply not a reality.

Ruling continues, “A major challenge is the variations in the luminaires and the sources. The manufacturing of the luminaires can be fairly tight, but the sources used vary significantly from lamp to lamp. For example, the exact position of the lamp within the luminaire, particularly when it is a short-arc lamp, makes a tremendous difference in a luminaire's light output.”

Wyatt adds, “Another challenge is often simply confusion over the collected data or calculated results. Confusion often comes about in the presentation of the data, with people referring to ‘brightness’, rather than illuminance, luminance, or total lumens while mixing up measurement types and units.”

One manufacturer may use a certain lamp type, one may use an entirely other. One manufacturer may use a certain measurement method, one may use another. One manufacturer may report their results one way, another will report theirs in another. Therefore, it would seem that a lack of consistency in measurement style and consistency in the products being measured leads to many varying results in the measurement of automated luminaires.

### **WHAT IS THE VARI-LITE METHOD OF MEASURING PHOTOMETRY?**

Implemented in November 2005, Vari-Lite employs the Dubinovsky method of measuring Photometry in its automated luminaires. Created by Michael Dubinovsky PhD., this proven method involves the measuring of lumen output from a fixed luminaire shining on a wall, and is currently used by a number of manufacturers in the automated luminaire market. The Dubinovsky method has garnered respect throughout the industry for a number of reasons.

Wyatt explains, “We began using the Dubinovsky method because it's inexpensive, quick, and repeatable. The test set-up is straight-forward with data being recorded, and calculations being made, in an Excel spreadsheet.”

When measuring an inexact calculation, repeatability is the key. By completing a defined number of tests, and using the testing methods as laid out by Dubinovsky, an optical engineer may now conclude a consistent calculation.

Wyatt adds, “This method gives us everything we need to publish accurate, repeatable photometric testing results”

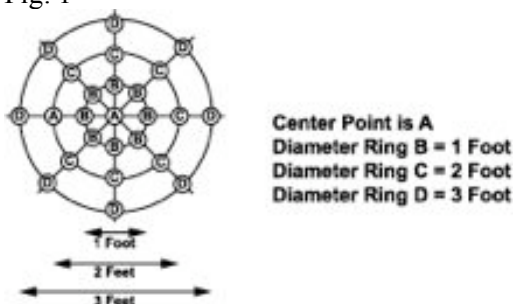
Vari-Lite prides itself on the award-winning optics of its automated luminaires. Holding itself to a higher standard, Vari-Lite will always utilize the latest and most accurate measuring standards in the testing of its products. All of this is accomplished through the Dubinovsky method. While other manufacturers may employ a different testing procedure, Vari-Lite believes it was Dubinovsky who set the standard by which all should be judged.

### **THE DUBINOVSKY METHOD IN GREATER DETAIL**

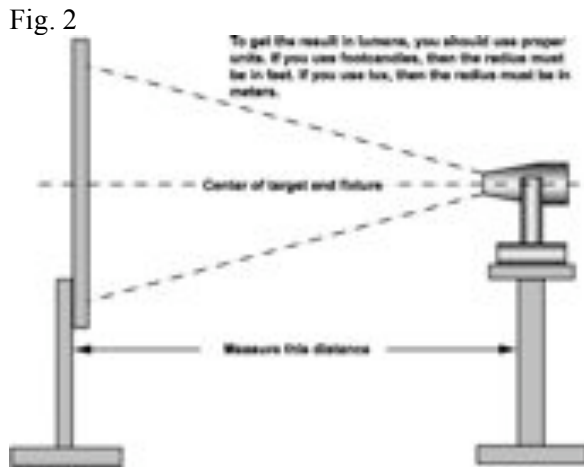
To explain the Dubinovsky method, Wyatt devised the following example.

On a piece of board approximately 4 feet in diameter, make three circles with diameters 1', 2' and 3' concentrically revolving around a common center point. Then, divide the circles with lines at 45 degrees (see Fig. 1).

Fig. 1



Draw small targets upon each point that the lines intersect the circles. Then draw one target in the center point. Mount the board on a stand so that the center point of the circle is at the same height as the center of the light fixture to be measured (see Fig. 2).



For Spot fixtures, or a hard-edge beam, point the light fixture output at the board and adjust the distance of the fixture from the board so that the outer edge of the beam is the same diameter as the outside circle of the target on the board. Measure the distance of the front of the fixture output lens from the board and record on the auto calculating spreadsheet. Record the light level readings at each of the 25 points and record into the auto calculating spreadsheet (**see attached Microsoft Excel document Calculation of Fixture Output**).

For Wash fixtures, or a soft-edge beam, point light fixture output at the board and adjust the distance of the fixture from the board so that the illumination at the outer edge is 10% of the center point illumination. Measure the distance of the front of the fixture output lens from the board and record on the auto calculating spreadsheet. Record the light level readings at each of the 25 points and record into the auto calculating spreadsheet (**see attached Microsoft Excel document Calculation of Fixture Output**).

When all the values have been entered into the attached document, the total lumen output will be calculated and displayed along with the beam angle.

## **WHAT ARE THE VARIOUS METHODS USED IN MEASURING PHOTOMETRY?**

So what are the different techniques being employed by manufacturers to calculate lumen output in automated luminaires? How does one know which technique is the most valid? And is there a standard by which all manufacturers should complete the same testing for more uniformed results in the industry?

Wyatt expounds, “There are a few different ways to measure useful luminaire output. In addition to the Dubinovsky method, there are also methods that use an integrating sphere. However, this type of measurement, while giving a bigger number for the datasheet, can be misleading, because it captures all light, independent of its direction or usefulness.”

Ruling agrees. “There are a lot of ways that manufacturers calculate Photometry in their luminaires. For measuring luminaire output, as opposed to source output, the methods can be divided into two

large groups. One group is based on using Goniophotometers, either ones that move the sensor or ones that move the luminaire. And other method involves shining the light from a luminaire at a wall and measuring the illumination produced. ESTA has labeled the latter 'flat-wall photometry'."

On Wednesday, March 7, 2007, the American National Standards Institute approved a revision to ANSI E1.9-2001, *Reporting Photometric Performance Data for Luminaires Used in Entertainment Lighting*. The revision to the Entertainment Services and Technology Association (ESTA) document now known as ANSI E1.9-2007, was written to ease the implementation in reporting photometric data.

"The old version required a minimum of six isolux diagrams for an ellipsoidal reflector spot that is a zoom instrument," said Ruling. "The new version requires only two. Six diagrams was too much data and too much space on a cut-sheet for most manufacturers. Collecting and printing data costs money. But this standard is simply a standard for reporting the photometric data that is gained by whatever measuring process a manufacturer chooses to use," stated Ruling. "It does not specify the process by which it is obtained."

Started in 1997, the ANSI E1.9 project was put into action in response to the controversy over the "right" distribution for ellipsoidal reflector spotlights and the difficulty of showing the flat wash from asymmetrical cyc-lights. However, to reach a consensus and to satisfy the greatest number of people, everything that anyone could want on a data sheet was added to ANSI E1.9-2001, making it a very comprehensive data reporting standard and also a very expensive one. Few manufacturers have been able to justify the cost of providing all the data required by ANSI E1.9-2001, but the new revision is less costly to implement, and should encourage more manufacturers to employ its use. As a result, the end user should receive an accurate portrayal of the actual light to be expected from a luminaire.

Ruling continued to explain, "ESTA also has another standard that does bear on measuring the photometric performance of luminaires. It is ANSI E1.25-2006 - *Entertainment Technology - Recommended Basic Conditions for Measuring the Photometric Output of Stage and Studio Luminaires by Measuring Illumination Levels Produced on a Planar Surface*. It describes the basic conditions, temperature, power supply voltage, etc..., for any method of measuring the output of a stage and studio luminaire that involves shining the light at a wall and measuring the illumination levels produced. It doesn't tell you exactly how to measure the light output; it only tells you the basic testing conditions. Most of the manufacturers in our industry use the same measuring system. The issue was the basic testing conditions. This document spells out what those conditions are, and then you follow your individual testing instructions."

ESTA is seeking to shorten the distance between the abundance of variables that come into play when manufacturers test and report the photometric data of their automated luminaires. But until the day when all manufacturers are required to test and report data in the exact same manner, it is the responsibility of the market to understand just how each manufacturer goes about this process. The Dubinovsky method of measuring Photometry is a field tested and proven approach for the accurate gathering of this data, and therefore it is the method of choice for Vari-Lite.